Engineering Manual
Track

TMC 251

TURNOUTS

Version 4.7

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Engineering Manual

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Document control

Version	Date	Summary of change
1.0	October 2006	First issue as a RailCorp document. Includes content from C 2315, C 3361, TS 3502, TS 3521, CSI 029, RC.3361, CTN 00/02, CTN 01/13, CTN 04/11, CTN 05/26, CTN 06/01, CTN 06/10, CTN 06/22
2.0	April 2007	Correction of foot gauge measurements; Additional guidance on placement of crossing; Includes reference to Chapter 15; removal on restriction on welding near heat numbers; inclusion of VAE Expansion switch installation guidelines; inclusion of Storage and handling guidelines
3.0	October 2007	Inclusion of notification of defective components, correction and clarification of plain track acceptance limits
4.0	May 2008	New Section C5-5 – Rail Brace Bolts – addition of information on identification of bolts from CTN 07/15. Renumbering C5-6 to C5-13; C6-7 – Inclusion of detail of fastening requirements for turnout bearer replacement; C9-5 and C9-6 - inclusion of content of CTN 07/06 Bearer location for spring assist
4.1	December 2008	Section C5-5 – Rail Brace Bolts – addition of information on ultrasonic testing of bolts from CTN 08/07
4.2	May 2009	C6-1 – addition of note on identification of design position of switches
4.3	December 2009	New C2-4 - Reporting broken crossings; C4-5.1 Addition of zero cant foot gauge to Table 6; New C6-7 – Replacing cracked switch plates; C6-8 renumbered; Appendix D New Broken Crossing form
4.4	February 2011	C2-1 - Additional requirements for inspection of turnouts with signals – from CTN 10/21; C4-1.1 - Note added regarding measurement method for switch fitting; C6 - Correction of incorrect labelling of Figures 29 and 30; C10 - Addition of note regarding pre-assembly of diamonds and slips; C15-1 – Addition of comment regarding storage of rail components
4.5	August 2011	C3 - Competencies updated to current National Competencies; C4-1.1 – Addition of acceptance limits for switch position; C4-5.2 - Correction of error in acceptance limits for general height for mechanised resurfacing (+ and - need to be reversed – reduction of limit from 150mm to 100mm; addition of requirements to consider impact of track lifts on ballast top bridges; C13-3 – New section welding of expansion switches – includes content of CTN 11/12

4.6	April 2012	Reformatted to new template – Page numbering converted to continuous numbering. Separate document control on individual chapters removed; 1-4.3 - Inclusion of additional drawing numbers; C2-3 - Inclusion on requirements for spiking points out of use; C3 - Inclusion of competency requirements for spiking points out of use; C4-4 - Addition of requirement to do visual check on “as constructed” geometry; C4-5.2 - Varied maintenance acceptance limits on height at restricted clearance locations; C6-6 - Additional guidance on replacing track plates. Includes content of CTN 12/01
4.7	April 2013	Changes detailed in Chapter Revisions

Summary of changes from previous version

Summary of change	Chapter
Control changes	Document control
Inclusion of VAE reference drawing	C1-4.4
Updated National competencies	3
Change to timber bearer length to reflect change in ESC 230	C6-8
New chapter - Installing VAE in-bearers	8
Chapters renumbered	9 to 16

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Chapter 1 General

C1-1 Purpose

This manual provides requirements, processes and guidelines for the installation of and maintenance of turnouts and turnout components, including switches, crossings, diamonds, catchpoints, expansion switches, bearers and manual point levers. It includes interface requirements with equipment operated and maintained by the signalling discipline, but does not include installation and maintenance requirements for that equipment.

C1-2 Context

This manual is part of RailCorp's engineering standards and procedures publications. More specifically, it is part of the Civil Engineering suite that comprises standards, installation and maintenance manuals and specifications.

Manuals contain requirements, process and guidelines for the management of track assets and for carrying out examination, construction, installation and maintenance activities.

The manual is written for the persons undertaking installation and maintenance activities.

It also contains management requirements for Civil Maintenance Engineers and Team Managers needing to know what they are required to do to manage turnout installation and repair activities on their area, and production managers needing to know what they are required to do to manage the renewal activity their teams are undertaking.

C1-3 How to read the Manual

The best way to find information in the manual is to look at the Table of Contents starting on page 4. Ask yourself what job you are doing? The Table of Contents is written to reflect work activities.

When you read the information, you will not need to refer to RailCorp Engineering standards. Any requirements from standards have been included in the sections of the manual and shown like this:

In addition they shall meet the following requirements extracted from RailCorp standard ESC 250 Turnouts and Special Trackwork.

- Gauge dimensions at the switch tip shall conform to the design ± 2mm.
- Gauge at crossings shall conform to the design ± 2 mm

Reference is however made to other Manuals.

C1-4 References

C1-4.1 Australian and International Standards

Nil

C1-4.2 RailCorp Documents

ESC 210 – Track Geometry & Stability
ESC 220 – Rail and Rail Joints
ESC 230 – Sleepers and Track Support
ESC 240 – Ballast
ESC 250 – Turnouts and Special Trackwork
TMC 001 – Civil Technical Competencies & Engineering Authority
TMC 202 – Track Fundamentals
TMC 203 – Track Inspection
TMC 211 – Track Geometry and Stability
TMC 221 – Rail Installation & Repair
TMC 222 – Rail Welding
TMC 224 – Rail Defects & Testing
TMC 241 – Ballast

C1-4.3 RailCorp Drawings

CV0166867
CV0166868
CV0166869
CV0166870
CV0365884
M02-678

C1-4.4 Other Drawings

VAM13575

Chapter 2 Management Requirements

C2-1 Signals requirements for track work affecting points

C2-1.1 For turnout renewals

When the renewal of switches or stockrails or turnouts is planned the **Team Manager** responsible must arrange a joint inspection with the Signals Project Engineer (for new projects) or the signal maintainer for non-project works and confirm:

1. The location and design of the turnout.

   If there are any changes to the turnout location or design then new location details including GIJ locations and the impact on signal equipment must be established.

2. The signal point operation requirements, including the hole drillings required.

   These may be different from existing.

3. The signal requirements for connection of point equipment to bearers where this is different to existing.

4. Track maintenance requirements that need to be carried out in conjunction with the renewal. These might include:

   - packing heels,
   - correcting out of square,
   - correcting vertical alignment, or
   - correcting tip of switch positioning relative to the timbers so signalling equipment is not obstructed.

Complete the checklist in Appendix A for each instance where renewal is carried out affecting switches or stockrails with signal equipment attached. The checklist is to be signed by the responsible track and signal staff and will be held by the signal representative.

NOTE: In the current organisational structure the Team Manager may not necessarily be the person managing the renewal and may not be directly involved. When this is the case the following additional requirement is to be enforced.

- When the renewal of switches is planned the person managing the renewal (normally the Asset Engineer, Project Engineer or Team Manager) **must** ensure that the joint inspection has been conducted between the Team Manager and the Signals Project Engineer and that the Checklist in Appendix A has been completed.
- The checklist details must be incorporated into the switch, stockrail or turnout renewal requirements.

C2-1.2 For maintenance

Whenever turnout maintenance is carried out, such as bolt replacement, that does not normally require the presence of a signal representative, then at the completion of the work the **Team Manager** must confirm that the points are working properly.

This is to be done by arranging for the signaller to throw the points to both sides and confirm that they are working correctly. In association with this the track staff are to ensure that the switch is throwing over correctly and fitting properly against the stockrail.

If bolts are tightened on A or B chairs then the signal representative must be advised to ensure the point adjustment is correct.

C2-2 Removal of redundant turnouts

The presence of redundant turnouts in track causes increased maintenance, an increased risk of developing defects and may affect reliability.

This is particularly the case where the interlocking equipment has been removed from a turnout, pending its removal from track.

Provision must be made for redundant turnouts to be removed from the track as soon as practicable following decommissioning. If turnouts are not removed within four weeks the switches are to be straight railed. All infrastructure must be planned to be removed within 16 weeks.

Any turnout components remaining in track must be appropriately maintained until they are removed.

C2-3 Security of points

The following configuration requirements are extracted from ESC 250

Where points 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, the points shall be secured against potential movement.

Traditionally with timber turnouts the points have been secured by spiking a fishplate to the timber bearer.

For concrete bearers and in-bearer turnouts spiking plates have been designed and approved for use as follows:Gauge dimensions at the switch tip shall conform to the design ± 2mm.

- For in-bearer turnouts - Signals drawing - M02-678.
- For concrete turnouts without in-bearer - CV0365884

The safe working units provide requirements for when points are required to be spiked out of use.

Maintenance and construction teams should hold sufficient of the two types of spiking plate to meet planned and emergency use.

Signals Mechanical Staff are authorised to apply the in-bearer spiking plate where approved by the Chief Engineer Signals.

Fabricated plates can be obtained from Bathurst Rail Fabrication Workshops. Requests should specify whether the plate is for concrete turnouts with or without in-bearer and the relevant drawing number.

C2-4 Reporting Defective Components

New or recently installed track components or tools are sometimes defective, or otherwise fail to meet specified requirements. In some circumstances it will be necessary to recall the product and take action with the supplier.

To ensure that appropriate investigation is undertaken and action is taken by field staff, engineering and logistics staff, follow the process below.

Team member

If you suspect that track components or tools that have been delivered to you are defective, report the defect to your Team Manager.

Team Manager

If you are notified by your field staff that potentially defective components or tools have been supplied:

1. Raise an NCR. (NCR Form attached as Appendix C).
2. Conduct an assessment of the non-conforming product by inspection and, if practical, test sample at least 2-3 other such items from the same batch.

   This will help to determine the extent of the problem.
3. Forward the NCR to:

   Ilya Soyfer, Logistics Support Engineer in Track Services

   (phone 8922 1148 (2 1148)

   fax 8922 1154 (2 1154)

   email ilya.soyfer@railcorp.nsw.gov.au.
4. If there is any immediate concern, contact should be made by phone.
5. Track Services will investigate the failure and its implications and take other actions as required. This may include:

   - Quarantine all product to avoid installation
   - Allow installed product to remain in track under special conditions
   - Remove all product from track etc

   If this occurs official notification will be by the issue of a Civil Technical Note

C2-5 Reporting Broken Crossings

As part of our increased focus on failures of crossings, we want to store all failed crossings in a central location so that they can be fully investigated to determine failure cause and to develop improved design, manufacture and maintenance techniques.

The storage area is located at Arthur St Lidcombe.

When a crossing fails in track:

1. Replace the crossing
2. Contact the Chief Engineer Track or the Technical Officer Rail Inspection Services to establish if the crossing is to be stored.
3. If it is required for investigation, mark the following information in crayon on the crossing:

   "Kilometrage, Points Number, Failure Date"
4. Complete a Points Fail Form (See Appendix 1)

5. Contact the Senior Advisor Rail Welding & Lubrication to make arrangements for the crossing to be sent to the Broken Crossing Depot.

6. Forward the completed Crossing Fail Form to the Technical Officer Rail Inspection Services.

Chapter 3 Competencies

NOTE: These competencies may enable activities to be carried out in other manuals. For a comprehensive list of all activities that are covered by a given competency see Engineering Manual TMC 001 – Track General.

To carry out this work	You need these competencies
Repair turnout components – including switches, stockrails, crossings and checkrails	TLIB3095A - Check and repair points and crossings
Renew turnout components – including switches, stockrails, crossings and checkrails	TLIB3095A - Check and repair points and crossings
Remove and install track plates, pads and insulators	TLIS2031A - Install railway sleepers **AND** TLIS2034A - Install and repair rail fastening systems
Remove and install turnout bearers	TLIS2031A - Install railway sleepers **AND** TLIS2034A - Install and repair rail fastening systems
Rebore and regauge bearers	TLIS2031A - Install railway sleepers **AND** TLIS2034A - Install and repair rail fastening systems
Drill switches and stockrails	TLIB3095A - Check and repair points and crossings **OR** TLIS3040A Construct concrete or steel points and crossings **OR** TLIS3041A - Construct timber or composite points and crossings
Build concrete or steel turnouts and special trackwork	TLIS3040A Construct concrete or steel points and crossings
Build timber or composite turnouts and special trackwork	TLIS3041A - Construct timber or composite points and crossings
Install turnouts and special trackwork	TLIS3045A - Install turnouts
Install and maintain manual points levers	TLIB3095A - Check and repair points and crossings
Spike points “out of use” on timber and concrete bearers	TLIB3095A - Check and repair points and crossings
Restore ballast profile after work on turnouts	TLIS2030A - Carry out track ballasting
Certify turnouts and special trackwork (**EXCEPT** “Vulnerable turnouts”) during or after resurfacing	TLIB3094B - Check and repair track geometry
Certify “Vulnerable turnouts” during or after resurfacing	TLIB3094B - Check and repair track geometry **AND** TLIB3095A - Check and repair points and crossings

To carry out this work	You need these competencies		
Certify track during or after repair or renewal of turnout components – including switches, stockrails, crossings and checkrails and point levers	TLIB3094B - Check and repair track geometry	**AND**	TLIB3095A - Check and repair points and crossings
Certify track during or after installation of turnouts and special trackwork	TLIB3094B - Check and repair track geometry	**AND**	TLIB3095A - Check and repair points and crossings

Chapter 4 Construction and maintenance acceptance limits

C4-1 Construction acceptance limits

C4-1.1 Turnouts

The finished geometry for new turnout installations shall meet the plain track geometry requirements detailed in Section C4-4.

In addition they shall meet the following requirements extracted from RailCorp standard ESC 250 Turnouts and Special Trackwork.

- Gauge dimensions at the switch tip shall conform to the design ± 2mm.
- Gauge at crossings shall conform to the design ± 2 mm
- Flangeways at V 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
- Switch points and crossing intersections shall not vary more than 10mm from the design location and switches shall be square to within 6mm

- The switch must lay up against the stockrail within the following limits without any applied force. This check is to be made with all stretcher bars disconnected and plates lubricated or switch rollers operating.

  - The gap between the tip of the switch and stockrail shall be less than 1 mm.
  - Note: The method of measurement is described in TMC 203
  - The maximum gap between switch and stockrail at the end of the machined section of the switch must not exceed 5mm.

- Switch operating forces

  This check is made with all stretcher bars connected but with all operating rods disconnected (exception: where a mechanical back drive is to be used; this should, if possible, remain connected).

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

The following requirements are extracted from ESC 250

- Other fabrication and installation tolerances shall be in accordance with the design specification or manufacturer's instructions.
- 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.
- 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. Civil Maintenance Engineers may, however, approve the installation of crossing units with fixed, swage fastened joints.
- For turnouts fitted with dry slide chairs, no oil or grease shall be applied to these chairs.
- Plain track components shall meet the acceptance standards detailed in the component standards in Table 1

The following requirements are extracted from ESC 250

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

Table 1 - Standards for components

- Bearer Spacing

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

C4-1.2 Diamond crossings

The finished geometry for new diamond crossing installations shall meet the plain track geometry requirements detailed in Section C4-4.

In addition they shall meet the following requirements extracted from RailCorp standard ESC 250 Turnouts and Special Trackwork.

- Gauge at V and K crossings shall conform to the design ± 2mm.
- Flangeways at V and K crossings shall conform to the design ± 1mm.
- Checkrail effectiveness at V crossings shall conform to the design ± 2mm.
- The relative locations of the four crossings in a diamond must be within 10mm of the designed distances.
- The crossing intersection points (Theoretical Point) must be within 10mm of the position defined by reference pegs or survey monuments.

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

Bearer spacing shall meet the requirements specified in turnouts.

Plain track components shall meet the acceptance standards detailed in the component standards in Table 1

C4-1.3 Slips

The finished geometry and condition of new slip installations shall meet the following requirements extracted from RailCorp standard ESC 250 Turnouts and Special Trackwork.

Geometry and condition of new installations shall meet the acceptance standards for turnouts and diamond crossings.

C4-1.4 Catchpoints

The finished geometry for new catchpoint installations shall meet the plain track geometry requirements detailed in Section C4-4.

In addition they shall meet the following requirements extracted from RailCorp standard ESC 250 Turnouts and Special Trackwork.

Gauge generally in catchpoints shall conform to the design ± 3mm.

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

Bearer spacing shall meet the requirements specified in turnouts.

Plain track components shall meet the acceptance standards detailed in the component standards in Table 1.

C4-1.5 Expansion switches

New Expansion switch installations shall meet the following requirements extracted from RailCorp standard ESC 250 Turnouts and Special Trackwork.

Expansion switches shall be installed to the adjustment suitable for the substructure position and temperature and the rail temperature.

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

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

The switch heel and stock rail may be welded to adjoining rails.

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

Bearer spacing shall meet the requirements specified in turnouts.

Plain track components shall meet the acceptance standards detailed in the component standards in Table 1.

C4-1.6 Manual Point levers

New Manual Point lever installations shall meet the following requirements extracted from RailCorp standard ESC 250 Turnouts and Special Trackwork.

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

C4-2 Maintenance acceptance limits

C4-2.1 Turnouts

The finished geometry for turnout after maintenance work shall meet the plain track geometry requirements detailed in Section C4-5.

In addition the following maintenance limits extracted from RailCorp standard ESC 250 Turnouts and Special Trackwork shall be applied to manual regauging of turnouts or component renewal.

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.

Housed switches shall conform to the design ± 1mm of the specified parameters.

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

After maintenance, crossing and checkrail measurements on all tracks shall be within the limits in Table 2.

	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 2 - Turnout geometry maintenance limits

C4-2.2 Diamond Crossings

The finished geometry for turnout installations after maintenance work shall meet the plain track geometry requirements detailed in Section C4-5.

In addition the following maintenance limits extracted from RailCorp standard ESC 250 Turnouts and Special Trackwork shall be applied to manual regauging or component renewal in diamond crossings.

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.

After maintenance, crossing and checkrail measurements on all tracks shall be within the limits in Table 2.

C4-2.3 Slips

The finished geometry for turnout installations after maintenance work shall meet the plain track geometry requirements detailed in Section C4-5.

In addition the following maintenance limits extracted from RailCorp standard ESC 250 Turnouts and Special Trackwork shall be applied to manual regauging or component renewal in slips.

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.

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.

After maintenance, crossing and checkrail measurements on all tracks shall be within the limits in Table 2.

C4-2.4 Catchpoints

The finished geometry for turnout installations after maintenance work shall meet the plain track geometry requirements detailed in Section C4-5.

In addition the following maintenance limits extracted from RailCorp standard ESC 250 Turnouts and Special Trackwork shall be applied to manual regauging or component renewal in catchpoints.

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.

C4-3 Component repair

C4-3.1 Switches

The following maintenance limits extracted from RailCorp standard ESC 250 Turnouts and Special Trackwork shall be applied to repair of switches in turnouts and special trackwork.

Repair of switches by wirefeed welding is prohibited. Switch profile and condition may only be repaired by grinding.

After maintenance switch tip measurements shall be within the limits in Table 3.

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

Table 3 – Switch tip maintenance limits

- there is to 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.
- there is to be no damage in the first 2m from the tip of the switch blade, deeper than 19mm from the running surface.

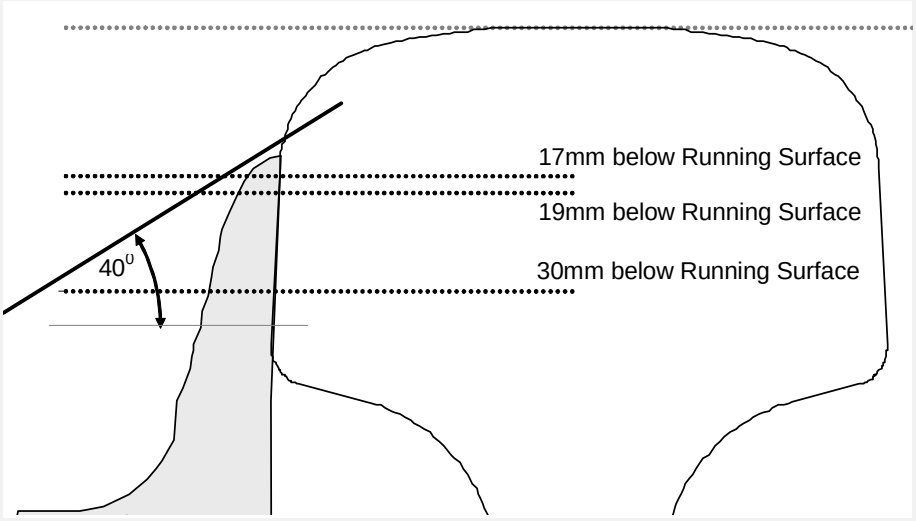


Figure 1 – Switch tip acceptance limits

Crossings and wingrails

Repair of crossings and wingrails by wirefeed welding is an approved repair method.

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

All repairs shall be ultrasonically tested using the procedures detailed in RailCorp Engineering Manual TMC 224 – Rail Defects & Testing.

ALL ultrasonic indicators must be below reportable limits as detailed TMC 224.

C4-4 Construction acceptance limits for plain track geometry

The following construction acceptance limits are extracted from RailCorp Standard ESC 210.

This document contains mandatory requirements and guidelines. To aid understanding and compliance, all instances have been 'flagged' as follows:

Mandatory Requirement - MUST be met	**MR**	*Guideline - preferred where practical*	**G**

This section specifies the track geometry requirements for the construction and upgrading of trackwork. Gauge requirements are based on new rails. Where other rails are used then an appropriate allowance is to be made for rail wear. **G**

The limits provided in this section assume that the track has been aligned using maintenance surfacing machinery including laser technology and sophisticated smoothing algorithms. On this basis individual locations between specified survey points will be automatically aligned to an acceptable intermediate tolerance. **G**

A visual examination is required of alignment and surface geometry between survey points. Any deviations from smooth alignment or surface shall be measured in accordance with, and meet the requirements of, the unevenness criteria in Table 8. **MR**

Where track has been fixed or placed by other methods then more detailed survey may be required to ensure smooth alignment to the geometry required. These shall be specified as part of the design. **G**

Where interfaces exist between new construction and existing track appropriate variations in tolerances are acceptable. These will depend on the time the interface will exist between stages of upgrading activity, the track speed, traffic etc. They may not exceed the maintenance acceptance levels for unevenness specified in Table 8 or the Base Operating limits for track geometry for the relevant track speed specified in Engineering Manual TMC 203 – Track Inspection. **MR**

C4-4.1 Accuracy to Survey

The following construction acceptance limits are extracted from RailCorp Standard ESC 210.

Survey marks shall be provided as specified in ESC 210. The survey marks and the information provided will form the primary source of information for assessing compliance. **MR**

Installed track shall conform to the basic surveyed design within the tolerances for alignment and level detailed in Table 4. **MR**

		Main line mm	Sidings mm
Alignment			
Alignment at platforms (Note 4)		±6	NA
Alignment at restricted clearance locations (Note 1)		±10	±10
Alignment general (Note 5)		±15	±25
Variation in alignment between stations up to 20m apart (Note 6)		±15	±20
Superelevation			
Superelevation variation from design (Note 6)		±5	±8
Track Surface			
Height at platform relative to design rail level	Level access	±15	NA
	Standard access (Note 6)	− 0 to + 50	NA
Height at other restricted height clearance locations (Note 8)		− 0 to + 50	− 0 to + 50
General height relative to design (Note 2)		− 30 to + 50	− 30 to + 50
Variation in level between stations up to 20m apart (Note 6)		±20	±30
Gauge			
Gauge		±4	±6

Table 4 - Construction Survey Acceptance limits

Note 1. Where separate construction tolerances have been supplied as part of a Transit Space Infringement Approval these will take precedence.

2. Additional restrictions on height tolerance may be required to suit overhead wiring. For example in areas of fixed tension the allowable tolerance would be normally restricted to - 10 to + 50.

3. Note: Measurement convention (+ means track is lower than design rail level) - see Figure 2 below

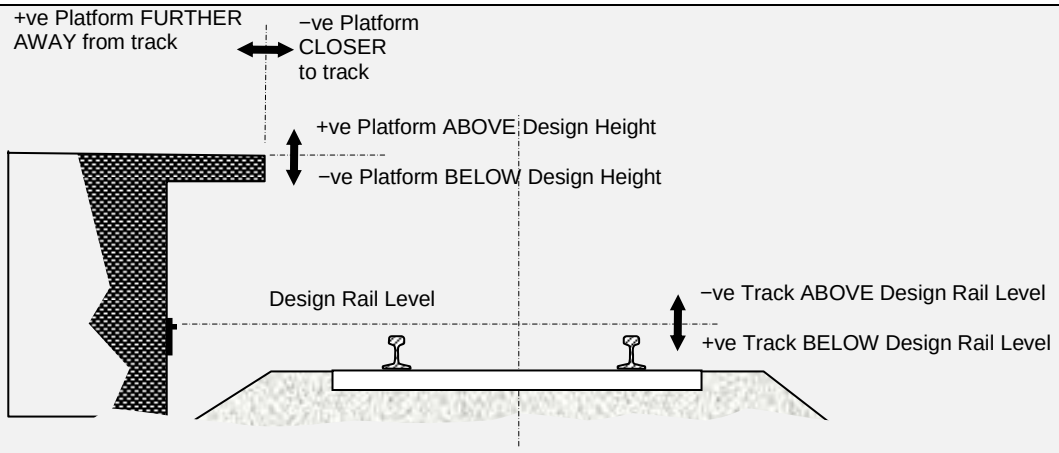


Figure 2 - Measurement conventions

Civil Maintenance Engineers may accept the following limited variations:

Note 4. At standard access platforms odd exceptions up to ±15mm.

5. Odd exceptions (up to 25mm Main Line and 35mm sidings) provided these do not compromise track adjustment.
6. Odd marginal exceptions.
7. Odd marginal exceptions provided that a review of the track twist (long and short) is undertaken.
8. Odd marginal exceptions provided the level must not exceed the plaqued height.

The total number of exceptions for all geometry parameters that can be agreed by the Civil Maintenance Engineer should not exceed 5% of locations.

C4-5 Maintenance acceptance limits for plain track geometry

The following maintenance acceptance limits are extracted from RailCorp Standard ESC 210.

This section details the minimum standard of track geometry that is to be achieved at the completion of the different types of maintenance activities.	**MR**
This section details the minimum standard of track geometry that is to be achieved at the completion of the different types of maintenance activities.	**MR**
Maintenance of geometric alignment on ballasted track may be carried out by mechanised surfacing or by manual maintenance (fettling).	**G**
Criteria have been specified for compliance to survey and for track unevenness depending on the nature of the work (manual or mechanised) and the specific site conditions. Separate requirements have been specified for maintenance activities affecting track gauge.	**G**

C4-5.1 Gauge of Track

The following maintenance acceptance limits are extracted from RailCorp Standard ESC 210.

The limits in Table 5 shall be applied when new sleepers are installed (at each sleeper) or track is cross bored or regauged. **MR**

		Main line mm	Sidings mm
Gauge			
Variation to design gauge	Wide	5	5
	Tight (including head flow)	5	5
		Limiting tight gauge 1430mm	
Variation in 1m (due to rail wear)		2	2
maximum deviation at a discontinuity (e.g. a joint)		1	1

Table 5 - Maintenance Acceptance limits for gauge

Where gauge widening has been applied on curves by design, the limit applies to the widened design gauge. **MR**

Rail play is not permitted except small amounts arising from construction tolerances (e.g. 1mm between insulator and foot of rail). **MR**

Work shall be carried out to correct "foot gauge" ± 5mm. (See Table 6). **MR**

Rail Cant		Rail Size (kg/m			
		47	50	53	60
1 in 20	Plain Track	1390	1391	1373	1374
Zero	In Turnouts	1379	1379	1360	1360

Table 6 – Foot Gauge

Civil Maintenance Engineers may authorise the following limited variations:

1. Correction of wide gauge on curve worn rail by tightening the "foot gauge.
2. Greater than 5mm tight gauge where rail flow is present.

Gauge must not exceed the BOS limits without appropriate protective action.

The maximum deviation at a discontinuity such as at a joint ("foul joint") shall be in accordance with Table 5. Particular care is required to ensure that new joints cut into the track have matching profiles at the gauge face and running surface.

C4-5.2 Accuracy to Survey

The following maintenance acceptance limits are extracted from RailCorp Standard ESC 210.

Track on which maintenance work has been undertaken shall conform to the basic surveyed design within the tolerances for alignment and level detailed in Table 7. **MR**

Operating Class	Variation from design	
	Main line mm	Sidings mm
Alignment		
Alignment at platforms	±15	NA

Alignment at restricted clearance locations (Note 1)	±15	±15
Alignment general (Note 6)	±15	±25
Superelevation		
Superelevation (Note 7)	±6	±8
Track Surface		
Height at platform for level access (Note 8) (Note 9)	− 25 (Note 5) to + 15	NA
Height at platform for standard access (Note 8)	− 0 (Note 5) to + 50	NA
Height at other restricted height clearance locations (Note 8)	− 25 to + 50	− 25 to + 50
General height, only applicable to mechanised resurfacing	− 100 (Note 2) to + 50	− 100 (Note 2) to + 50

Table 7 - Maintenance Survey Acceptance limits

Note
1. Where separate construction tolerances have been supplied as part of a Transit Space Infringement Approval these will take precedence.
2. will depend on the overhead wiring configuration in the area. Allowances above 50mm can only be utilised after confirmation with the Electrical Maintenance Authority.
3. Before any significant track lifting is carried out including any mechanised resurfacing the track maintainer shall check with the Electrical Maintenance Authority to ensure that the proposed lift will meet electrical clearance requirements. Any proposed lifts shall also consider the loading on ballast top bridge structures and the impact on any ballast retaining structures such as wingwalls. The requirements do not apply to manual fettling of short term settlement locations.
4. Note: Measurement convention (+ means track is lower than design rail level) see Figure 2.
5. Over time the track level will rise as a result of maintenance resurfacing. When track maintenance is carried out any lifts that will take the rail level above the tolerances should be minimised.

Civil Maintenance Engineers may approve the following limited variations:

Note
6. Odd exceptions (up to 25mm Main Line and 35mm sidings) provided they are not on curves less than 600m radius (due to impact on track adjustment).
7. Odd marginal exceptions for mechanised surfacing provided that a review of the impact on the track twist (long and short) is undertaken.
8. Approval for work to proceed if tolerance cannot be achieved as track is too high. A minimum lift only is to be applied.
9. Resurfacing maintenance lifting can be used to correct track that is too low to design.

   Ballast cleaning, reconditioning or platform raising would be required to lower track that is too high to design. If track is too high then minimum lift strategies must be applied for any maintenance resurfacing required pending correction.
10. Stakeholders must be advised where tolerances are exceeded and must be consulted on corrective strategies.

Available survey information includes survey plaques, marks on masts etc. as well as F Sheets (or G sheets). Where survey is required and is not available advice must be obtained from the Civil Maintenance Engineer on the procedure to be adopted.

C4-5.3 Unevenness

The following maintenance acceptance limits are extracted from RailCorp Standard ESC 210.

Track on which maintenance work has been undertaken shall conform to the limits track unevenness detailed in Table 8. **MR**

Operating Class	Main line mm	Sidings mm
Line		
Tangent Mid-ordinate (mm) from overlapping chords and maximum versine (mm) for 8m chord with 2m overlap	1	4
Curve Mid-ordinate variation (mm) in successive overlapping chords for 8m chord with 2m overlap	2	7
Twist		
Track twist over 2m(1)	6	10
Track twist over 14m(1)	12	20
Track Surface		
mid-ordinate of 6m chord	6	10

Table 8 - Maintenance Acceptance limits

Note 1. Where the track being assessed is within a transition the designed variation in superelevation (i.e. a designed twist) shall be considered when determining compliance.
2. Irrespective of any allowances in the table above the Base Operating limits for track geometry for the relevant track speed specified in TMC 203 must not be exceeded.

C4-5.4 Mechanised Surfacing

The following maintenance acceptance limits are extracted from RailCorp Standard ESC 210.

Where mechanised surfacing is undertaken track geometry shall conform to the basic surveyed design within the tolerances for alignment and level detailed in Table 7. **MR**

In addition a visual examination shall be undertaken to confirm geometry is visually smooth. If visible deviations are evident then the anomaly shall be checked as follows: **MR**

Alignment use overlapping chords as per Table 8.

Surface use overlapping chords or a “Level” to determine compliance to Table 8.

Superelevation shall be checked against the tolerances in Table 7 at the following locations: **MR**

- At all geometry change points including TP, TRS, CTP, CTRS, Ea points.
- At all surveyed locations
- At no more than 20m intervals on track of consistent curvature
- At no more than 5m intervals on track with changing curvature (e.g. transitions)
- At any location where any visible deviation in rail surface is evident

Where mechanised surfacing is undertaken track geometry shall be controlled by reference to survey plaques on structures. The location of geometry change points must also be used including TP, TRS, CTP, CTRS, Ea points. These must be located or marked prior to work commencing. Design superelevation must be available before work commences either from survey marks or from G Sheets or other source data unless advice has been obtained from the Civil Maintenance Engineer on the procedure to be adopted.

The limits provided in this section assume that laser technology and sophisticated smoothing algorithms are used including manual adjustment for curve compensation where required. On this basis individual locations between specified survey points are assumed to be automatically aligned to an acceptable intermediate tolerance.

C4-5.5 Manual Maintenance

The following maintenance acceptance limits are extracted from RailCorp Standard ESC 210.

Where Manual maintenance activities are undertaken track geometry shall conform to the Unevenness Criteria in Table 8 and with the following survey acceptance criteria from Table 7. • track height at platforms and restricted height locations • track height to design for longer sections of track (more than 30m) at the nearest survey reference points • Superelevation at 2m intervals through the worksite and for 14m either side	**MR**
Track twist is to be checked for 2m and 14m chord lengths against Twist criteria in Table 8.	**MR**
On multiple tracks with centres less than 4 000mm, where variations in the superelevation roll the vehicles towards each other, the sum of the variations in superelevation shall not exceed 12mm.	**MR**

Where activities **DO NOT** involve changes to alignment (such as corrective lifting of track) then alignment checks are not required except:

- At platforms or restricted clearance locations.
- If there is any indication that the track may have moved during maintenance or shows visible alignment irregularity. Particular care is needed with sharper curves (less than 600m radius).

Check Top unevenness visually to ensure a smooth vertical alignment against the tolerance for Track Surface in Table 8. If in doubt use chord measurements, or a level to measure compliance.

Survey heights are not required to be taken where small sections are lifted and the track either side provides an even reference.

Where manual lining takes place line unevenness is to be assessed using overlapping chords as per Table 8.

Where short transitions are part of the track geometry design, care must be taken to ensure twist criteria are met.

For manual work methods, if the geometric requirements for alignment, superelevation, twist and top limits cannot reasonably be met then at least the Base Operating limits for track geometry for the relevant track speed specified in Engineering Manual TMC 203 must be met, and the ride of the first train over the section observed.

Chapter 5 Repairing turnout components

This chapter describes the methods used in RailCorp to repair defects in turnout components without replacement.

C5-1 Repairing switches

C5-1.1 Switch opening defects

There could be many causes of a switch not closing correctly:

1. **Switch bent or crippled**

   If this is the case an effort can be made to crow the rail to remove the defect. When crowing a switch, care must be taken not to break the switch.

   If the switch is crippled and cannot be repaired, it should be replaced using the procedure in Section C6-1.

2. **Switch studs wrong, damaged or loose**

   Switch studs are placed between the stockrail and the switch to support the switch as it deflects the wheel flanges. The studs vary in length depending on where they are to be placed. If the stud provided is too long it will not allow the switch to close up. If it is too short it will not provide support for the switch.

   Check that the studs are in good condition, are the correct length, are in the right order and are tight. Tighten or replace them if necessary.

WARNING

If replacing studs on a switch, slide a wedge between the switch and the stockrail. The switch should be chocked and locked.

3. **Foreign material between the back of the switch and the stockrail**

   Ballast, old bolts, old studs etc. that find their way between the stockrail and switch could also prevent the switch from closing correctly. All foreign material should be kept well clear of the switch area to prevent this.

4. **Incorrect switch height**

   It is sometimes found that the point of the switch is level with the top of the stock rail (excluding heavy duty switches) or stock rail undercut. This may be caused by a depressed heel joint, a worn stockrail, poor top on the A & B bearers or incorrect adjustment of the interlocking gear, particularly the switch roller attachment. In 53kg conventional turnouts, tables are provided on the switch chairs to support the blade over its area of travel, but switches should not be allowed to float. This fault may lead to the switch and stockrail being crippled under wheel impact.

   Check that the correct chairs are installed. Taller chairs further back may be lifting the switch up.

   If the heel joint or the front of the stock rail (A, A1, A2 bearers) is in a "hole" the point of the switch will tend to rise up and away from the stockrail with the passage of a train or naturally with an undercut switch. Adjust the bearing of

the switch on the slide plates and keep the bearers under and around the heel and switch tip well packed.

5. "Dead lever" (in non-interlocked points)

A lever is dead when it reaches the end of its cycle before the switches are completely closed. The correct adjustment and maintenance of levers is therefore, critically important.

C5-1.2 Other switch defects

1. Switch blade chipped or broken at the switch toe

Grind the switch nose to the correct profile using a rail grinder when the point of the switch becomes chipped or blunt along the top edge and is thicker than the standard section to such a degree that it might prove a contributing factor to a derailment.

Grind the switch nose when the switch point is worn to a thin and sharp edge. Grind the edge slightly to prevent chipping or cracking of the nose, removing only the minimum amount of steel.

Remove rail flow of steel at the top edge of the back of the switch. Where this flow is considerable, remove most of it with a hammer and cold set or chisel before finishing with grinding.

Where the damage is more than 200mm long and/or 7mm below design profile, there is no approved method of repairing the switch blade. Replace the switch using the procedure in Section C6-1.

Where grinding is undertaken using an angle grinder, care must be taken not to over heat the rail.

2. Hogged switch rail

This is usually caused by either the manufacturing process and/or the rolling out of stress under traffic, or poor handling techniques.

The rail will usually bear on first and last slide chairs only and it is not practicable to rectify this condition on site. Replace the switch using the procedure in Section C6-1.

3. Switch soleplates (PRE)

In approved Pacific Rail Engineering (PRE) tangential turnout designs installed on timber bearers, the slide baseplate end stops may become detached from the soleplate. These may be repaired by re-welding the stop(s) to the soleplate under workshop conditions.

If the slide baseplate end stops become worn because the baseplate(s) are not securely held down repair is not practical. Replace the complete soleplate.

Replace damaged soleplate insulation fittings.

Where the fittings have been pulled apart then it will be necessary to reset the switch toes to gauge and fit new bolts and insulation to the soleplate.

C5-2 Repairing switch heels

Repair heels by undertaking one or all of the following steps

1. Replace cracked heel blocks.
2. Replace loose or missing heel bolts.
3. Adjust tightness of heel bolts (Note on heeled switches, bolts are fully tightened and bear between the collar shoulder and head).

   To allow for manufacturing tolerance or any wear in the bolts, fully tighten the back bolts and then the front bolts. If the switch cannot be moved check for wear or poorly bent heel plates.
4. Repair foul heel joints by removing rail overflow.

   Remove rail flow by cutting it out with rail saw or hacksaw, or by grinding it out.
5. Replace loose fastenings under the heel joint.
6. Pack bearers under and around the heel.

C5-3 Drilling of switches & stockrails

When drilling of switches or stockrails is necessary it MUST be carried out as follows:

- ONLY drill holes using a jig (where an approved jig is available).
- For holes up to 22mm diameter the minimum distance between holes (edge to edge) is 11mm including tolerances.
- Other holes are to be no closer than 45mm centre to centre for holes up to 30mm (the maximum hole diameter).
- Holes must be drilled circular (holes must not be elongated) using broach drill bits.
- The hole must be drilled clean and square and deburred after drilling to reduce the risk of crack propagation due to localised stress raisers.
- The temperature of the drill must not be excessive ie blueing of the rail must not occur.
- The hole must be drilled using a Contec drill kit for switch blades supplied by Techsol (or approved equivalent).

C5-3.1 Drilling of conventional switches

Switches are normally factory drilled to fit the required signalling equipment. For conventional switch blades new drilling may be required on site. Altered drilling should be carried out to suit the standard drawings for the equipment. In any case drilling must not contravene the following:

- The centre of the hole must be between 62mm and 72mm above the rail foot.
- Holes must not be drilled within 45mm of the switch tip.

C5-3.2 Drilling of stockrails

Stockrails are normally factory drilled to fit the required signalling equipment. Altered drilling should be carried out to suit the standard drawings of the equipment.

- The centre of the hole is to be 75mm from the bottom of the rail for 60kg/m rail and 68mm from the bottom of the rail for 53kg/m rail.
- For holes up to 22mm diameter the minimum distance between holes (edge to edge) is 11mm, including tolerances.

- Where required 22mm holes are countersunk on the blade side using a 90° countersink bit.

C5-4 Repairing stockrails

Repair stockrails by undertaking one or all of the following steps.

1. Grind Rail wear or overflow on the stockrail.

   Remove overflow of steel on the top of the gauge face of the stockrail by grinding.

   Start the cutting or grinding on the stockrail near the point where the back of the switch makes contact and continue to a point about 50mm in front of the switch nose. Then remove the roll-over from the top back edge of the switch.

   DO NOT remove any rollover on the stockrail more than 50mm in front of the switch as it provides partial protection for the switch point.

   If the gauge face of the stockrail is worn, the switch, when closed, will engage the lower portion of the head of the stockrail and leave a gap between the top of the switch and the stockrail.

   This work is specially important on the high rail of a curve where the stockrail is curve worn and the back of the switch nose does not follow the contour of the worn gauge face of the stockrail. Attention is necessary to prevent the possibility of a worn wheel flange mounting the switch.

   When the work is completed arrange with Signals personnel for adjustment of the switch opening and switch seating. With the exception of housed points no portion of the switch contacting the stockrail should be left higher than the stockrail.

   Replace the stockrail using the procedure in Section C6-2 if it cannot be repaired.

2. Adjust stockrail creep at switch.

   You will have to cut in front of the switch and behind the heel blocks to relieve forces, square up the points and weld.

3. Replace cracked, bent or broken rail braces.

C5-5 Replacing rail brace bolts

C5-5.1 Testing bolts

Broken rail brace bolts may cause signal failures. This problem is mainly related to non-approved rail brace bolts which have been installed in the past. The bolts typically break at the top of the shank. Ultrasonic bolt testing, using an ultrasonic crack measuring instrument, can detect cracks and potential failures in bolts. The method of testing is detailed in TMC 224.

Carry out testing at:

- High risk locations, such as those where non-approved bolts have been identified

  Non-approved bolts can be identified from the markings on the head (see C5-5.2). Bolt inspections may be used as an alternative to replacement of non-approved bolts.

- High risk locations where there is a history of failures.
- Locations where upgrading or major maintenance work is planned in turnouts.

  Take the opportunity to replace any incorrect bolts with the correct type, along with any worn or distorted bolts noted in service.

C5-5.2 Identifying bolts

Currently approved Rail Brace Bolts are hexagonal bolts that will have the three radial marks evenly spaced around the head and the letters “S” stamped in (see Figure 3).

Older hexagonal bolts (no longer approved) may have 3 or 6 radial marks and may have the letter “W” or no letter at all (see Figure 4).

DO NOT purchase bolts directly from suppliers. Bolts issued from store will be correct.

Figure 3 - Approved bolts

Figure 4 - Old non-approved bolts

Swage fastenings (“Huck Bolts”) are also approved (See Section C5-5.5). Square headed bolts which may still be supplied with PRE switches are also approved, but if a bolt needs to be replaced use the hexagonal bolt as above.

Note: Rail Brace Bolts are only found on conventional turnouts (and not on tangential turnouts)

C5-5.3 Bolt length

Always use the correct bolt length. Overlong bolts will not be able to be fully tightened. Use of multiple washers is poor practice and the bolt will quickly become loose.

A125mm long bolt is the preferred option as the additional length allows the use of a 10mm thick spring washer. The shorter, 120mm long, bolt can, however, be used with a flat washer.

The correct switch stud bolts should always be used. Using the wrong size can cause the switch to jam. Grinding off ill-fitting stud bolts is not recommended. The resulting heat stress can cause future cracking and failure of the stud. If any ground off studs are found they should be replaced.

Make sure the spring washer is fully compressed (See Figure 5).

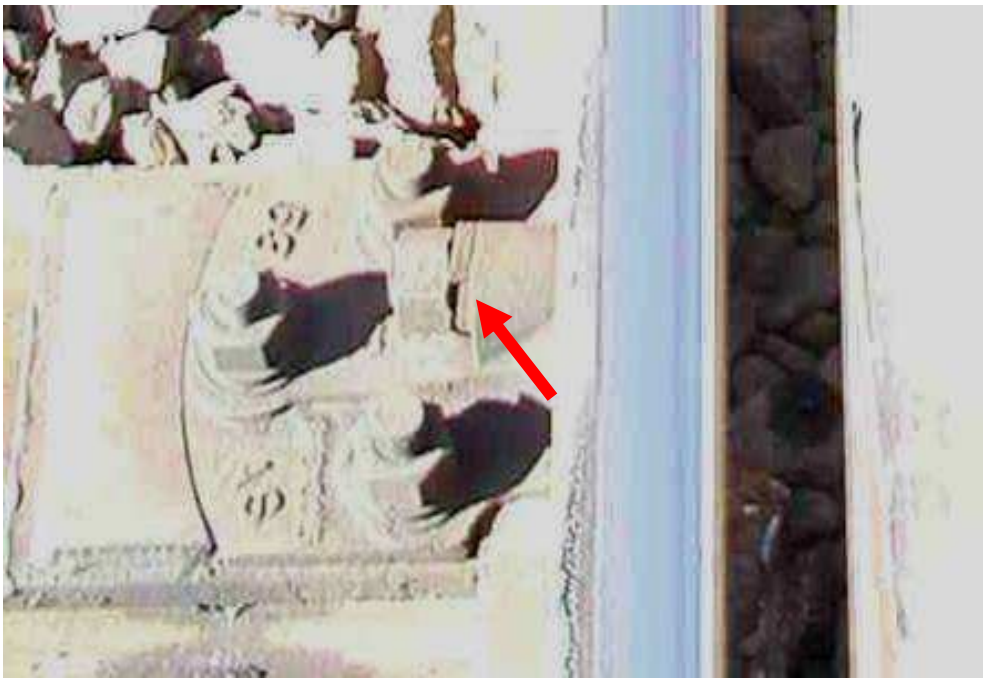


Figure 5 - Bolts Loose - washer not fully compressed

C5-5.4 Keeping bolts tight

If you can, tighten the bolt up to the recommended torque for that bolt type. Two types are in use - the traditional standard carbon bolts and the newer high-strength bolts (grade 8.8 which have an 8.8 stamped on the head). Torque settings for these are:

- standard carbon - 248Nm (183ft.lbs)
- high-strength - 640Nm (472ft.lbs)

If an Impact Wrench ("rattle gun") is used you could still finish off tightening up the bolts with a torque wrench.

Where manual methods are used the following is recommended:

- For standard bolts current tightening methods are OK ie fully tightened with small wrench/ spanner of about 600mm length.
- High-strength bolts should be tensioned to be fully tight with small wrench/ spanner about 600mm long and then tightened a further 1/3 of a turn with a large wrench/ spanner about 1200mm long.

Bolts should not be reused but they can be tightened up in the same hole.

Make sure the holes line up between the chair plate and the stockrail. There must be play between the bolt and edges of the hole. (i.e. the bolt easily slips through the hole and can be wobbled (jiggled) sideways and up and down before tightening. Mismatching holes will cause the bolt to sit unevenly and eventually cause it to fracture (See Figure 6). Some minor readjustment of the bearer may be necessary.

Figure 6 - Mismatched holes

Make sure the stockrail foot rests fully on chair plate before tightening the bolt. This is especially important with 60kg undercut switch rails.

If heat has been applied to a bolt to loosen the nut, the washer must be replaced before re-tightening the nut.

Prior to turnout resurfacing being carried out make sure bolts in switches are all tight. This will help resist timbers being moved by tampers and causing bolts to be misaligned.

After tamping has been carried out, if practical, check to make sure bolts in switches are still tight.

C5-5.5 Using swage fastenings as rail brace bolts

The use of approved swage fastenings is an option as shown in Figure 7 to Figure 10.

Special care is needed with seating of the stockrail and the correct alignment of the holes when swage fastenings are installed. If the stockrail foot is not fully resting on the chair plate, the rail brace can break resulting in the replacement of up to 4 swage fastenings.

Remember to check with Signal staff before carrying out any work on points in case signal adjustments are required.

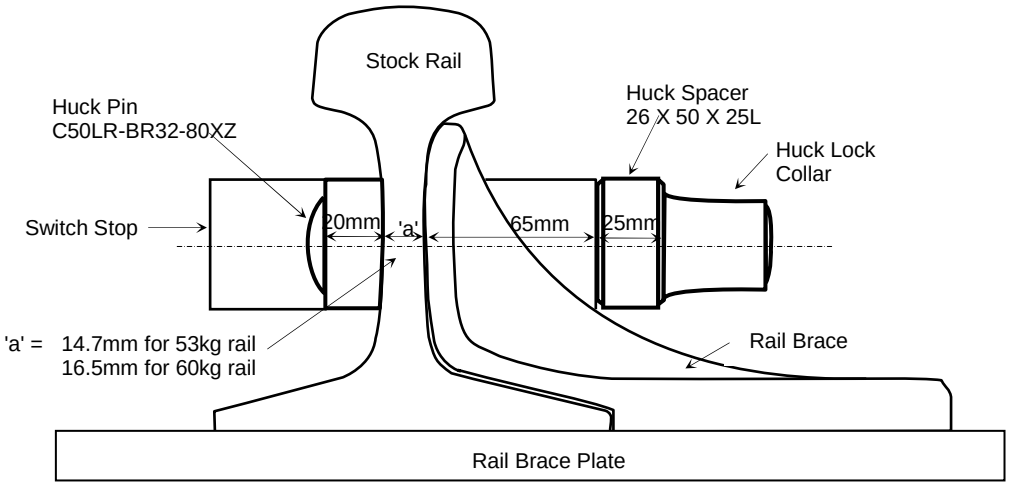


Figure 7 - For 53 and 60kg Rail Brace Plates with Switch Stops

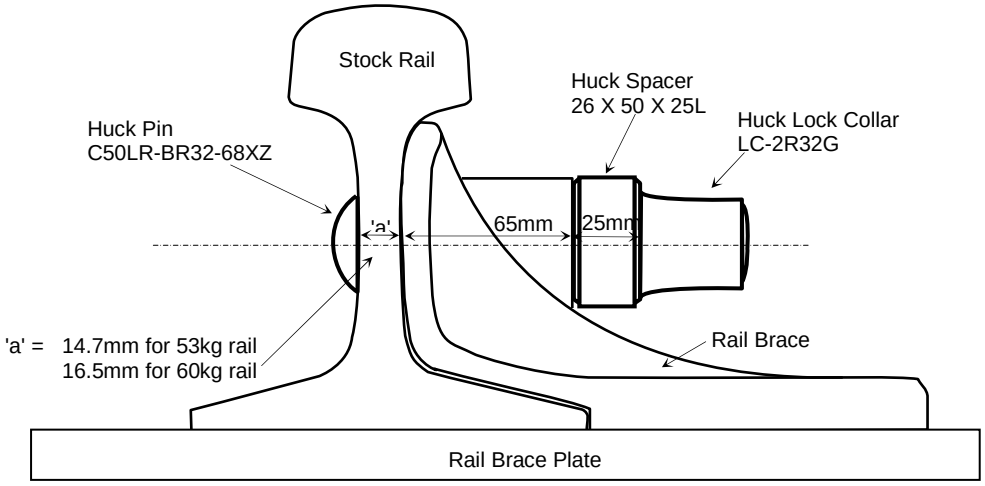


Figure 8 - For 53 and 60kg Rail Brace Plates

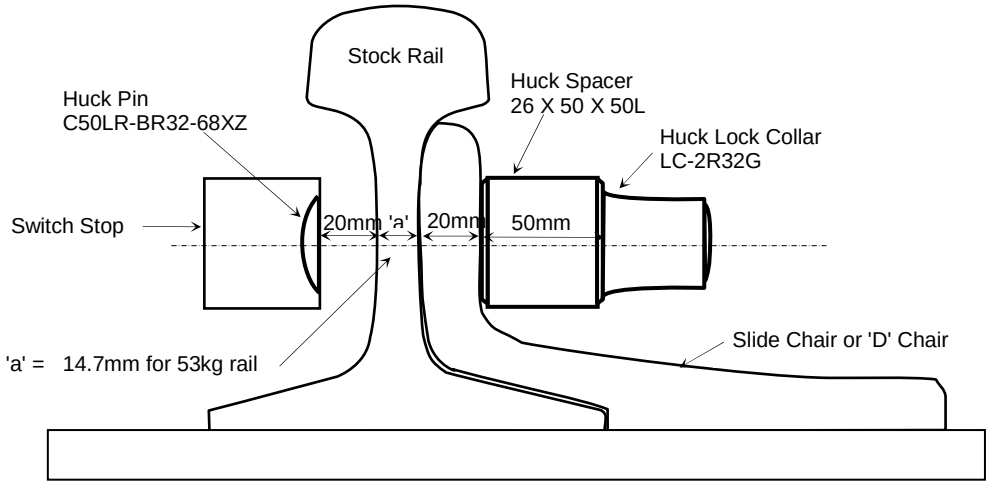


Figure 9 - For 53kg Slide Chairs with Switch Stops

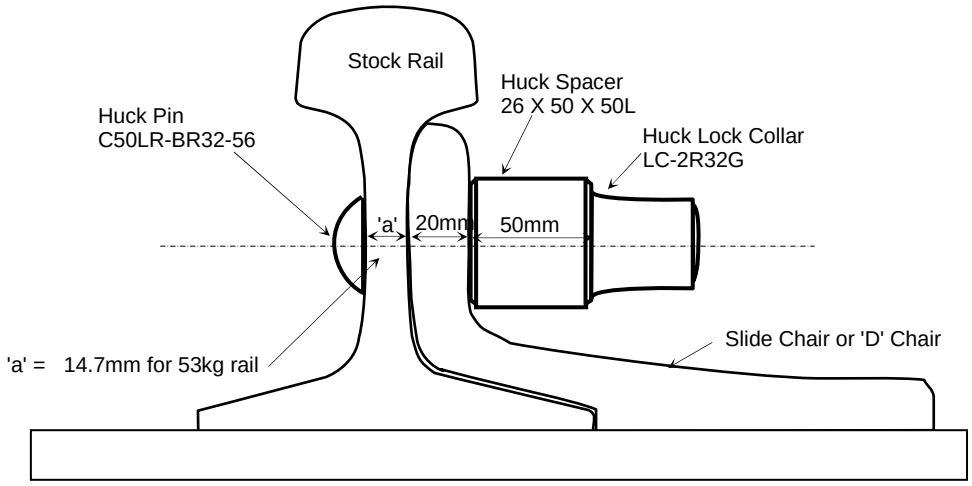


Figure 10 - For 53kg Slide Chairs

C5-6 Maintenance of plates and fastenings

C5-6.1 Repairing switch baseplates

1. Broken baseplates

   Broken baseplates indicate either that the bearers are becoming indented or that the baseplate was incorrectly seated at the time it was installed.

   Remove the baseplate to assess its seating on the bearer. If the bearer is severely or unevenly indented then change the affected bearer and baseplates using the procedure in Section C6-8.

   If bearer seating is suitable, clear away debris from the baseplate seatings and fit a new baseplate using the procedure in Section C6-6.

   Make sure that the new baseplates are correctly seated on the bearers and held to the rails(s) with new fastenings as required.

   When fitting fastenings hold the baseplate tightly to the rail until the fastening is fully home. If you don't do this the new casting will fail immediately.

   Where Pandrol clips are in use, NEVER use the clip to pull the baseplate or baseplate and bearer up to the rail as the additional loading imposed on the clip housing will cause the casting to shatter.

2. Defective slide baseplate distance blocks (Stop blocks) (PRE)

   Replace defective slide baseplate distance blocks. Note: these blocks are made to fit each particular type of switch and most are made to left and to right hand patterns. Make sure you use the correct distance blocks.

C5-6.2 Use of screwspikes with helical spring washers

C5-6.2.1 Requirements

Where chair plates in turnouts are fastened to bearers with screwspikes with double helical washers it is critical that the correct clamping force be applied to the screwspike/double helical washer combination to prevent lateral movement between bearer and plates (for normal track loading).

Fasten each chair plate with 4 screwspikes each having a clamping force of 40kN.

NOTE: Use of Torque wrenches to measure clamping force is not appropriate as the measurement is of variable friction between spike and the plastic insert or timber bearer rather than the clamping force between the helical spring washer and plate.

The required clamping force is achieved by compressing the installed Fe6 Double Helical Spring Washer to a stand height of 13.1mm.

The stand height is achieved by a guiding sleeve on the 41mm high-impact hexagon socket (or alternatively the 21 x 28mm rectangular, 1" drive GETA high-impact socket). See drawing number CV0166867 and CV0166868 for details. The sockets are available through Delkor Pty Ltd.

On the turnout plates, the bearing area of the double helical spring washer must be clean and free of burrs and risers so that the correct torque setting can be achieved and wear to the socket sleeve is minimised.

C5-6.2.2 Replacement of earlier installations

Early installations of screwspikes used an insulation washer and insulation sleeves through the fastening holes of the turnout bearer plates, but did not use helical washers. To change to screwspikes with helical spring washers, remove washers and insulation sleeves from bearer plates and replace insulation sleeves with steel bushes (I.D 26mm). The height of the steel bushes is to be designed so that, when installed, the top of the bush does not protrude above the top of the turnout bearer plate.

C5-6.2.3 Re-use of double helical spring washers

Double helical spring washers Fe6 or Fe15 should be rejected for re-use when the stand height (unloaded height) is reduced to 17mm or less.

To determine the rejection limit of the washers use the gauge (See drawing number CV0166869 and CV0166870 for details). The gauge is available from Delkor.

Place the double helical spring washer over the gauge shaft and the test block over the washer onto the shaft. If the red line on the shaft of the washer acceptance gauge is visible, reject the washer.

C5-7 Repairing crossings and conventional checkrails

Repair crossings and conventional checkrails (machined from rail section) by undertaking one or all of the following steps:

1. Repair the crossing nose by Wire Feed Welding using the approved procedures detailed in RailCorp Engineering Manual TMC 222 – Rail Welding.

   The type of material used to make a crossing dictates the welding process that can be used

   Fabricated crossings are weldable with normal wire feed welding.

   Compound Manganese must not be repaired in track by the standard wirefeed welding repair process. Crossings can, however, be exchanged and repaired out of track. Repaired crossings will typically last at least as long as new crossings.

   Chrome Vanadium crossings may be repaired using wirefeed welding using the same process utilised for high carbon steels.

Refer to Engineering Manual TMC 202 – Track Fundamentals for identification of crossing material.

2. Repair wing rails by wirefeed welding.

3. Tighten all bolts.

   Crossing bolts come with special tapered washers that have an angle so they match the angle between the crossing and the bolt. The nut is stopped from rotating by putting Loctite on the threads when the bolts are done up. If the bolt becomes loose then it can be re tightened by removing the nut and either cleaning up the thread and re-applying Loctite or by using a spring washer (either of these would prevent the nut loosening). The nut can be removed easily if it is heated up first which weakens the Loctite.

   If the crossing is assembled with swage fasteners (Huck bolts), loose fastenings cannot be tightened. Loose and broken swage fasteners can normally be replaced using the procedures in RailCorp Engineering Manual TMC 221 – Rail Installation & Repair, without the need to remove the crossing from the track.

   Special hydraulic equipment is required for both the removal and fitting of swage fasteners.

   If fasteners are not immediately available, standard crossing bolts, nuts and washers may be used.

   Where crossing chocks become loose due to loose crossing bolts, special care is required during tightening. The flangeways between crossing nose and wing rails must be reset to the design dimensions and the vertical position of the nose and chocks set to prevent a low crossing nose.

4. Pack bearers, particularly under the nose of the crossing.

5. Replace broken baseplates using the procedure in Section C6-6.

   This can usually be done without the need to remove the crossing from the track.

   When the broken baseplate is removed, carefully check the condition of the bearer supporting the baseplate to make sure that the bearer condition is not causing the problem.

6. Replace the crossing, using the procedure in Section C6-4, if it cannot be repaired in steps (1), (2), or (4).

C5-8 Repairing checkrails

1. Repair checkrails by undertaking one or all of the following:

2. Remove or add spacer shims in the checkrail flangeway until the correct flangeway clearance and checkrail effectiveness measurement is obtained.

   If the flangeway is WIDE make sure that the correct check blocks are fitted. If not, replace them with the correct blocks at time of replacement of checkrail. Otherwise replace the checkrail.

   If the flangeway is TIGHT replace the worn check blocks or grind checkrail carrier rail overflow.

3. Correct the flare at the end of the checkrail.

4. Grind any metal flow on the crossing nose that is forming a lip (See Section C5-9).

5. Repair chocked assemblies in the crossing and checkrails.

6. Replace the checkrail, using the procedure in Section C6-5, if it cannot be repaired.

C5-9 Grinding of crossings and wingrails

Grind crossings to remove the lip that develops on the nose of the crossing and, to a lesser extent, the wingrail. If left untreated this can damage the running surfaces by cracking, or overhardening the nose causing flaking and chipping.

The profile of the nose or wing rail is normally self-correcting under the wheel loads. The flow is caused:

- by the higher stresses due to more concentrated wheel rail contact (which occurs until the profile has worn in), and
- on some types of crossings because the hardness is low prior to work hardening in service.

Grinding should be carried out:

- When the lip reaches 1mm. However with head hardened rail, the crossing nose may not flow much more than 1mm, therefore grinding is worthwhile whenever flow is evident.
- During the wearing in period of new crossings (more than one grind may be required) High spots should be also ground off.
- In the wearing in period after build up repair of crossings.
- As part of the normal wear of crossings in some cases (normally over a longer time scale).
- To correct damage that may occur due to impact and unusual wear and to restore badly worn profiles. This would normally be carried out in association with building up.
- The anticipated grinding requirements for various crossing types are shown in Table 9.

Crossing Type	Period in MGT		
	After Installation	From Repair	In Service
Fabricated	2	4	20
Manganese	3	4	35

Table 9 – Recommended grinding requirements

C5-10 Installing swage fastenings in crossings

Swage fasteners are generally suitable for all track components designed for bolted connections. Due to their better holding ability, a more durable joint is achieved with swage fasteners than with bolted connections (providing the material of the joint components does not yield after application of fasteners).

The swage fasteners may be used as follows:

The following maintenance acceptance limits are extracted from RailCorp Standard ESC 220.

Swage fasteners are suitable for operating conditions with designed axle loads ≤ 25 tonnes at speeds ≤ 120 kph.

Only approved configurations (as documented in ESC 220) may be used.

The following placement and installation requirements apply:

1. Swage fasteners may only be applied to joints designed for no rail movement.

2. The application of the swage fasteners is to be restricted to trackwork in good condition, where the contacting surfaces and components of the joint can support the high clamping forces involved.

3. Swage fastener heads and collars must be fitted with washers made from cast or formed high strength steel to spread the clamping forces of the swage fasteners over a larger area. The hole diameter of the washer under collar must not be larger than 1.5mm in diameter more than the shaft size of the swage fastener.

Prohibited Configurations

- Swage fasteners may not be used where axle loads > 25t operate.
- Swage fasteners are not recommended for locations where a high level of 25t axle load traffic operates.

1. Check worn crossings and checkrails, which have been loose for a period of time under traffic for conformance to plan dimensions before the application of swage fastenings.

   Note: Softer spacing blocks of these components are subject to wear, thus resulting in reduction of overall dimensions. If these blocks are worn or remain loose when threaded bolts inserted for checking are tightened, swage fasteners are not to be used unless blocks are replaced.

2. Singly remove and replace all existing screw fasteners. Examine rails and other components for fatigue cracks or wear. Ensure that contacting surfaces are clean and bearing evenly.

3. Use clamps, rail tensors and wedges as required to level and adjust track. Tighten track components with black bolts to check assembly overall and flangeway clearance, checkrail effectiveness and gauge.

4. If necessary, file or grind off irregularities to ensure even bearing of the components so that no gap exists. Replace any worn spacing blocks if flangeway clearance is below the recommended dimension whilst the rail surface is not worn or has no metal flow. If metal flow exists grind it off before assembly.

5. After completion of the installation, the quality of the work is to be checked.

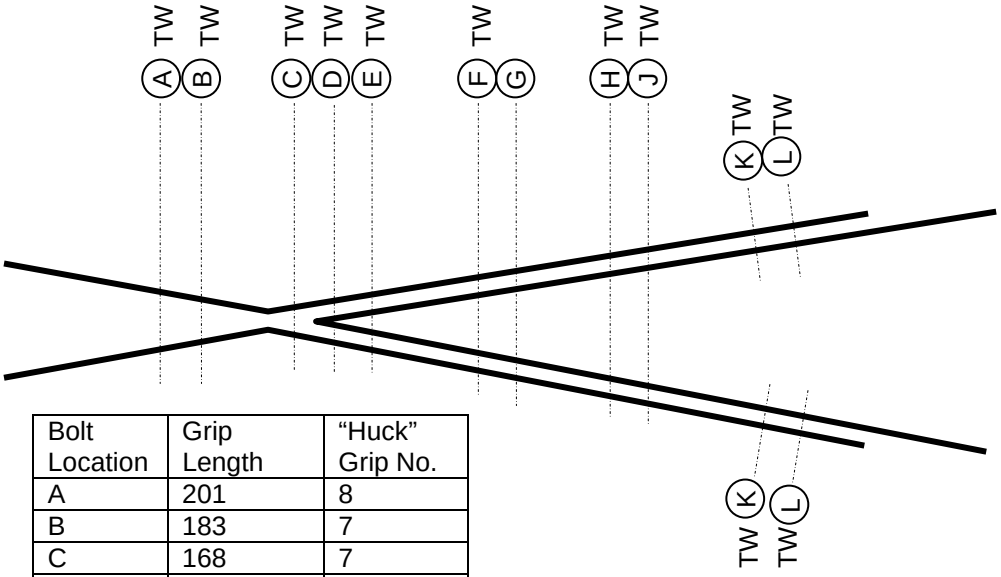
   ~ Check for track tolerances, wheel flange clearance (correct by grinding) and firm rail joints.

   ~ Check that all components are firmly tightened and swage fasteners are seated evenly.

~ Check swage fasteners using correct swage gauge for length of bolt and collar diameter.

For determination of swage fastener length and material requirements see the following figures:

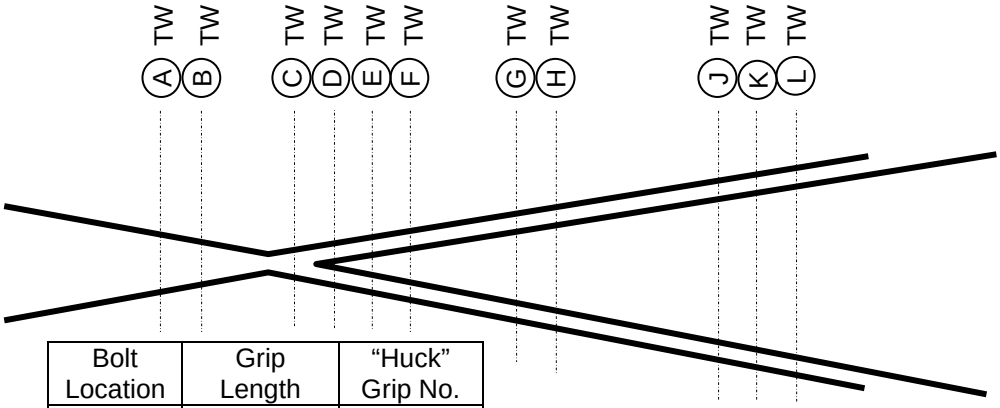
	Size	Turnout Crossing Angle
Figure 11	53	1:7.5
Figure 12		1:8.25
Figure 13		1:9
Figure 14		1:10.5
Figure 15		1:12
Figure 16		1:15
Figure 17	60	1:9
Figure 18		1:10.5
Figure 19		1:12
Figure 20		1:15



Bolt Location	Grip Length	"Huck" Grip No.
A	201	8
B	183	7
C	168	7
D	209	8
E	226	9
F	283	11
G	301	12
H	351	14
J	368	14
K	83	52
L	83	52

- Bolts are to be M30 type "C50L Huckbolts to lengths specified Tapered C.S washers (2 per bolt) are to be used where indicated thus 'TW'
- M27 High Strength Steel washer to be used between collar and tapered washer
- 7 Flat washers per bolt (maximum) are permitted
- LC-2R Collars are to be used

Figure 11 - 1 in 7.5 'V' Crossing - 53kg rail

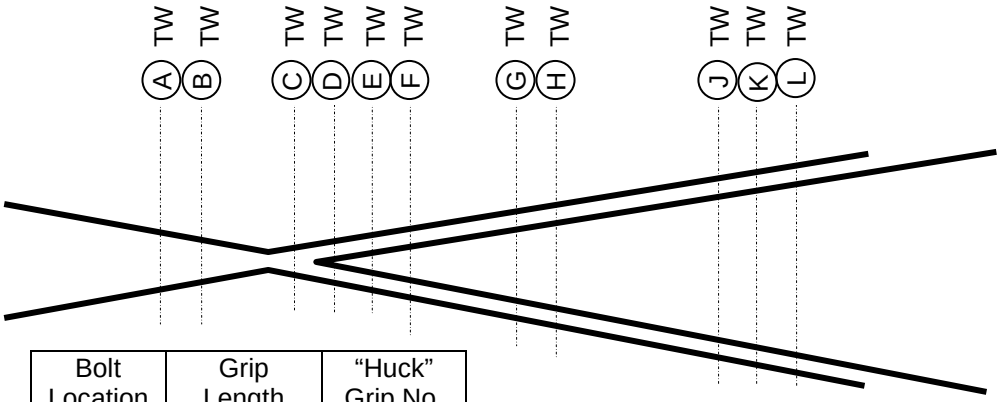


Bolt Location	Grip Length	"Huck" Grip No.
A	191	8
B	176	7
C	168	7
D	208	8
E	225	9
F	240	9
G	284	11
H	300	12
J	381	15
K	397	16
L	413	16 *

- Bolts are to be M30 type "C50L Huckbolts to lengths specified.
- Tapered C.S washers (2 per bolt) are to be used where indicated thus 'TW'
- M27 High Strength Steel washer to be used between collar and tapered washer
- 7 Flat washers per bolt (maximum) are permitted LC-2R Collars are to be used

* substitute with grip No. 17 for curved crossing

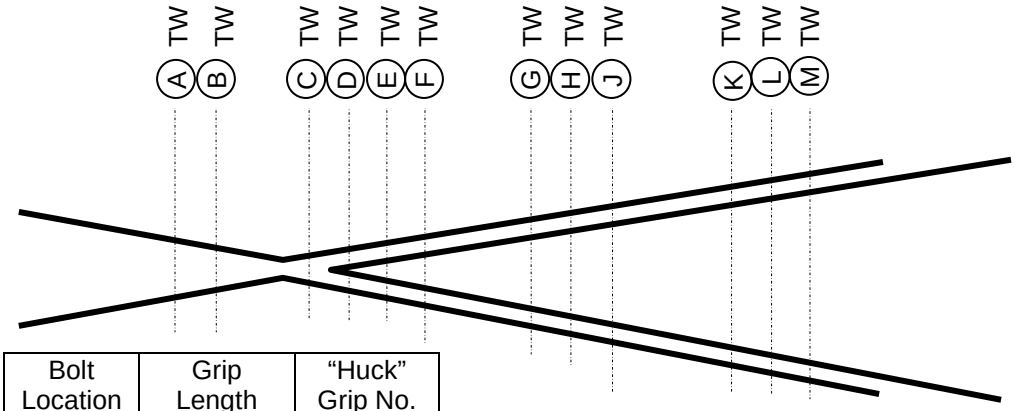
Figure 12 - 1 in 8.25 'V' Crossing - 53kg rail



Bolt Location	Grip Length	"Huck" Grip No.
A	196	8
B	182	7
C	197	8
D	209	8
E	223	9
F	238	9
G	288	11
H	302	12
J	382	15
K	396	16
L	410	16

- Bolts are to be M30 type "C50L Huckbolts to lengths specified.
- Tapered C.S washers (2 per bolt) are to be used where indicated thus 'TW'
- M27 High Strength Steel washer to be used between collar and tapered washer
- 7 Flat washers per bolt (maximum) are permitted
- LC-2R Collars are to be used

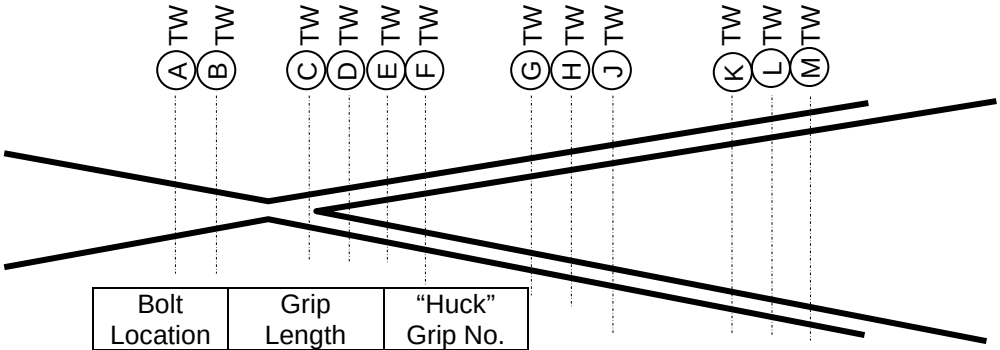
Figure 13 - 1 in 9 'V' Crossing 53kg rail



Bolt Location	Grip Length	"Huck" Grip No.
A	182	7
B	170	7
C	200	8
D	211	8
E	221	9
F	234	9
G	281	11
H	293	12
J	306	12
K	355	14
L	368	14
M	380	15

- Bolts are to be M30 type "C50L Huckbolts to lengths specified.
- Tapered C.S washers (2 per bolt) are to be used where indicated thus 'TW'
- M27 High Strength Steel washer to be used between collar and tapered washer
- 7 Flat washers per bolt (maximum) are permitted
- LC-2R Collars are to be used

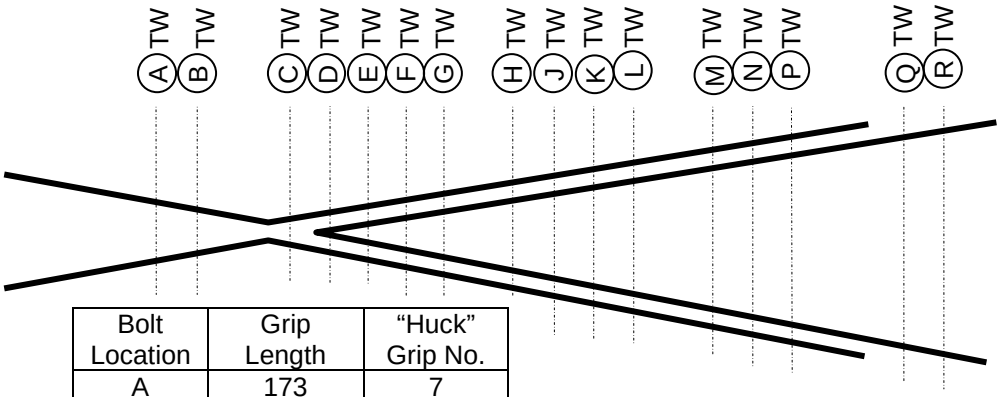
Figure 14 - 1 in 10.5 'V' Crossing 53kg rail



Bolt Location	Grip Length	"Huck" Grip No.
A	179	7
B	168	7
C	197	8
D	209	8
E	220	9
F	231	9
G	283	11
H	294	12
J	305	12
K	360	14
L	371	15
M	382	15

- Bolts are to be M30 type "C50L Huckbolts to lengths specified.
- Tapered C.S washers (2 per bolt) are to be used where indicated thus 'TW'
- M27 High Strength Steel washer to be used between collar and tapered washer
- 7 Flat washers per bolt (maximum) are permitted
- LC-2R Collars are to be used

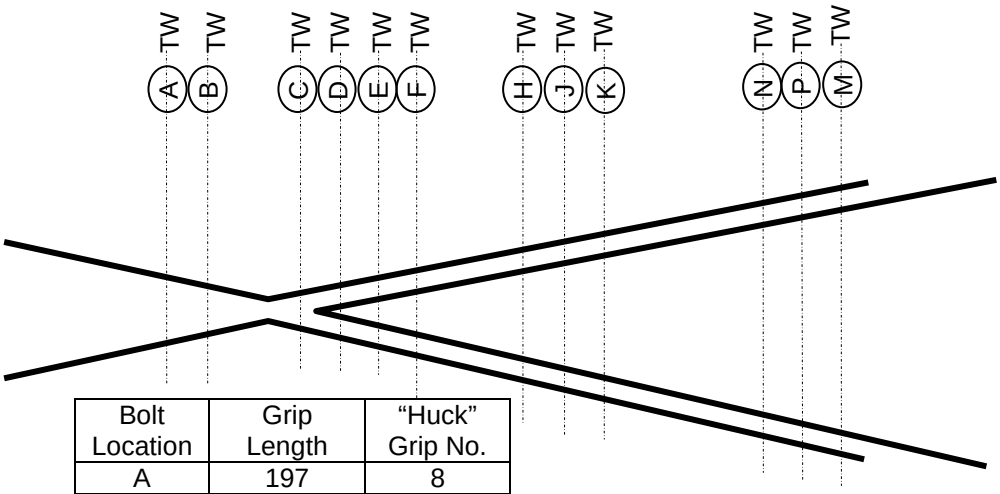
Figure 15 - 1 in 12 'V' Crossing - 53kg rail



Bolt Location	Grip Length	"Huck" Grip No.
A	173	7
B	164	6
C	202	8
D	209	8
E	218	9
F	226	9
G	236	9
H	277	11
J	286	11
K	294	12
L	303	12
M	363	14
N	375	15
P	384	15
Q	231	9
R	239	9

- Bolts are to be M30 type "C50L Huckbolts to lengths specified.
- Tapered C.S washers (2 per bolt) are to be used where indicated thus 'TW'
- M27 High Strength Steel washer to be used between collar and tapered washer
- 7 Flat washers per bolt (maximum) are permitted
- LC-2R Collars are to be used

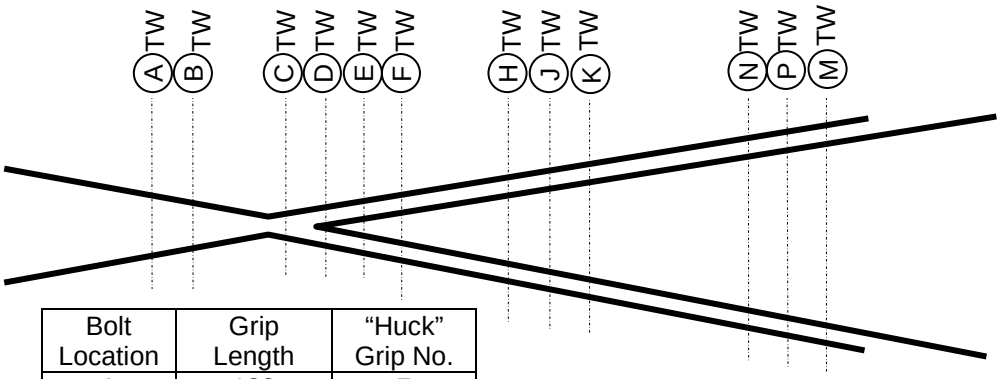
Figure 16 - 1 in 15 'V' Crossing - 53kg rail



Bolt Location	Grip Length	"Huck" Grip No.
A	197	8
B	183	7
C	200	8
D	210	8
E	224	9
F	239	9
G	275	11
H	289	11
J	304	12
K	381	15
L	396	16
M	410	15

- Bolts are to be M30 type "C50L Huckbolts to lengths specified.
- Tapered C.S washers (2 per bolt) are to be used where indicated thus 'TW'
- M27 High Strength Steel washer to be used between collar and tapered washer
- 7 Flat washers per bolt (maximum) are permitted
- LC-2R Collars are to be used

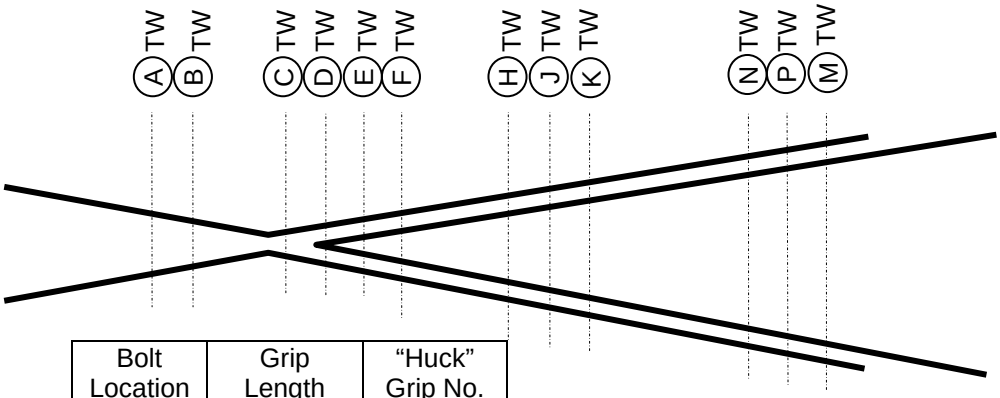
Figure 17 - 1 in 9 'V' Crossing - 60kg rail



Bolt Location	Grip Length	"Huck" Grip No.
A	183	7
B	171	7
C	202	8
D	210	8
E	222	9
F	235	9
G	273	11
H	286	11
J	298	12
K	356	14
L	369	15
M	381	15

- Bolts are to be M30 type "C50L Huckbolts to lengths specified.
- Tapered C.S washers (2 per bolt) are to be used where indicated thus 'TW'
- M27 High Strength Steel washer to be used between collar and tapered washer
- 7 Flat washers per bolt (maximum) are permitted
- LC-2R Collars are to be used

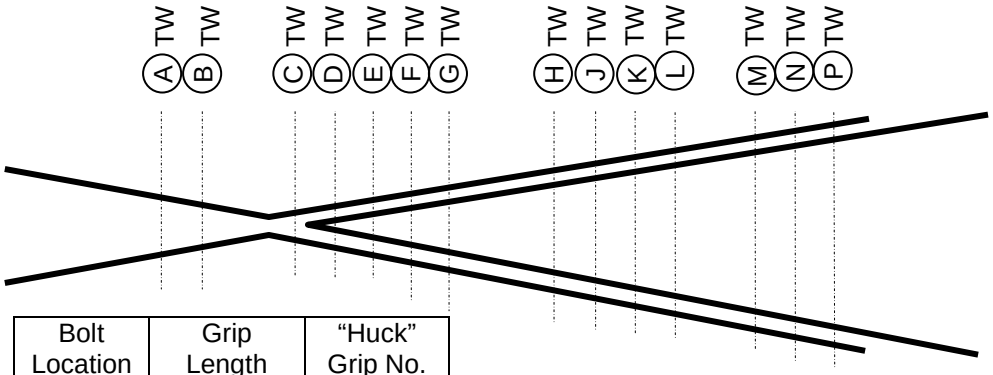
Figure 18 - 1 in 10.5 'V' Crossing - 60kg rail



Bolt Location	Grip Length	"Huck" Grip No.
A	180	7
B	169	7
C	203	8
D	210	8
E	221	9
F	232	9
G	273	11
H	284	11
J	295	12
K	349	14
L	360	14
M	371	15

- Bolts are to be M30 type "C50L Huckbolts to lengths specified.
- Tapered C.S washers (2 per bolt) are to be used where indicated thus 'TW'
- M27 High Strength Steel washer to be used between collar and tapered washer
- 7 Flat washers per bolt (maximum) are permitted
- LC-2R Collars are to be used

Figure 19 - 1 in 12 'V' Crossing - 60kg rail



Bolt Location	Grip Length	"Huck" Grip No.
A	173	7
B	165	6
C	206	8
D	211	8
E	219	9
F	228	9
G	237	9
H	273	11
J	281	11
K	290	11
L	299	12
M	365	14
N	373	15
P	383	15

- Bolts are to be M30 type "C50L Huckbolts to lengths specified.
- Tapered C.S washers (2 per bolt) are to be used where indicated thus 'TW'
- M27 High Strength Steel washer to be used between collar and tapered washer
- 7 Flat washers per bolt (maximum) are permitted
- LC-2R Collars are to be used

Figure 20 - 1 in 15 'V' Crossing - 60kg rail

C5-11 Adjusting and repairing checkrails and housings

Where checkrails or housings have worn to a sharp top edge, grind a small chamfer on this edge.

There are adjustable and non-adjustable checkrails and adjustable housings. The non-adjustable have solid chocks whilst the adjustable fall into two groups:

- Adjustable chocks between checkrail and carrier
- Addition of shims between the support chair and checkrail or housing

To adjust the checkrail to correct flangeway clearance:

1. check the flangeway clearance at each checkrail chair. Note particularly those locations where the flangeway clearance exceeds maximum tolerances.

2. Loosen all checkrail bolts so that the checkrail may be moved laterally, and remove the shims. Note that the shims are slotted, so that the shims may be removed and replaced without requiring complete removal of the bolt.

3. Insert sufficient shims between the checkrail and the vertical face of the checkrail chair seat to restore the flangeway clearance to required dimensions.

4. Replace the remaining shims outside the vertical face of the chair seat.

5. Repeat Step 3 at each successive chair location until the flangeway clearance is restored at all locations along the length of the checkrail.

6. Ensure that all shims have been mounted on the checkrail bolts, and tighten all bolts.

Where a crossing has become worn and needs replacing it is likely that the checkrails will be severely worn.

The checkrails then need to be replaced at the same time as the crossing or the crossing will have a shortened life.

C5-12 Adjusting housed points

C5-12.1 Adjusting the housing

The wheel flange gap needs to be maintained between 44mm (the 'as new' dimension) and 46mm.

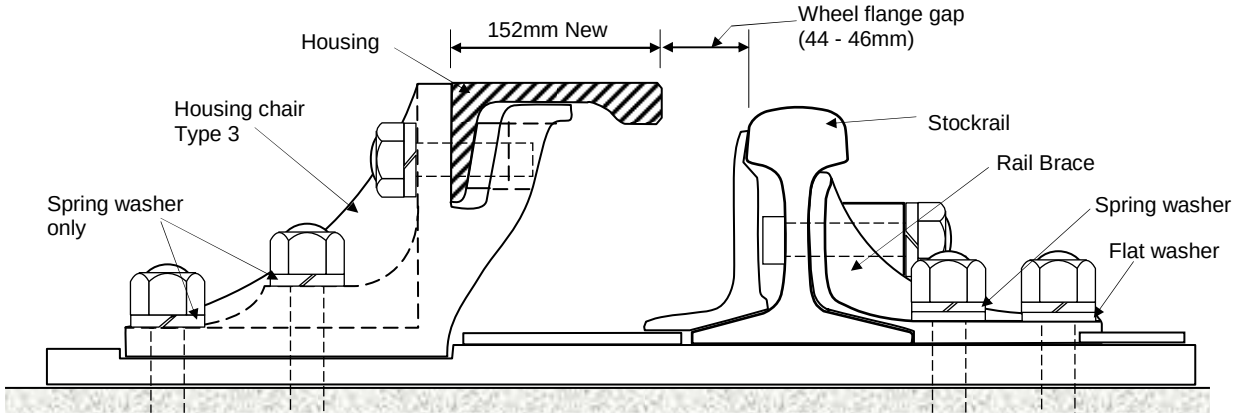


Figure 21 – New housing dimensions

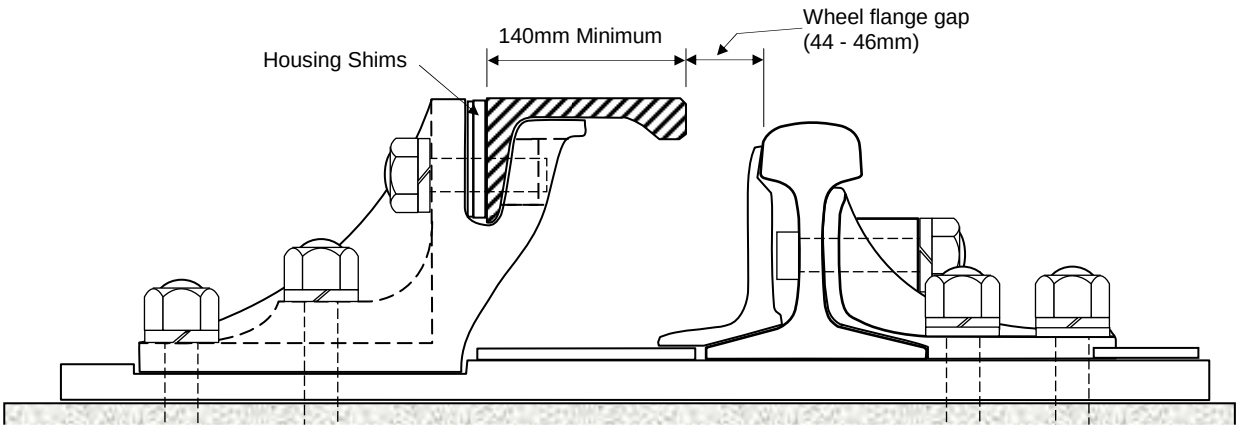


Figure 22 – Worn housing dimensions

The adjustment is performed with shims of 1.6, 3.2 and 6.4mm. This means that the wheel flange gap must be at least 45.6mm before a 1.6mm shim can be inserted.

1. Unscrew all housing chair bolts sufficiently to obtain a small movement of the housing. The housing need not be dismantled as rail expansion may make it difficult to replace the bolts once they are removed.

2. Place the housed points clearance gauge over the top of the housing with the 44mm portion of the gauge hanging down between the checking face of the housing and the gauge face of the closed switch, at a location 419mm back from the actual point of the switch. (See Figure 23).

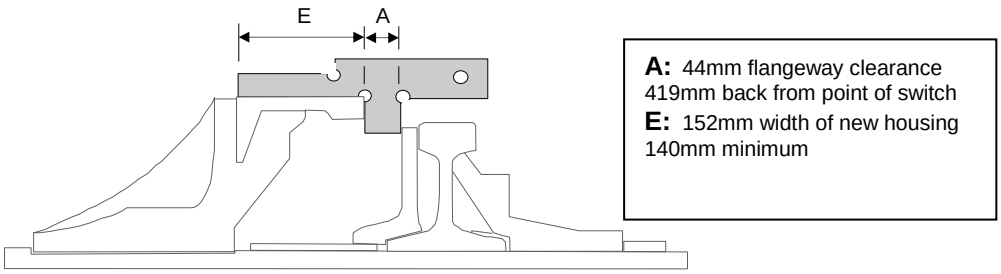


Figure 23 – Measuring flangeway clearance

3. Move the housing towards the stockrail, using a hammer and a cold chisel until 44mm wheel flange gap is obtained.

4. Insert packing shims behind the housing on the chair bolts to maintain the correct clearance when the bolts are tightened.

5. Shim all housing chairs by the same amount in order to obtain the minimum 44mm flangeway throughout the length of the housing, especially at the flare end.

6. A housing that has worn below 140mm cannot be adjusted any more and must be replaced.

7. Adjust the checkrail in front of the housing similarly with a 44mm clearance through the straight portion. The approach end should show a 102mm flare as at “F” in Figure 24.

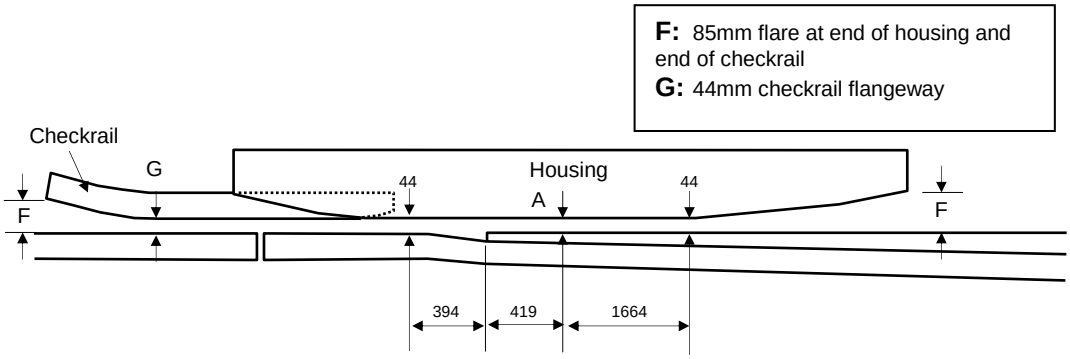


Figure 24 - Standard housing

C5-12.2 Checking adjustment

If a set of housed points is correctly maintained, the switches should not show any wheel marks for at least 400mm back from the switch point.

C5-12.3 Grinding a worn checking face

When the checking face of the housing is worn to a sharp edge, grind the arris formed by the top surface and checking face to a 6mm radius to remove the sharp edge. The holes drilled in the clearance gauge will serve as a template to scribe a 6mm radius on the end of the housing as a guide before grinding.

The sharp arris can also occur on the lower housing corner. If it becomes too large, the switch will jamb on the housing. Use the Housed points gauge (dimension C in Figure 25) to check that the clearance is ≥ 3mm.

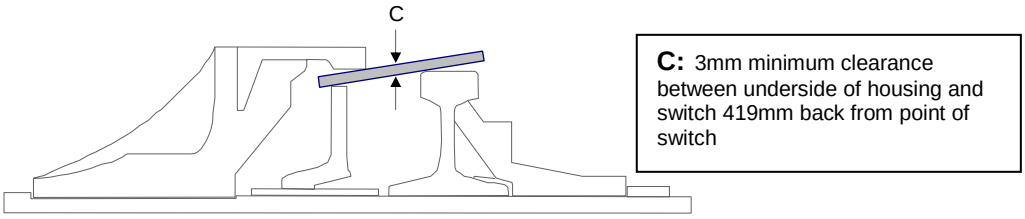


Figure 25 – Checking switch clearance

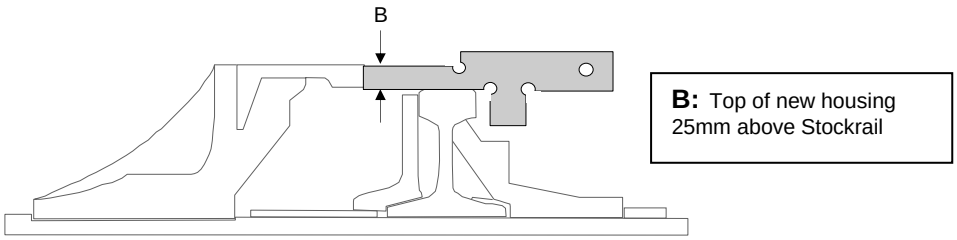


Figure 26 - Checking height of Housing above Rail Level

C5-12.4 Bent housings

When a housing becomes bent or crippled, it should be renewed.

C5-13 Repairing diamond crossings

Repair diamond crossings by undertaking one or all of the following steps:

Disassemble insulated rail joints in the fully checked area of a diamond.

1. Check condition of end post and replace if necessary.
2. Correct Diamond geometry - diagonal length, diagonal width side measurements and theoretical crossing intersection point.
3. Mark Crossings after installation or repair.
4. Repair timber bearers by repositioning plates and reboring holes for new fastenings.
5. Repair rail seat abrasion in concrete bearers.
6. Replace bearers using the procedure in Section C6-8 if they cannot be respiked in step 4.

Chapter 6 Renewing turnout components

This chapter describes the methods used in RailCorp to renew turnout components.

C6-1 Replacing switches

Replace a switch by undertaking the following steps:

1. Check that the replacement switch matches the existing (rail size, length, hand and style (angle, undercut etc.). If the rail size is not obvious, measure the head height and width of the stock rail and switch with callipers and determine the rail size from these measurements.

   Check that the new switch matches the specification.

   Check that the drilling pattern is correct to allow for heel blocks and signalling equipment to be reconnected.

   Note that VAE tangential switches prior to 2000 have a concealed heel dowel between the plate and rail foot underneath.

2. Use the guidelines in Chapter 16 to establish appropriate storage and handling requirements.

3. Disconnect the switch.

   Arrange disconnection of the signalling equipment from the switch.

   If it is a heeled switch, undo and remove heel bolts.

   If the switch is not jointed.

   - Measure and mark on rail location for a cut.
   - Cut the rail.

4. Remove the switch.

5. Clean the bed plates.

6. Lift new switch into position. Make sure the switch is supported at multiple lifting points to prevent hogging or crippling of the switch. (See Chapter 16).

7. Locate correct position for switch tip and adjust position. In newer turnouts the design position will be marked with a punchmark on the outside head of the stockrail.

8. Weld the switch to the closure rail (if the switch is not jointed). If a weld is insufficient to connect the rails, install a closure using the rail installation procedures in Engineering Manual TMC 221 Rail Installation & Repair and the welding procedures in TMC 222 – Rail Welding.

The following placement and installation requirements extracted from ESC 220 apply to installation of welds and closures in turnouts.

General

1. Rail ends or Aluminothermic welds may not be located closer than 1.2 m from the centre of a bonded insulated joint.

2. Aluminothermic welds may not be placed within 2.2 metres of any weld (flashbutt or aluminothermic) or mechanical joint on plain track (main line or siding) except as indicated below.

   In turnouts, aluminothermic welds may be placed closer than 2.2 metres to a minimum distance of 1.2m to a flashbutt weld, aluminothermic weld or mechanical rail joint, provided that:

   - The flashbutt weld or joint has no internal defects
   - The rail length is well secured by two ties with the ties held by more than two rails such that they will not be able to skew if the rail breaks in two places.
   - The aluminothermic weld is ultrasonically tested within 6 hours of completion.

3. Aluminothermic welds may be installed opposite each other on adjacent rails as long as the gauge side of each weld is ground prior to passage of trains.

4. Aluminothermic welds are not permitted on a sleeper.

Closures

5. The minimum length of a closure to be welded into track is 2.2 metres except as indicated below:

   - In turnouts, closures shorter than 2.2 metres to a minimum length of 1.2m may be used, provided that:
     - The closure is well secured by two ties with the ties held by more than two rails such that they will not be able to skew if the rail breaks in two places.
     - The aluminothermic welds are ultrasonically tested within 6 hours of completion.

6. A flame cut rail end which has been left in track more than 12 hours (30 minutes for Head Hardened rail) must be re-cut immediately prior to welding, removing a minimum of 25mm.

7. The closure must conform to existing rail with a maximum 5mm mismatch in height (unless the rail is being welded using a junction weld in which case appropriate limits apply) and 5 mm in gauge wear.

8. For curves of 500m radius and under, the closure and the last 600mm of each adjacent rail end is to be crowed to the correct curvature.

Welding near bolt holes

9. Rail ends which have been part of mechanical joints in service in the track are to be removed and replaced with a closure where rail ends have wear >0.3mm or any indication of damage.

10. Bolt holes that are being, or have been, used in track to form a mechanical joint must be closely examined and if there is any damage, no matter how slight, then all the bolt holes must be removed. If there is no damage then they may be treated as if they were unused.

11. Bolt holes that have not been used in track to form a mechanical joint shall be dealt with as follows:

    - 4 hole pattern - Rails with the 4 hole pattern where only the outer 2 holes are bored on each rail end can be welded straight into track provided that the first bolt hole is maintained at a minimum of 80mm from the weld.
    - 6 Hole Pattern - Rails which have all 3 holes bored on each rail end must be cut behind the first bolt hole so that a minimum of 80mm is achieved from the weld to the first bolt hole (see Figure 27).

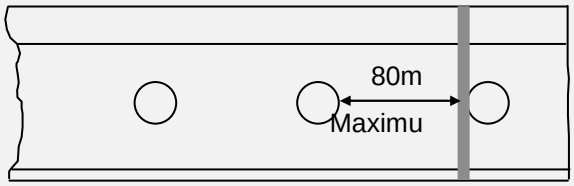


Figure 27 - Minimum distance of bolt hole from weld

Welding near signal bonding holes

Aluminothermic welds may not be placed within 80mm of any holes drilled in the rail web for attachment of signalling bonds. This includes holes currently in use, those no longer in use and those that have been plugged.

Note: The end of the cut rail cannot be located after the weld has been completed. When testing welds for compliance the measurement from the weld collar to the bolt hole or bonding hole shall be 70mm.

Install the heel joint, heel block or creep block.

1. Check the match between head of the switch and the stockrail and grind the stockrail if required.

2. Check and correct the bearing of the switch on the bed plates.

3. Check fit of switch to stockrail between point and full head (crow if necessary).

4. Arrange reconnection of the signalling equipment to the switch.

5. Arrange check of the switch operation.

   Check for uniform alignment along the running edge of the blade and for the integrity of fastenings.

   Adjust the switch if required.

In an emergency where maintenance correction activities cannot be undertaken, then additional drilling of the switch (in consultation with signal staff) may be carried out so that signalling equipment can be fitted to the new switch.

6. Check line and level through switch.

7. For tangential switch assemblies, make sure all keys and pins are in slide chair plates.

8. Certify track.

   - Certify the track using the procedure in TMC 211 and the maintenance acceptance limits in Chapter 4 of this manual.
   - If work has not been completed satisfactorily, assess whether a speed restriction is required using the operating limits in TMC 203.

C6-2 Heels in VAE switches

Special attention is required when planning the replacement of VAE tangential switches. The heel arrangement has changed.

The older design does not have any chocks that join the mainline and turnout rails in the heel area. Restraint for the switch rail in this design is provided by a hidden dowel pin that sits in the plate and recesses into the underside of the rail foot. The older design can be identified by noting the absence of any kind of visible heel arrangement (See Figure 28).

In the new design a heel arrangement is fitted. The plating for this is also different.

When a replacement switch or stockrail is required for the old design a complete switch & stockrail assembly to the new design must be used. The assembly will include the anti creep assembly but staff must separately order new plates for the affected area. These must be installed in accordance with the relevant drawing.

The standard design detail is shown in Figure 29 (old design) and Figure 30 (new design).

Figure 28 - Old VAE Design for Tangential Turnouts

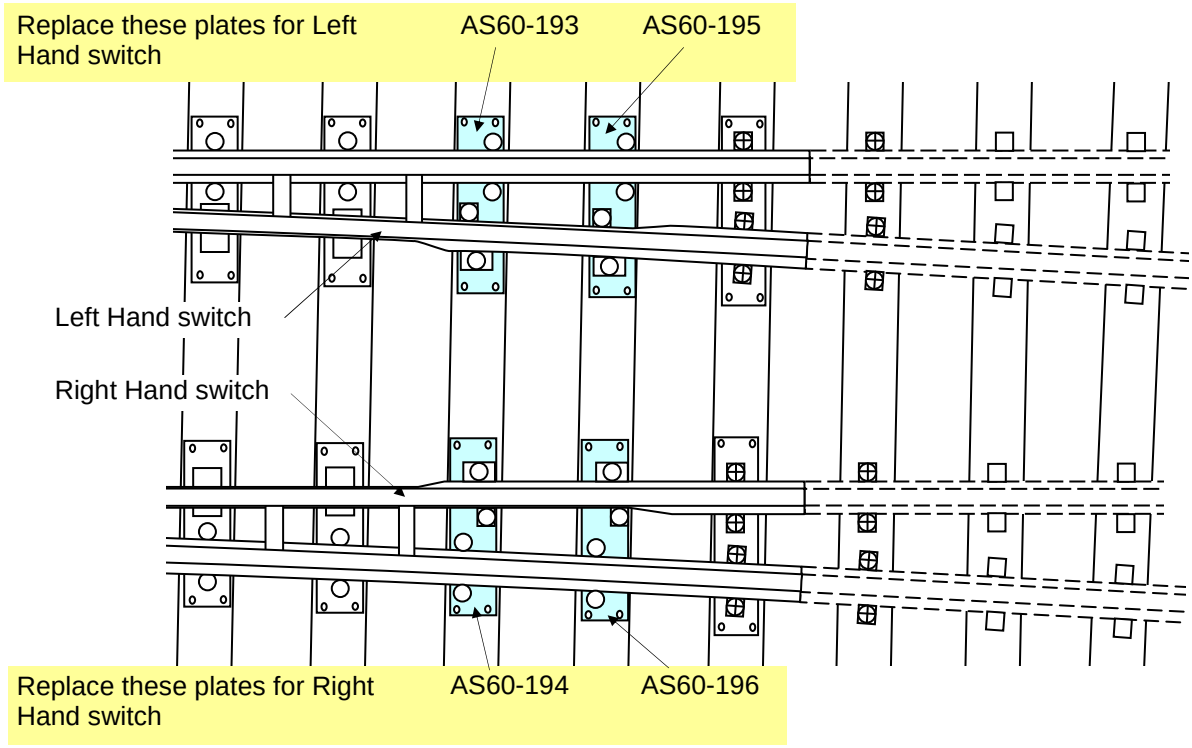


Figure 29 - Old VAE switch design

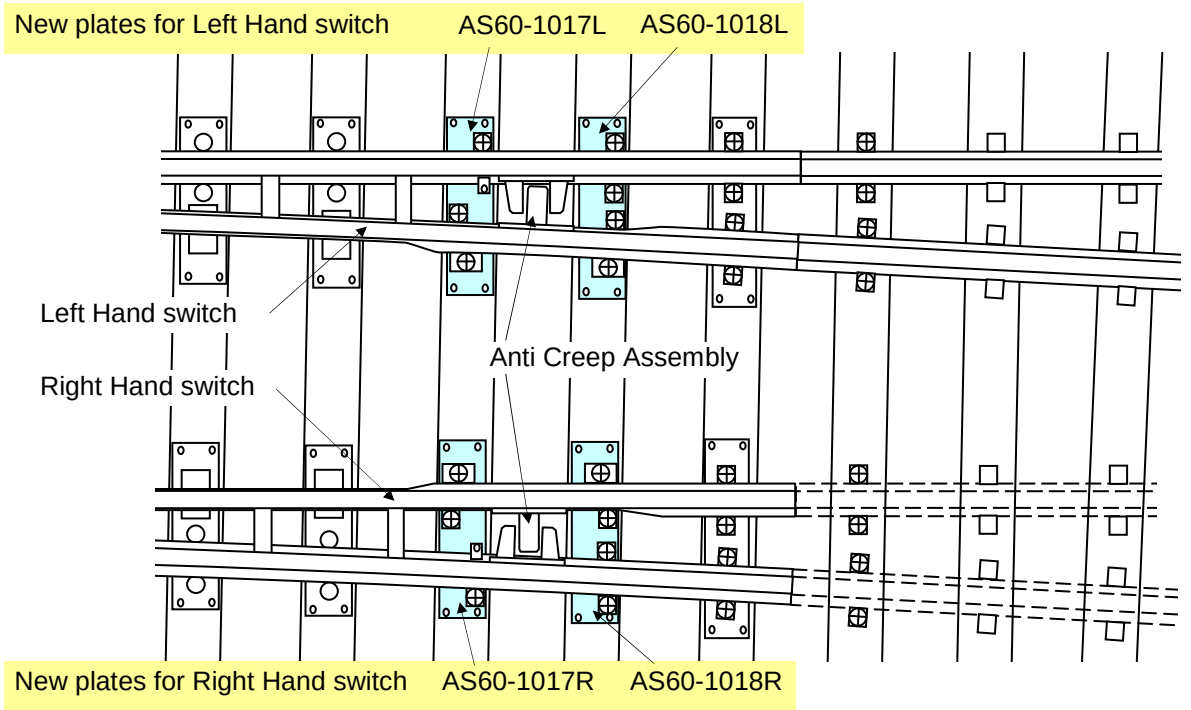


Figure 30 – New VAE switch design

C6-3 Replacing a switch/stockrail assembly

Replace stockrail/switch assembly by undertaking the following steps:

1. Check the new switch/stockrail assembly for match with existing (rail size, length, type).

In cases where the rail size is being upgraded (from 53 to 60kg or from 47 to 50kg) junction rails or junction welds will be required for installation.

2. Use the guidelines in Chapter 16 to establish appropriate storage and handling requirements.

3. Check the new switch/stockrail for match with specification.

4. Disconnect the switch.

   On manual points, remove the points rodding. Otherwise, arrange disconnection of the signalling equipment from the switch.

   If it is a heeled switch, undo and remove heel bolts.

   If the switch is not jointed.

   - Measure and mark on rail the location to cut the stockrail and switch
   - Cut the rails

5. Remove stockrail fastenings.

6. Remove switch and stockrail.

7. Clean bed plates.

8. Lift new switch and stockrail into position using the guidelines in Chapter 16.

   Check that the stockrail foot rests fully on chair plate prior to operation and prior to the addition of signalling equipment such as signal motors. These can lock the turnout timbers into a relatively immovable position.

   Check that the chair plate and stockrail bolt holes line up.

   Take particular care with the support of the stockrail on the chair plate at newly constructed turnouts and the positioning of turnout ties in the switch area.

   Check bolt tightness after a day or so and re-tighten bolts as required.

9. Locate the correct position for the switch tip and adjust the position of the switch and stockrail to suit.

10. Install closures (if necessary) and welds. Welds and closures should be minimised as alignment and weld fatigue reduce the asset life.

11. Install stockrail fastenings, switch stops etc.

12. Install heel joint (if switch is jointed).

13. Check match between rail ends of the stockrail and grind the stockrail if required.

14. Check and correct the bearing of the switch on the bed plates.

15. Check fit of switch to stockrail.

16. Fit manually operated points rodding or arrange reconnection of the signalling equipment to switch.

17. Arrange check of operation.

    Adjust the switch if required

18. Check line and level through switch.

19. For tangential switch assemblies, make sure all keys and pins are in slide chair plates.

20. Certify track

    - Certify the track using the procedure in TMC 211 and the maintenance acceptance limits in Chapter 4 of this manual.
    - If work has not been completed satisfactorily, assess whether a speed restriction is required using the operating limits in TMC 203.

C6-4 Replacing a crossing

Replace crossing assemblies by undertaking the following steps:

1. Check the quality of the new crossing.

2. Use the guidelines in Chapter 16 to establish appropriate storage and handling requirements.

3. If the old crossing is worn on the gauge face of the nose, check and adjust the checkrail effectiveness to the correct dimension before installing the new crossing.

4. Measure new to old crossing (length, crossing rate and leg openings) to establish that the replacement is correct.

5. Mark recovery points for location of the theoretical point of the crossing.

   If there is evidence to suggest that the crossing is in the wrong place, check the location of the existing crossing by measuring the distance from the theoretical point to the switch tip and comparing it to the design dimensions.

6. Measure and mark locations on crossing legs for cutting (This is not required if you are making a like for like replacement of a jointed crossing).

7. Remove rail fastenings from the crossing.

8. Cut rails to remove the crossing (or unbolt joints if applicable).

9. Remove the crossing from the turnout using a mobile crane or off-track plant and stack it clear of the work site in a place from where it can be recovered and disposed of.

10. Check the condition of the bearers associated with the crossing and replace any that have failed or have poor fastening strength.

11. Check condition of track plates and replace if necessary.

12. Place the new crossing into position using a mobile crane, on-track or off-track plant (See Chapter 16).

13. Check the location of the theoretical point using the recovery points marked in Step 5. Adjust the crossing location if required.

14. Check the crossing alignment (including gauge and checkrail effectiveness) and correct if necessary.

15. Re-install fastenings/ anchors.

16. Lift and pack track.

17. Install aluminothermic welds.

18. Arrange for the signalling bonds to be rewelded.

19. Certify track.

    - o Certify the track using the procedure in TMC 211 and the maintenance acceptance limits in Chapter 4 of this manual.
    - o If work has not been completed satisfactorily, assess whether a speed restriction is required using the operating limits in TMC 203.

20. After 1 to 6 weeks in track, check the crossing for metal flow.

    Grind flow from nose of crossing and wing rails.

C6-5 Replacing a checkrail

Replace raised checkrail assemblies (UIC 33 Section) by undertaking the following steps:

1. Check new checkrail for match with existing (height, length, bolt hole number and location).

2. Check the new checkrail for match with specification.

3. Remove the checkrail fastenings.

4. Lift out the checkrail.

5. Install the new checkrail.

6. Install fastenings.

7. Refit dragging equipment deflectors to raised checkrail ends.

8. Check height, flangeway clearance and checkrail effectiveness and adjust if required.

The following design requirements are extracted from RailCorp Standard ESC 250. They apply to raised checkrails ONLY.

The check rail end opening shall be flared, and provide an opening ≥ 80mm to the gauge face of the running rail at the flared end. The flare angle shall be as shown in Figure 31.

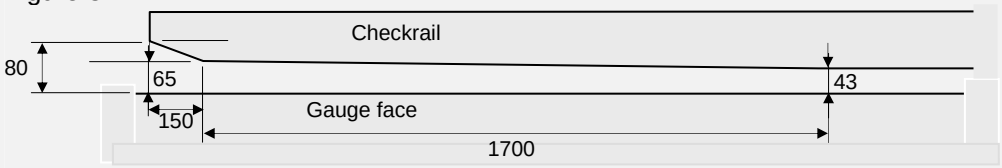


Figure 31 Figure 1 – Flare on checkrail end

Check rail height shall be between 0mm and 25mm above the running rail and shall take into consideration rolling stock clearances.

9. Certify track

    - o Certify the track using the procedure in TMC 211 and the maintenance acceptance limits in Chapter 4 of this manual.
    - o If work has not been completed satisfactorily, assess whether a speed restriction is required using the operating limits in TMC 203.

C6-6 Replacing a plate

Timbering and plating designs consider signalling requirements and turnouts constructed to the design should be satisfactory. When renewing plates check the design requirements.

Problems can arise when modifications to the design are carried out such as:

- altering the plating
- moving the designed position of the insulated joint
- positioning separate plates on each rail too close together

Replace track plates by undertaking the following steps:

1. Remove fastenings.
2. Remove the ballast on either side of the plate.
3. Reduce rail bearing on plate and knock plate sideways out into the hole.
4. Pull out the old plate.
5. Place the new plate in the ballast crib.
6. Lift up the rail using a jack or bar. Do not raise adjacent bearers.
7. Position the new plate, replace fastenings and restore ballast profile.

There should always be a minimum clearance of at least 15mm between plates on turnouts. Track circuit failures may occur if plates are too close together.

When renewing plates near an insulated joint check the design requirements. Special plating arrangements generally apply.

C6-7 Cracked switch plates

Some older style PRE tangential turnouts (installed in the late 1990's) have cracked switch plates.

There are two types of cracking;

- Cracking at the weld where the switch pad plate is connected to the supporting plate (see Figure 33)
- Cracking from the slot machined in the plate because it has a square corner (see Figure 34)

Newer plate designs give a larger radius on the weld and to provide a radius in the top corners of the slot in the plate (See Figure 32)

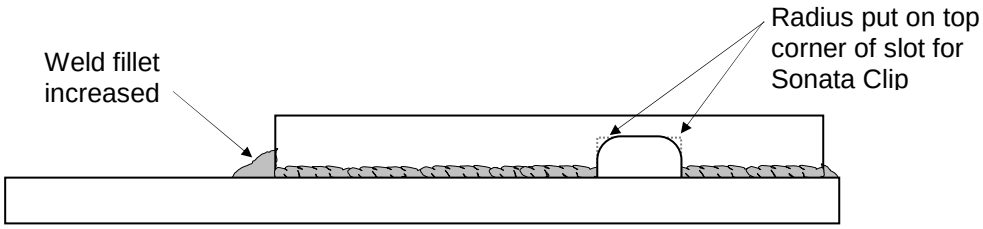


Figure 32 – Revised design

When plates are replaced they should be replaced with a PVT slide plate as the Sonata type cannot be retrofitted.

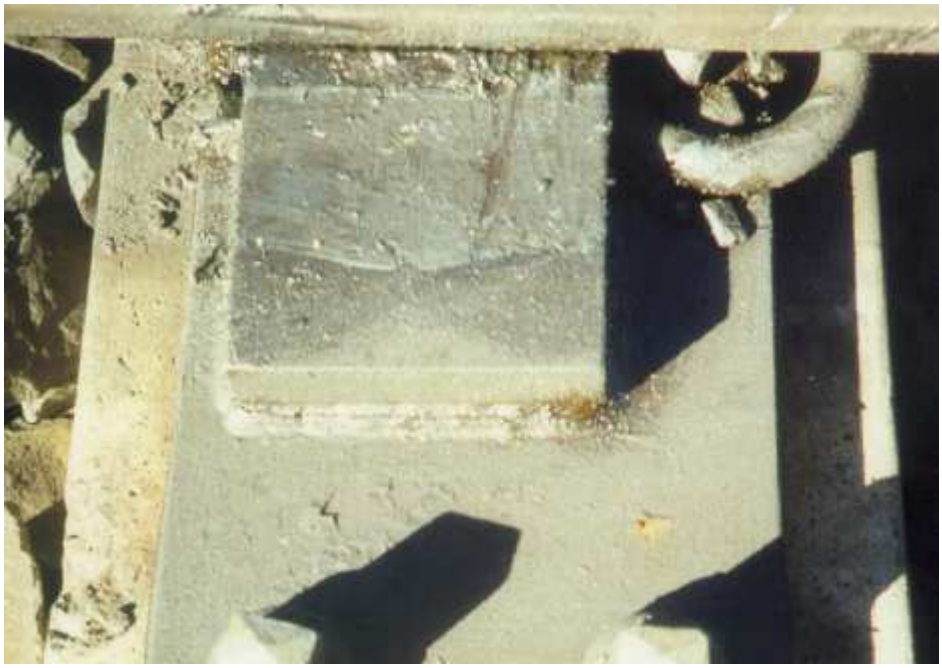


Figure 33 - Cracked Weld

Figure 34 - Crack from machined slot

C6-8 Renewing turnout bearers

Establish the size of replacement timber bearers using the following information:

The following design requirements are extracted from ESC 230

Timber Bearer Size

Dimensions of timber turnout bearers shall be selected as follows:

Width – 250mm

Depth – 180mm for general application
200mm for bearers on which points motors will be attached.

Length – The minimum length of timber bearers shall be calculated as the measurement from the "Outside" gauge face to "outside" gauge face at the point at which the bearer is to be installed + ~~1.2m~~ 1.0m. The length shall be rounded up to match the next available size for the selected bearer depth in Table 10.

Minimum lengths for turnout switch and crossing timbers shall be in accordance with the requirements specified in Table 10.

Width (mm)	Depth (mm)	Standard Timber Lengths Turnouts and Crossovers (m)
250	180	2.8, 3.0, 3.2, 3.4, 3.6, 3.8, 4.0, 4.2, 4.4, 4.6, 4.8, 5.0, 5.2, 5.4, 5.8, 6.0, 6.2, 6.4
	200	2.8, 3.0, 3.2, 3.4, 3.6, 3.8, 4.0, 4.2, 4.8, 5.0, 5.2,

Table 10 – Timber turnout bearer dimensions

1. Select the bearer to replace.
2. Check that the bearer is the correct one for the job (right length if timber, right gauge if concrete) and all components are available.
3. Arrange disconnection of signalling equipment if required.
4. Remove rail fastenings.
5. Remove shoulder ballast.
6. Clear ballast from the crib on either side of the bearer to the underside of the timber.
7. Remove bearers by sliding out manually, using mobile crane or off track plant.
8. Break up the ballast bed under the old bearer to a depth of at least 50mm.
9. Insert the new bearer from the side using a mobile crane or off track plant, ensuring the heartwood (if timber) is facing down.

   DO NOT place bearers underneath insulated joints.
10. Insert plates under the rails and adjust the longitudinal position to correspond with the requirements of the turnout bearer setout diagram.

When renewing plates near an insulated joint check the design requirements. Special plating arrangements generally apply.

11. Line up the end of the new bearer with the ends of the adjoining bearers on the straight stockrail.

12. Check the alignment of the straight stockrail and drill and secure the stockrail to the bearer (timber only).

The following requirements are extracted from ESC 230.

Boring requirements in timber sleepers, transoms and bearers

Bearers shall be bored to match the track plates used in the approved configuration.

Hole sizes shall be as detailed in Table 11. Holes shall be bored completely through the timber.

Fastening type		**Hole diameter** (mm)
Dogspikes		21 ± 0.5
Lockspikes		16 ± 0.5
Dogscrews		17 ± 0.5
Lockscrews		14 ± 0.5
Screwspikes	27 mm dia	25 ± 0.5
	24 mm dia	18 ± 0.5
	22 mm dia	18 ± 0.5

Table 11 – Fastening hole diameters

Fastenings for timber sleepers, transoms and bearers

Standard configurations of fastening assemblies for timber sleepers, bridge transoms and turnout bearers are detailed in Table 12. Special arrangements apply for the fastening of chairs to A and B timber bearers in turnouts. These are detailed in Table 13.

Operating Class	**Fastening Type No. per Plate/ Rail**	**Sleeper Plates Dwg. No.**	**Lockspikes (Note 2) No per Plate**
Non Resilient (for existing installations ONLY)			
Main Lines (includes sleepers, transoms Note 5 and bearers)			
Passenger Main Line	2 Dogspikes (Note 1)	DF 30	2
Mixed Passenger Freight Main Line			
Light Line			
Sidings (includes sleepers, transoms and bearers)			
General Yard	2 Dogspikes (Note 1)	DF 30	2
Passenger operations/ or maintenance			
Passenger Siding			
Engineering Maintenance Siding	2 Dogspikes (Note 1)	NIL	NIL

Resilient			
Main Lines			
Turnouts in ALL classes	2 Resilient	Appropriate baseplates	4
Insulated Joints in ALL classes	Low profile clips e1627 (timber)	DF 62	4
Sidings			
Turnouts in ALL classes	2 Resilient		4

Table 12 - Timber sleeper fastening configuration

Note1 Round shank dogspikes or approved alternative fastenings may be used.
2 Lockspikes (L6) or approved alternative fastenings may be used.
3 Gauge lockspikes are approved for existing installations only and shall not be used in new installations. They CANNOT be re-installed when a sleeper is replaced.

A& B Timber Bearer Fastening Type	
New Installations	
60kg/m steelwork	Screwspikes
53kg/m steelwork	Holding down bolts or approved equivalent swage fastenings
For Repair/ Replacement	
60kg/m steelwork	If the screwpikes are no longer able to provide adequate grip or if timber quality is suspect use holding down bolts or approved equivalent swage fastenings
53kg/m steelwork	Holding down bolts or approved equivalent swage fastenings

Table 13 – A & B Timber Bearer fastening configuration

13. Gauge, bore and fasten the other rail on the through track.
14. Check alignment of the turnout rail. When correct, bore and fasten.
15. Gauge the curved stockrail, bore and fasten.
16. Restore ballast profile.
17. Check alignment and line track if required.
18. Lift and pack bearers.
19. Certify track.
    - Certify the track using the procedure in TMC 211 and the maintenance acceptance limits in Chapter 4 of this manual.
    - If work has not been completed satisfactorily, assess whether a speed restriction is required using the operating limits in TMC 203.

Chapter 7 Installing tangential switch fastening systems

Turnout manufacturers each have their own proprietary system for fastening the inside foot of the stockrail in the switch area. This chapter describes the systems, the method of installing and removing them, and special tools required for installation.

C7-1 VAE switch fastening system

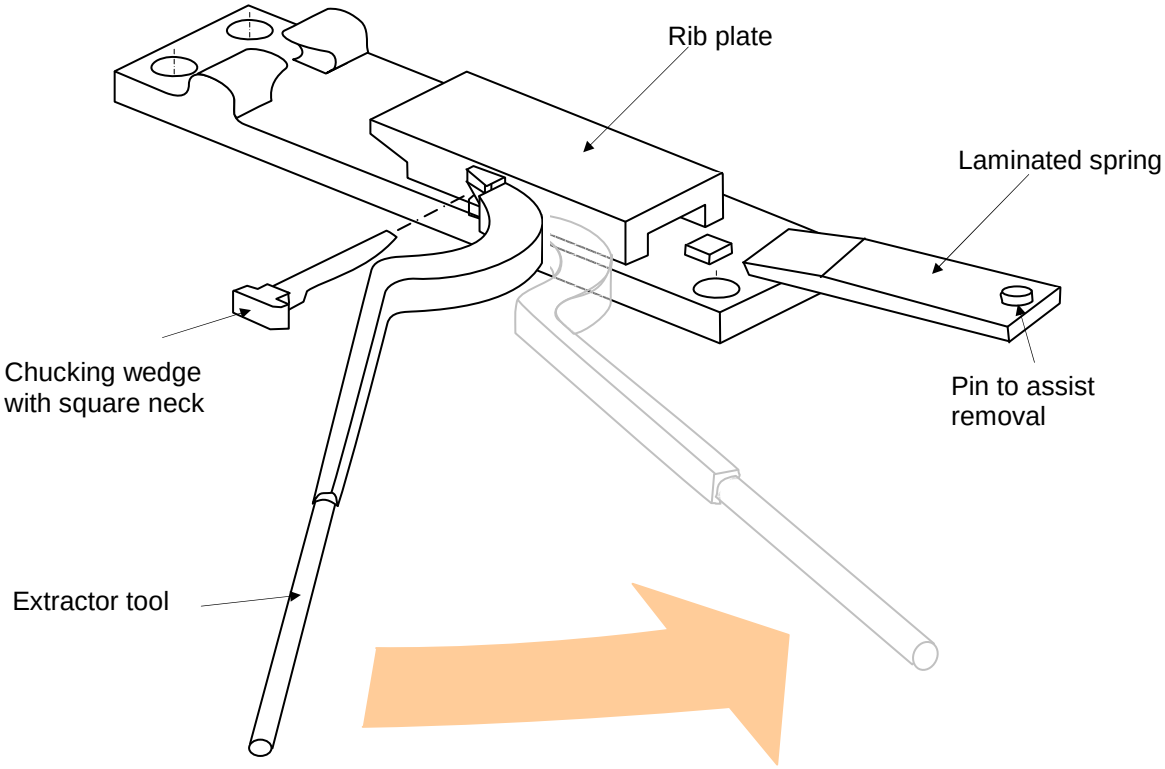


Figure 35 – VAE switch fastening system

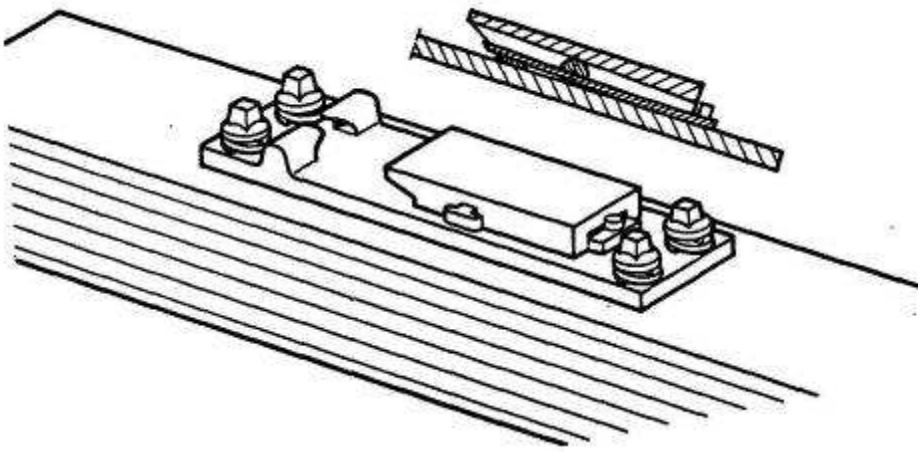
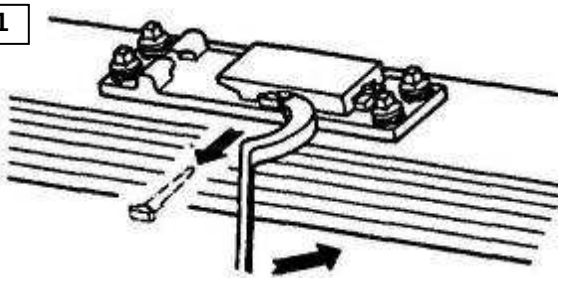


Figure 36

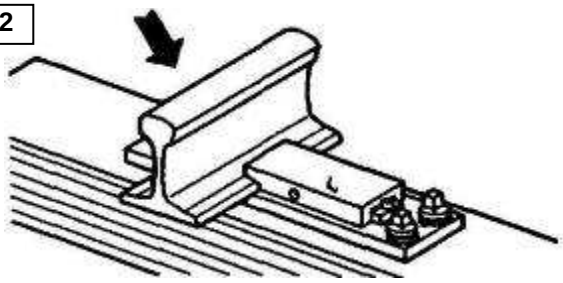
C7-1.1 Assembly

1



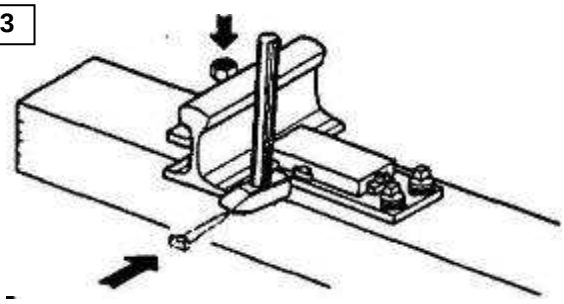
Remove the chucking wedge by placing the tip of the extractor tool between the square neck of the wedge and the rib plate. Move the laminated spring back from the foot of the rib plate.

2



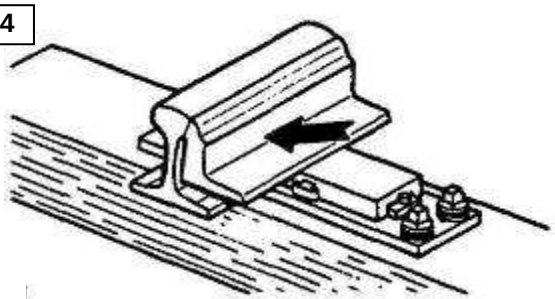
Install the stockrail. Push the laminated spring forward onto the foot of stockrail.

3



Insert the chucking wedge (flat side down) to the square neck with a hammer.

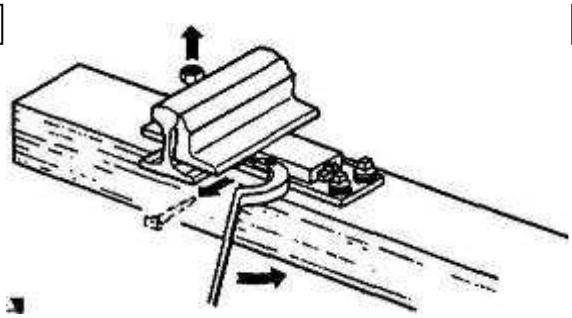
4



Install the switch point.

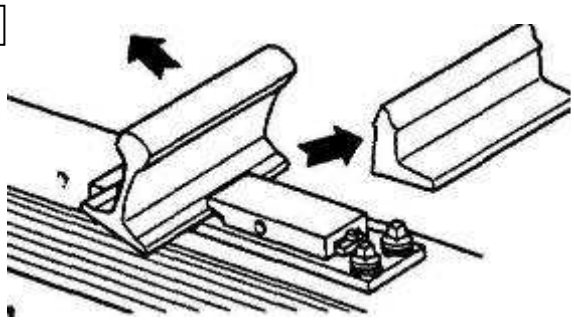
C7-1.2 Dismantling

5



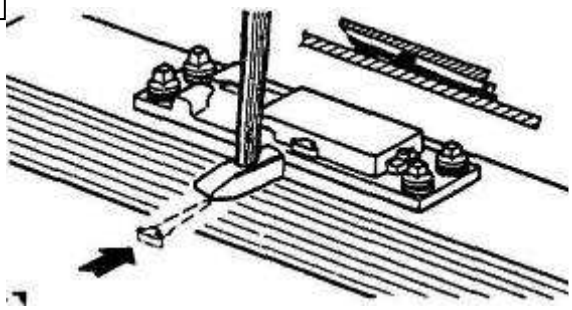
Remove the chucking wedge (this can be done without removing the switch) Remove the outside fastenings on the stockrail. Move the laminated spring back from the foot of the rib plate.

6



Remove the switch point and stockrail.

7



Replace the chucking wedge with hammers to the square neck.

C7-2 TKL Rail switch fastening system

C7-2.1 Introduction

TKL Rail uses the "Schwihag System" of inner stockrail-bracing clips and special elevated slide tables, which comprises the SSb2 standard ISRB clip; the SSb4 long ISRB clip for those locations where the separation between switchrail and stockrail exceeds the length of the SSb2 standard ISRB clip; and the Schwihag Type forged steel table which is welded in position on its baseplate to form the Schwihag Switch Plate.

The asymmetric switchrail is supported on a forged steel slide table, the inner edge of which projects over the inner flange of the stockrail. The table is recessed underneath so that a tunnel is formed during manufacture of the Schwihag Switch Plate which allows the ISRB clip (either Type SSb2 or SSb4 if supplied) to be fitted beneath the table.

The clip may be inserted into the slide table whether the Schwihag Switch Plate has been secured to the bearers by screwspikes or coachscrews or not. After the clip has been pushed fully home onto the stockrail, it is pre-loaded by lifting each open leg of the clip in turn onto its corresponding abutment at the rear of the slide table.

There are two projecting ridges on the underside of the slide table (i.e. on the roof of the tunnel). When the clip is properly fitted the first ridge comes in contact with the clip at a preset distance to ensure that the clip achieves its designed toe load of 12 kN. If, during service, there is excessive rotation of the stockrail away from the switchrail, the second ridge comes in contact with the clip much closer to the stockrail, greatly increasing the mechanical advantage of the clip and preventing any further rotation of the stockrail and preventing any further overloading of the clip.

C7-2.2 Assembly and Dismantling

Switch assemblies will be supplied with associated plating attached to switch and stockrail using Pandrol & Schwihag spring clips.

Pandrol clips located on short foot side of asymmetric switch rail are to be inserted in reverse i.e. from LH side of the lug.

Section C7-2.3 is reproduced courtesy of TKL Rail and Schwihag, and shows how the Installation Tool is used to assemble and to dismantle the SSb2 clips. The same procedure is used for SSb4 clips.

One Installation Tool is provided with each turnout or crossover. If during maintenance the designated Tool is unavailable a Pinch Bar will suffice for application and dismantling.

C7-2.3 Fitting Instructions for SSb2 spring clip in IBAV slide plates

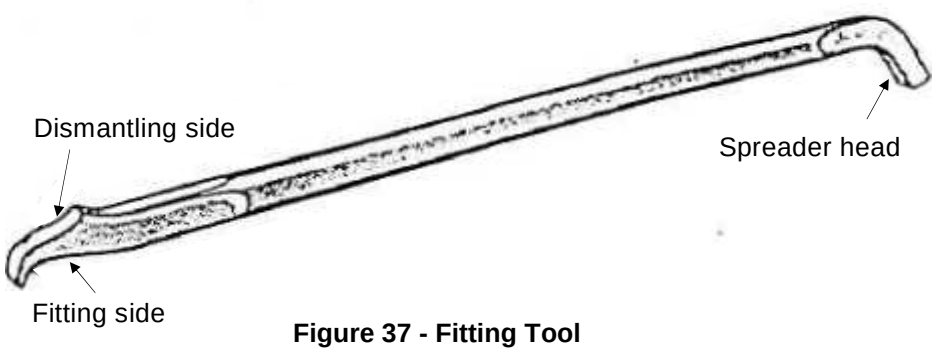
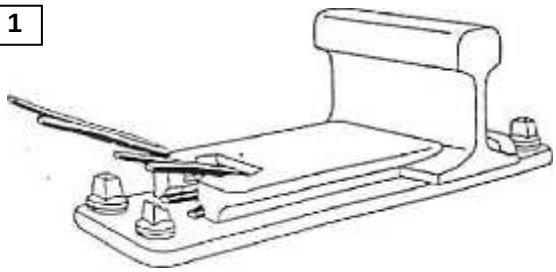


Figure 37 - Fitting Tool

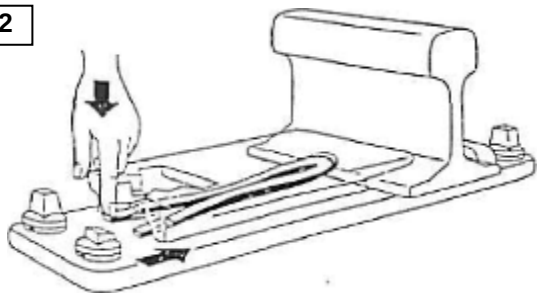
C7-2.3.1 Assembly

1



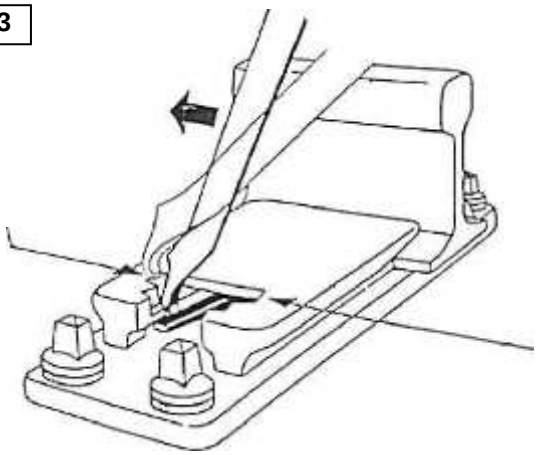
Push the spring-clip at an angle into the opening in the slide plate from above and push home.

2



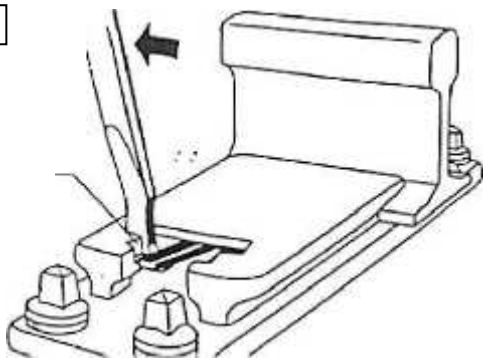
Press downwards on the ends of both shanks and then push the spring-clip forwards in the direction of the arrow until fully home.

3



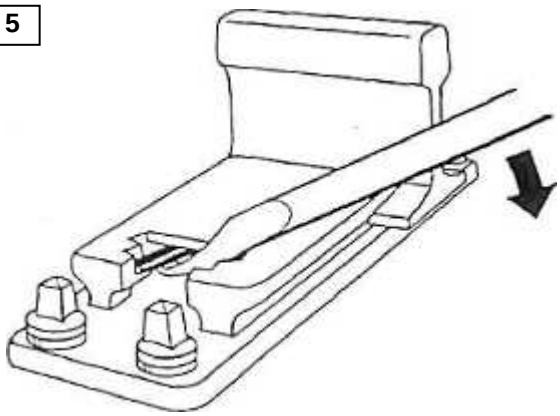
Insert fitting side of fitting tool into one of the fitting openings.

4



Using the fitting side of the lever stand behind the shank of the clip which is resting on the base-plate and with a levering movement in direction of arrow lift it onto the thrust abutment.

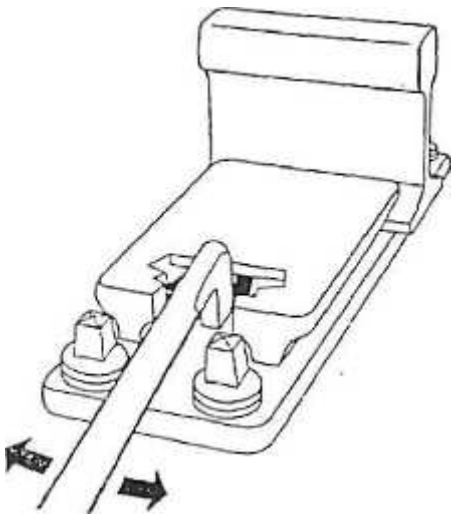
5



Rest the fitting tool on the opposite fitting opening and lift the shank of the spring clip previously positioned, over against the outer side of the rear thrust-abutment.

The opposite shank of the clip is then positioned in a similar way as illustrated on Figs. 3 & 4. (Final pressure as per Fig. 5 will not be necessary).

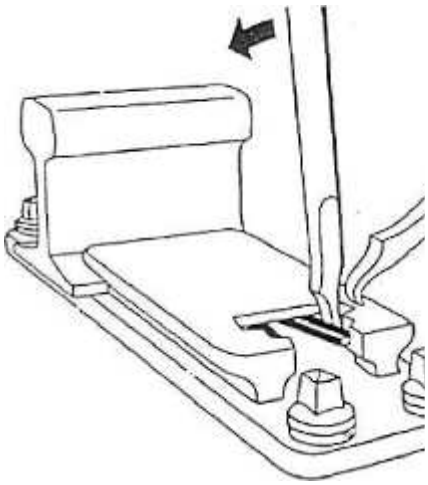
6



Insert the spreader head of the fitting tool between the two shanks and push home. By horizontal movement left & right (as per arrows) force the shank ends apart against the abutments.

C7-2.3.2 Dismantling

7



Insert the dismantling side of the too! into the fitting opening of the plate and with a levering movement in direction of arrow prize one shank-end free from the thrust abutment, and similarly with the other shank-end.

The clip will now lie without tension on the base plate and can be withdrawn by hand.

If a clip breaks, it is most likely to break along one of the legs. Should this occur, the broken piece will become dislodged from both the stockrail and from the rear thrust abutment, and will fall down onto the floor of the plate. This is readily observed during routine track inspection. Remove the broken piece and, using the system described above, dismantle and remove the remaining leg and install a new clip. Note that the remaining long leg will continue to remain in position, and will continue to retain the stockrail albeit by exerting only half of the toe load, despite having one leg broken. The remaining leg will also continue to retain its overload protection feature.

C7-3 Anti-Creep devices

A specially designed Anti-Creep Device is fitted between each switchblade and its matching stockrail near the heel-end of the switchrail. For longer switchblades in large radius turnouts, additional Anti-Creep Devices may be fitted along the length of the switchrail.

The Anti-Creep devices are designed to prevent differential longitudinal movement of the switchblades relative to their stockrails caused through rail creep, and to restrict the effects of differential creep and of thermal expansion and contraction of the switchrails on the adjustment of signalling and points operating equipment, yet at the same time to permit any relative lateral movement between the switchblade and the stockrail that is required to ensure correct opening and closing of the switchblade against its stockrail.

The Anti-Creep device ensures that longitudinal thermal expansion and contraction of the switchblade is confined to the unrestrained portion of the switchblade that lies ahead of the Anti-Creep device.

The "female" restraining unit of each Anti-Creep device is fastened to the stockrail, and the "male" tongue unit of each Anti-Creep device is fastened to the switchrail.

During assembly, the Tongue Unit should be centred in the restraining Unit at the Neutral Temperature (usually 35^0 C, +/- 5^0C, i.e. from 30^0C to 40^0C.).

If rail temperatures are above this range during assembly, then the tongue unit should be positioned touching the leading edge of the restraining unit (i.e. the edge closest to the point of the switchblade).

If rail temperatures are below this range during assembly, then the tongue unit should be positioned touching the trailing edge of the restraining unit (i.e. the edge closest to the heel of the switchblade).

In both cases for assembly outside the neutral range, it is recommended that any Pandrol clips securing the heel end of the switchrail be removed, and the position of the tongue unit be adjusted when rail temperatures are within the range and prior to any aluminothermic welding of the heel-end of the switchrail.

Chapter 8 Installing VAE in-bearers

(This material has been extracted from VAE Manual – "Installation and Mounting Instructions for the In-bearer assembly" – Revision 0 2006)

C8-1 Introduction

The VAE in-bearer sleeper assembly incorporates the switch machine and rodding inside the sleeper and allow access to the complete turnout for tamping.

The existing concrete sleeper layouts have been modified to incorporate the in-bearer design and results in the rearrangement of the front 6 to 8 sleepers in the turnout.

There are restraints to stop the sleeper assembly from moving in service. This includes a bolted horn connection to the stockrails well as additional clamping attachments onto the stockrail.

The bearers are designed to be installed in pairs in accordance with the in-bearer layout assembly drawing VAM13575.

The steel bearers are attached to the switch and stockrail with chair plates that are assembled to the bearer with insulating pads and insulating bushes on both the top and bottom of the assembly. The bearers are all standard and both the rodding and the bearers are non-handed.

The switch assembly is standard but there has been an additional hole incorporated in both stockrails to bolt the chair plate horn directly to the rail.

There are 8 plates attached to the switch assembly; two have forged horns and the other 6 have K clips that are bolted with D bolts that clamp the plates securely to the stock rails.

The switch machine baseplate has been designed to suit the proposed operation and is bolted to the steel bearers with insulating pads and insulating bushes in the baseplate.

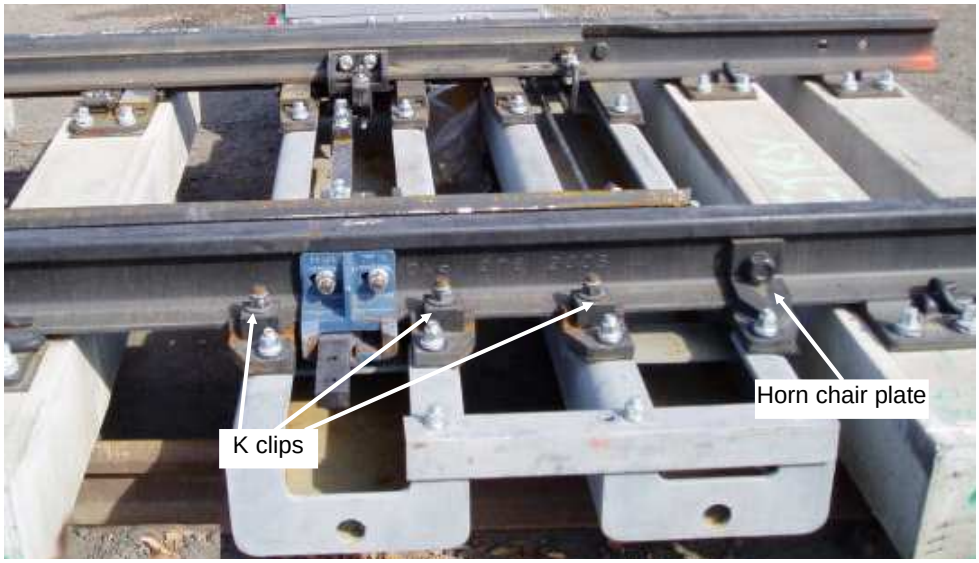


Figure 38 – In-bearer assembly

C8-2 Preconditions for the Mounting In-bearer

The concrete bearers must be laid out in accordance with the appropriate sleeper layout drawing.

The two steel bearers should be positioned accordingly.

For the mounting of the in-bearer these mounting instructions and assembly drawing VAM13575 must be used. The drawing shows all the sections and components needed so that bolts and insulating bushes can be installed correctly.

To ensure ease of assembly the following procedure should be adhered to.

C8-3 Mounting and assembly on site

1. Position the in-bearer set in the layout and align the remaining switch plates on the concrete sleepers and screw spike the plates to the bearers. Do not tension the screw spikes at this stage.

2. Align the front steel bearer with the two horned chair plates attached to the switch at the front of the turnout. The second bearer should be generally positioned at the same time.

3. The next series of steps from 4 to 8 involve assembling the switch machine plate and the chair plates to the steel sleeper. This involves the installation of a number of insulating bushes which are not normally the responsibility of track staff but in this instance they will be part of the track installation.

   The whole operation will not be successful if the bushes are damaged or not installed correctly.

4. Assemble the two bearers together by bolting the angle brace on one side and the switch machine baseplate on the other. The baseplate is assembled on insulating pads and must have eight top hat insulating bushes inserted into the baseplate prior to the bolts, washers and nut being installed and tightened.

5. Align the first hole set in the front bearer with the horned chair plate. Position the insulating pad under the plate. There are eccentric top hat bushes installed in the chair plates. These bushes have a notch to indicate the position of the eccentricity and this can be used to align the bushes to the holes. This is required to keep the beams universal but allow for one of the stockrails to be offset depending which hand the turnout stockrail is located on. The sections for the assembly of the chair plates are shown on the in-bearer assembly drawing VAM13575.

6. On the underside of the bearer standard top hat bushes are required to be inserted into the holes and then the bolts. The assembled sections are shown on the in-bearer assembly drawing VAM13575.

7. Once the horned chair plates have been assembled to the bearer, align the rear plate set and the chair plates on the second bearer so that the insulating pads, insulating bushes and the bolt sets can be installed. If it is necessary to align the holes to the chair plates release the K clip bolts and tap the chair plates to the correct position. Re-install the K clips.

8. Complete the assembly and recheck the tightness of all bolts.

9. The whole turnout can now be completed with all other screw spikes tightened to the appropriate torque. For torque settings see Table 14.

Bolt type connection	Bolt size	Torque
Bolts without insulation	M20	400Nm
Bolts with insulation bushes	M20	180Nm
Bolts with K Clips	M24	450Nm
Chair plate horn bolts	M27	450Nm

Table 14 – Torque settings for bolts

10. The turnout is complete and the switch machine and rodding can now be installed by signalling discipline personnel in accordance with the normal spherolock operation.

C8-4 In-bearer check prior to installation

Ensure all bolts are secure and insulating bushes have not been damaged in the assembly process.

Check that the M27 bolts and nuts have been installed on the horn chair plates and the K clips on the remaining chair plates have been torqued.

Chapter 9 Lifting and packing a turnout

This chapter describes the methods used in RailCorp to correct defects in top and cross-level of a turnout using manual methods and minor plant and equipment.

Resurfacing of turnouts is detailed in RailCorp Engineering Manual TMC 211 – Track Geometry and Stability.

1. Check and record track geometry to confirm defects.
2. If the defects are in the switch area (including the heel), arrange for signalling staff to be available to check and adjust points equipment (if interlocked).
3. Select reference rail and high points.
4. Select and mark jacking points and determine lift.
5. Remove excess ballast from the jacking point.
6. Install jacks.
7. Jack rails making sure that the correct cross level is restored.
8. Pack bearers with ballast.
9. Measure top and twist against required standard. If further lifting is required repeat steps 7 and 8.
10. Remove the jacks.
11. Relocate the jacks and repeat process if more track is to be lifted.
12. Measure and record geometry.
13. Restore ballast profile.
14. Certify track.
    - Certify the track using the procedure in TMC 211 and the maintenance acceptance limits in Chapter 4 of this manual.
    - If work has not been completed satisfactorily, assess whether a speed restriction is required using the operating limits in TMC 203.

Chapter 10 Building and installing tangential turnouts

C10-1 Planning

Find out who is manufacturing the turnout and obtain the construction plans.

Check the availability of bearers and other items from plans. There is often a significant lead time required when ordering.

C10-2 Prepare assembly site

Most of the time, turnouts are constructed away from the track and are then carried or lifted into place. Therefore, before any thought of assembly, select a suitable construction site.

To select the construction site consider the following:

1. Is site big enough?

   Is the site large enough to accommodate the completed layout? The site must be prepared at least as long and as wide as the completed layout.

2. Access to/on site.

   Is there easy access for people and machinery? The persons who are constructing the turnout must have fairly easy access for themselves and their equipment.

   Will the construction of the turnout pose any inconvenience to the normal passage of traffic, either road or rail? The site selected for construction should not be in the middle of a busy access road or foul a siding etc.

3. Obstruction free - adjacent and above.

   Is the site clear of any potential obstructions? Some obstructions might be overhead wires, signal troughing or lines, etc.

4. Close to installation site.

   Is the site close to where the turnout will be installed into the track? The site should be as close as possible to the installation point.

5. Level.

   Is the site firm, flat and level? The more level the site the easier the construction and the better the quality of the finished assembly.

6. Method of installation.

   Does the method of installation pose any difficulties with site selection? If cranes are being used to lift and manoeuvre the assembled turnout, will they have adequate standing room?

7. Other Considerations.

   - New material stockpile.
   - Ballast etc. is the ballast accessible when turnout is installed or blocked by redundant material.
   - Does it have to be dropped before construction commences?

- Minimum cartage distance.
- Allow for ground wastage.
- Redundant material.
- Ensure deposit site does not hinder access for installation.
- Old turnout - Where are you going to put it for dismantling and removal.
- Old ballast Stockpile site.

C10-3 Building a stand

The stand should be large enough to accommodate the completed turnout and strong enough to support the turnout and the workers. The most common `stands' are constructed from old sleepers and rails. During construction, every effort should be made to finish with a reasonably level product as this will assist with the turnout construction. Remember different bearer thicknesses.

C10-4 Preparation

1. Check that all turnout components have been supplied in accordance with relevant drawings.

   - Basic layout plans.
   - Recommended order of assembly.
   - Switch assembly plan.
   - Crossing assembly plan.

   Parts supplied by the turnout manufacturer will generally include crossings, switch & stockrail assemblies, checkrail assemblies, closure rails, all plating and the special fastenings in the switch area.

   All prefabricated turnout components are pre-set, curved and in the case of switches, crossing and checkrail units, assembled prior to leaving the turnout manufacturer.

   Turnout components must be handled during delivery, assembly and installation in such a way to ensure these manufacturing sets and curves are not altered. Use the guidelines detailed in Chapter 16 to establish appropriate handling requirements.

   Points in particular must be kept in the one plane and care taken not to introduce any vertical sets in the unit.

   Signalling equipment will normally be supplied by the manufacturer. This should be set aside for installation by Signalling staff. The responsible signals staff should be notified when any signalling equipment has arrived.

   For concrete bearer turnouts the bearers will generally be supplied with pads and insulators.

   Parts that have to be separately ordered include, timber bearers (for timber turnouts), glued insulated joints (the requirements for these need to be confirmed with Signals), elastic clips and screw spikes.

   Special tools for installing and removing the special fastenings in the switch area need to be obtained separately from the turnout manufacturer or other supplier.

2. If the correct parts do not arrive, make arrangements to secure them before construction commences.

3. Sort and stack the material so that any part may be located quickly and easily.

4. Check component condition.

   The following component checks should be made on the equipment supplied:

   - Check for obvious surface damage or corrosion of steelwork.
   - Check visually for distortion especially switch and stockrail assemblies.
   - Check lengths of closure rails, switches, stockrails, crossings and checkrails.
   - Make sure all bearing faces of rails, bearings and track plates are clean before assembly.
   - Check pre-assembled items to ensure components are firmly attached and bolts are tight.
   - Check that bearer location marks (either punch marks or paint marks) are present on rails.
   - Check that concrete bearers (for concrete bearer turnouts) are numbered and the leading edge of bearers are paint marked.

5. Check construction layout with surveyors if necessary.

C10-5 Assembly of tangential turnout

Always refer to the plan

With the aid of the appropriate plan, the first step in the construction is to lay the bearers on the prepared area.

C10-5.1 Place bearers

1. Set out a stringline along what will be the straight edge of the turnout but offset by 300mm.

2. Roughly mark along the string the position of every fifth bearer by using the cumulative measurement (shown on the plan).

3. Place bearers in accordance with the relevant layout plan (which will show each bearer position) in order from No.1 at the point end, onwards with the leading edge facing away from the points.

Concrete	Timber
- Concrete bearers have their number stamped in the concrete and are marked with a square symbol to show the leading edge (the side of the bearer that is to be placed away from the points).	- Timber bearer lengths are shown on the layout plan. - Measure timbers and mark length in chalk. - Measure and select the correct length timbers. - Lay bearers and sleepers with heart side down.
- Use cant reducing sleepers at each end of the layout to return to 1 in 20 rail cant.	- Use cant reducing sleepers plates at each end of the layout to return to 1 in 20 rail cant. - Make sure chairs and plates bear fully and truly on the tops of all timbers. Adze timbers if necessary, so that bearing surfaces are flat, smooth and in

	the same plane. - Bore timbers correctly for fastenings.

Place the bearers in a fan shape ie half way between being square to the main line and square to the turnout. This is different to conventional turnouts where all bearers are square to the through line.

The first few bearers are still square to the main line in a tangential turnout but the angle changes more and more as you move through the turnout.

Once past the turnout proper several bearers are used to move gradually back to square to the mainline on the mainline and square to the turnout on the turnout road.

4. Align the straight edge of the bearers.

5. Use the measurement shown on the layout drawing to set every 5th bearer along the straight edge (See Figure 39).

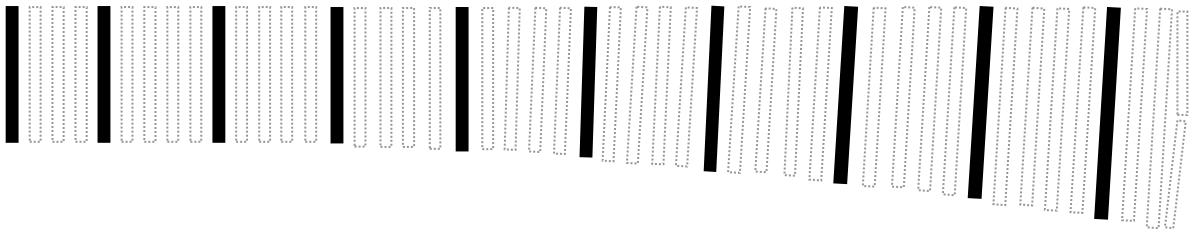


Figure 39

6. Space the remaining bearers evenly between (See Figure 40).

   Note: It is particularly important that bearers are laid out correctly. They cannot be placed exactly until the outer rails of the turnout are laid out.

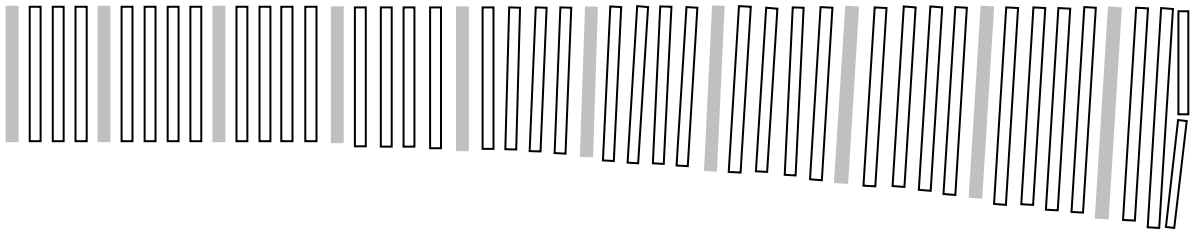


Figure 40

C10-5.2 Place steelwork

Lay the rails and steel work in their approximate positions on the bearers. Rails, switches & stockrails, crossings and checkrail assemblies can be crippled if not lifted carefully. Normally at least two lifting points should be used for lengths over 6 metres.

Concrete	Timber
	- Check for plate centre line markings on stockrails in timber turnouts. For timber turnouts the manufacturer should have already marked the centre line of the plates on the foot of the stockrails on each side of the turnout (note there is a difference between each side of the turnout and this difference becomes

Concrete	Timber
	important as you move towards the rear of the turnout). - *If centre line markings are not there, refer to the drawings and measure and mark the centre line of plates on the foot of the stockrails on each side of the turnout.* - Check for plate numbers marked on stockrails in timber turnouts. For timber turnouts the manufacturer should have already marked the required number of any special plate on the rail. - *If plate numbers are not marked on the stockrails, refer to the assembly drawings*. - Adjust steel into accurate position in the order you placed it on the stand. As each piece is adjusted put plates into position and lower the rail onto the plates. Align plates with the rail not the timbers. - If you are using Pandrol type plates, now is when you clip the rail to the plate DO NOT TIE YET!!!

The assembly should be in the following order:

1. Layout the switch and stockrail assembly for the straight side on the bearers, then the closure rails right through the length of the turnout, including though the crossing area. (See Figure 41).

   - Use the first bearer as a reference for the initial longitudinal placement of the switch and stockrail assembly.
   - Join up components loosely, i.e. allow a 5mm gap at joints.

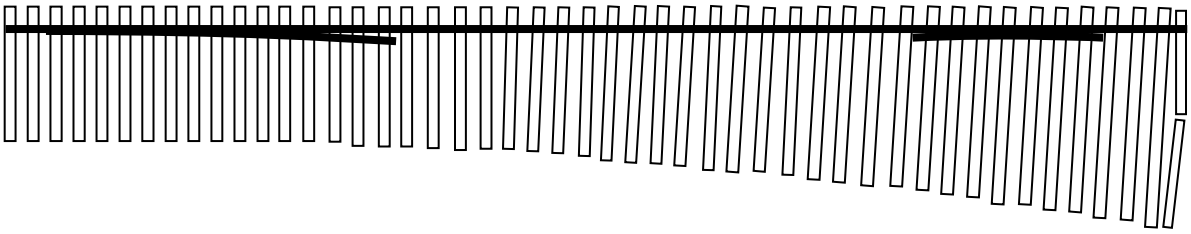


Figure 41 – First stock/switch assembly and closure rail in place

2. Layout the other switch and stockrail assembly and then the closure rails on the other rail of the mainline including the crossing. (See Figure 42).

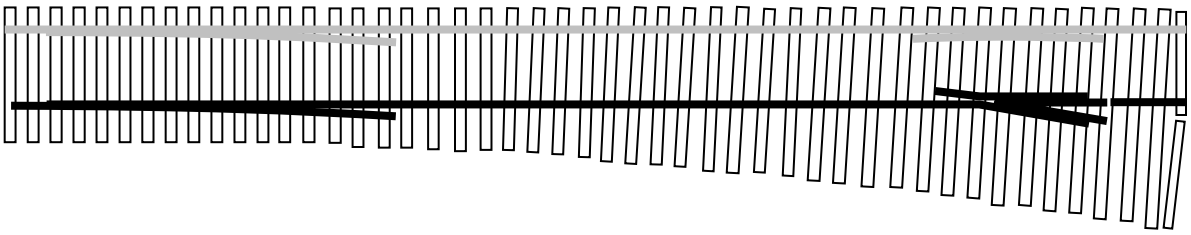


Figure 42 – Second stock/switch assembly and crossing in place

3. Space the ties along the outer stockrails on each side of the turnout and check correct position in accordance with running edge distance shown on the layout drawing.

4. Use the points end of the rail already placed in (1) above to set the switch and stockrail assembly square at the points. Square up the points by using the following method:

   - o A “T” square may be used for this. If a “T” square is not available the following technique may be used (see Figure 43).
   - o Mark the point on the gauge face of the “through” stockrail where the switch tip should be.
   - o Measure ahead from this point, a distance of 3.733m and mark the gauge face of the stockrail.
   - o Ensure correct gauge of the rails - 1435m.
   - o Measure diagonally across from the point located in Step 2 to the opposite stockrail. The point on the gauge face where the diagonal measures exactly 4m is the point where the tip of the other switch should be.

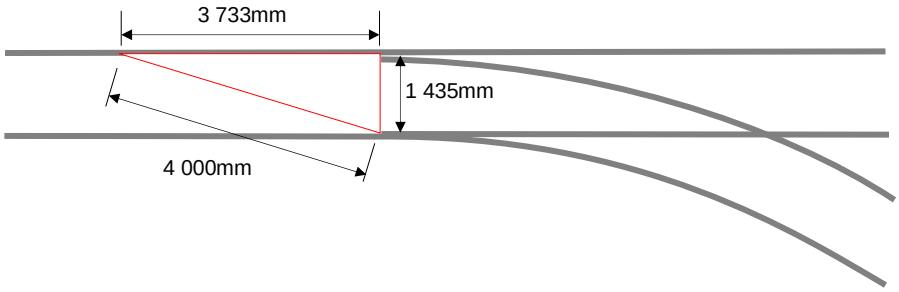


Figure 43 - Method of squaring switches without the aid of a “T” square

5. Layout the remaining rails working from the points end through the turnout. (See Figure 44).

   - o Use the back of the already placed switch and stockrail assemblies to fix the start of these remaining rails . Some specially curved turnouts are supplied with gauge measurements between the straight main and curved outer turnout rail.

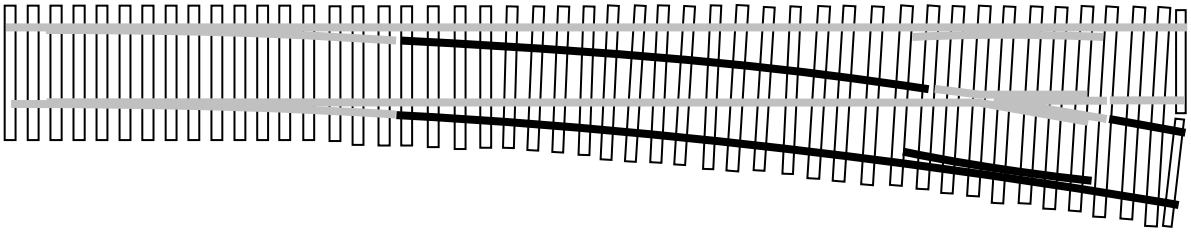


Figure 44 – Remaining steelwork in place

Concrete	Timber
- align the rail roughly in position using the fixing holes on the bearers as a reference. - Note that the screwspikes can cut into the sleeper insert instead of following the insert thread.	- bore fastening holes perpendicular to the surface of the timber or sleeper and through the timber from top to bottom so that the fastening may be driven vertically. - If reboring is necessary to achieve the specified gauge

Concrete	Timber
	and alignment do it so that the chair or track plate is still completely on the timber or sleeper. New holes are not to overlap any existing holes. - Drive lockspikes until approximately 30mm of the head remains above the plate. This will be when the bulge below the eye is nipped by the plate and the lower point of the eye has just entered the sleeper plate hole. - DO NOT overdrive them. - Place the lockspikes with the hole in the eye parallel to the rails, so that the spring action of the spike is along the sleeper length. - DO NOT drive spikes into an existing hole which has already held a spike.

- o Bolt up the joints as you go.
- o Gauge boards can be placed around the turnout to hold the rails roughly in position during subsequent operations.

6. Place any remaining special plates into position under the switch/stockrail assemblies. Make sure the plates are in the correct position.

7. Check gauge throughout the switch area.

8. Insert standard and special fastenings in the switch area.

Concrete	Timber
	- Bore holes for screw spikes on the straight switch/stockrail assembly and install screw spikes and spring washers. - Bore holes for screw spikes on the curved switch/stockrail assembly, maintaining the correct gauge using the stockrail to stockrail distance given on the plan and install screw spikes and spring washers.

VAE	PRE	TKL
- Insert pandrol clips in plates and keys and pins in the inside fastening system in accordance with the procedure in Chapter 7. Install with screw spikes and spring washers.		- Insert Pandrol clips on the short foot side of the asymmetric rail in reverse ie from LH side of the lug.

- Grease the wedges before installation.	- Loose plates behind the heel will suit both left and right hand sides of the turnout – identified by sleeper number.
- Install all other plate assemblies with insulation pads and screw spikes.	- Follow the procedure in Chapter 7 to install the Schwihag system fastenings. If you don't have the TKL installation tool a pinch bar can be used.

9. Position the outside closure rails.

Concrete	Timber
	- Mark the position of the centre line of the plates on the outside closure rails.

10. Position the bearers to the desired marks.

11. Install all standard plates.

12. Install plates under the crossing in accordance with the relevant drawing.

13. Position the checkrail plates in accordance with the marks on the outer rails.

14. Position the checkrails on the plates as shown on the assembly drawing and check that the boltholes are aligned.

15. Install the outer pandrol clips on the plates and then the inner pandrol clips.

16. The inner clips can be installed by sliding the pan-puller between the running rail and checkrail and installing the clips from the end where the clip is pulled towards the middle of the checkrail.

17. Bolt the checkrails into position.

18. Check the checkrail effectiveness measurement (use the design drawing and Section C4-1.1 of this manual) for all turnouts. Checkrails can be shimmed to achieve the correct measurement.

19. Complete bolting the turnout.

20. Check alignment (use the design drawing and Section C4-1 of this manual).

21. Check dimensions and construction.

    - Bearers shall be laid out in accordance with the design drawings. Tolerances on spacing are detailed in Section C4-1.
    - The torque on all bolts shall be (*to be determined*).
    - Check the gauge every two metres and at the nose of the crossing.
    - Check that switch stops are within 2mm of design.
    - Check the flangeway at the nose of the crossing.
    - Check that all the components are present.

DO NOT cut, bore or change shape of any pre-fabricated material to make it fit or join up unless absolutely certain that a manufacturing or delivery error has been made and cannot be corrected otherwise.

After assembly, measure the turnout to ensure it measures as shown on the drawings.

The geometry and condition of the assembled turnout shall comply with the appropriate construction standards detailed in Section C4-1.

Once you are sure all measurements are correct, you may move to the next step, NOT BEFORE!!

22. Tie Turnout 1:4.

    Be very careful the rail stays in the measured position when tying. Tie in placement order.

    When tied 1:4 recheck measurements and adjust as necessary.

23. Complete all Fastenings.

24. Arrange test assembly of signalling equipment.

    For non-standard turnouts arrange the test installation of signalling equipment to make sure it fits.

25. Check the bearer location for spring assist.

    Most tangential turnouts are fitted with a spring setting device known as a “spring assist” that ensures that the back of the switch is fully thrown over. For these spring assists it is important to ensure that the bearers are correctly positioned.

    Check that the bearer that supports the spring assist unit is correctly placed longitudinally on both rails. If this is not achieved then the spring assist will not function properly and may cause accelerated degradation of signalling equipment (leading to signal failure).

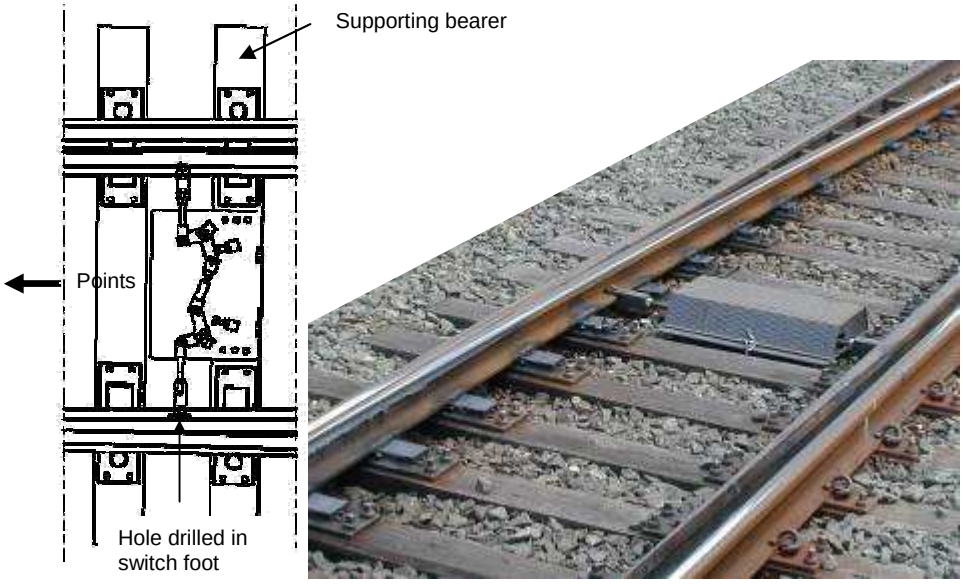


Figure 45 – Location of Spring Assist

The holes in the switch foot determine which bearer supports the spring assist unit. For concrete bearer turnouts the sping assist bearer can be identified by the pre-formed holes. In any case the spring assist bearers and their correct positioning is identified on layout drawings. Newer steelwork may also have the position of the bearers marked on the foot of the rail.

Where spring assists do not meet correct tolerances or are inneffective the problem may be able to be corrected by re-spacing the bearers.

C10-6 Installation

C10-6.1 Preparation for installation

1. Match Mark Plates and Steel.

   This shows the machine operator (tamper) that bearers have moved during installation in track, which will affect the turnout measurements.

2. Break the completed turnout into sections recommended for installation, ensuring that each section remains flat.

   Rails, switches & stockrails, crossings and checkrail assemblies can be crippled if not lifted carefully. Two lifting points minimum should be used for lifting assemblies.

3. Carry out survey for excavation and installation and mark the location for the installation of the turnout on the existing track.

4. Cut the rail and remove the section of track to be replaced by the turnout. If the turnout is of siding quality, position of rail cuts should not damage the second hand usefulness.

   Lift the existing track panels clear of track in an area designated during the planning process.

5. Dismantle the old panel.

   Remove all fastenings including dog spikes, lock spikes anchors and clips and rail from the sleepers. Stack sleepers, jewellery and rail for recovery.

   Make sure that you don’t damage other property/infrastructure during track removal.

   Remove timber sleepers and bundle into bundles of 20 using strapping equipment prior to removal from site.

C10-6.2 Installing the new special trackwork

1. Excavation.

   Excavate ballast and formation material to the required depth indicated by survey and geotechnical information using fettling equipment and off track plant.

   Protect drainage inlets and outlets to protect against sedimentation and silt runoff.

2. Undertake formation reconditioning if required using the procedure in RailCorp Manual TMC 241 - Ballast.

3. Lay bottom ballast.

   Place bottom ballast to the required depth indicated by survey information and compact using off track plant.

4. Lift the turnout into the proposed location by mobile crane(s) or front end loaders and lower into position.

   Take care to locate the points and crossing in accordance with the reference markers.

   DO NOT push or pull the turnout or components to get them into position.

5. Connect all rail joints to the existing track by installing fishplates or by field welding, after track geometry has been achieved.

6. Ballasting.

   Lay ballast from a ballast train or by using off track plant from a ballast stockpile.

   BE CAREFUL when using off track plant to plough off ballast around the checkrails. Checkrails are set higher than the running rails and will be damaged if struck.

7. Lift and pack the bearers using the procedures in Chapter 9 “Lift and Pack Turnout”.

8. Resurface the turnout using the procedure in RailCorp Engineering Manual TMC 211 – Track Geometry & Stability.

9. After assembly in track, measure the turnout to ensure it measures as shown on the drawings.

   The assembled turnout shall also comply with the appropriate construction acceptance limits in Section C4-1.

10. Check the condition and fit of all components.

    - Check for obvious surface damage or corrosion.
    - Check that there are no visual signs of cripple or distortion especially in switch & stockrail assemblies.
    - Check that the stockrail foot rests fully on chair plate prior to operation and prior to the addition of signalling equipment such as signal motors. These can lock the bearers into a relatively immovable position.
    - Check that chair plate and stockrail boltholes line up.

11. Arrange installation of signalling equipment.

12. Check the bearer location for the spring assist.

13. Certify track.

    - Certify the track using the procedure in TMC 211 and the construction acceptance limits in Chapter 4 of this manual.
    - If work has not been completed satisfactorily, assess whether a speed restriction is required using the operating limits in TMC 203.

Chapter 11 Building non tangential turnouts, diamonds and slips

The following steps are specific to pre-assembly of conventional turnouts. Other layouts, particularly diamonds and slips will follow similar steps. Because diamonds and slips are more complex the accurate measurement and placement of components is critical to successful construction. Always check the placement of components very carefully and make sure that the pre-assembled dimensions meet the design dimensions on the plan.

C11-1 Planning

Follow the steps in Section C10-1 to plan the turnout assembly.

C11-2 Prepare assembly site

Follow the steps in Section C10-2 and C10-3 to prepare the assembly site and build a stand on which the turnout will be assembled.

C11-3 Mark the Stand Rails

Always refer to the plan

With the aid of the appropriate plan, the first step in the construction is to lay the bearers on the prepared area.

1. Mark the bearer spacing on the stand rail in accordance with the relevant layout plan (which will show each bearer position).
2. Mark the start and finish of each timber size.

C11-4 Place bearers

1. Measure timbers and mark length in chalk.
2. Select the bearer length and place bearers on the stand in correct order over rail markings.

The following design requirements are extracted from ESC 230.

Timber Bearer Size

Dimensions of timber turnout bearers shall be selected as follows

Length – The minimum length of timber bearers shall be calculated as the measurement from the “Outside” gauge face to “outside” gauge face at the point at which the bearer is to be installed + 1.2m. The length shall be rounded up to match the next available size for the selected bearer depth in Table 15

Minimum lengths for turnout switch and crossing timbers shall be in accordance with the requirements specified in Table 15.

Width (mm)	Depth (mm)	Standard Timber Lengths Turnouts and Crossovers (m)
250	180	2.8, 3.0, 3.2, 3.4, 3.6, 3.8, 4.0, 4.2, 4.4, 4.6, 4.8, 5.0, 5.2, 5.4, 5.8, 6.0, 6.2, 6.4
	200	2.8, 3.0, 3.2, 3.4, 3.6, 3.8, 4.0, 4.2, 4.8, 5.0, 5.2,

Table 15 – Timber turnout bearer dimensions

3. Lay bearers and sleepers with the heart side down.

4. Square off the bearer on one side of the turnout.

   In a simple turnout out of straight track the timbers should be lined up on the straight track side.

   Place a chalk line on the bearer 600mm in from the straight end.

   Line up the marks on the bearers, it is easier to do this now than when all the weight of the rail is on it.

C11-5 Laying up the steel

5. Lay the rails and steelwork in their approximate positions on the bearers.

   Assemble the switches, stockrails and heelblocks together.

   Assemble the checkrails, checkrail carriers, chocks and shims together.

6. Select the ‘reference’ rail in the turnout.

   This is a critical step in the construction. The reference rail should be the ‘mainline’ or ‘through rail’. This rail will become the ‘benchmark’ for the placement of all other rails in the layout.

   Take special care to ensure that this rail is placed in and tied in its correct location and in correct geometry. Any error here will be an error all the way through.

7. Lay the other mainline rail in position, using gauge boards to ensure correct gauge is obtained.

8. Square up both switch points.

   Use the following method:

   - A “T” square may be used for this. If a “T” square is not available the following technique may be used (see Figure 46).
   - Mark the point on the gauge face of the “through” stockrail where the switch tip should be.
   - Measure ahead from this point, a distance of 3.733m and mark the gauge face of the stockrail.
   - Ensure correct gauge of the rails - 1435m.
   - Measure diagonally across from the point located in Step 2 to the opposite stockrail. The point on the gauge face where the diagonal measures exactly 4m is the point where the tip of the other switch should be.

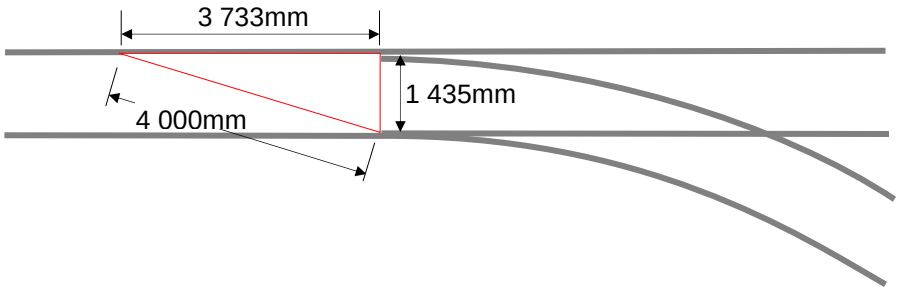


Figure 46 - Method of squaring switches without the aid of a “T” square

1. Lay the outer rail of the turnout curve next, taking care to ensure correct position and geometry.

   Take measurements to ensure the turnout rail is in position relative to the selected ‘reference' rail.

2. The second turnout rail is then gauged and tied in place to complete the assembly.

3. Lay up in the following order.

   - Stockrail and switch for straight or main.
   - Closures to crossing.
   - Crossing.
   - Closures to other stockrail.
   - Stockrail number 2.
   - Closures to checkrails.
   - Checkrails and checkrail carriers.

   Note: Be careful when laying the steel that the timbers do not tip.

4. Join up components loosely. i.e. allow movement at joints.

5. Adjust steel into accurate position in the order you placed it on the stand. As each piece is adjusted put plates into position and lower the rail onto the plates. Align the plates with the rail, not the timbers. Remove fishplates on timbers as you go and tighten fishplates at joints.

   If you are using Pandrol type plates, now is when you clip the rail to the plate. DO NOT TIE YET!!!

6. Check Measurements.

   - Check points are square.
   - Check that gauge is true.
   - Check the turnout measurements (see Section 9).
   - Check that crossing measurements are correct.

   Note: Once you are sure all measurements are correct, you may move to the next step, NOT BEFORE!!

7. Tie Turnout 1:4.

   Be very careful the rail stays in the measured position when tying. Tie in placement order.

   When tied 1:4 recheck measurements and adjust as necessary.

8. Complete all fastenings.

9. Arrange test assembly of signalling equipment.

   For non-standard turnouts arrange the test installation of signalling equipment to make sure it fits.

C11-6 Check turnout layout dimensions

To maintain correct turnout geometry, it is essential to place and to keep the various components in their designed location for the layout. The key layout dimensions are:

C11-6.1 Turnout Length

The distance measured from the nose of the switch to the theoretical point of the “V” Crossing. It is measured along the mainline rail (See Figure 47).

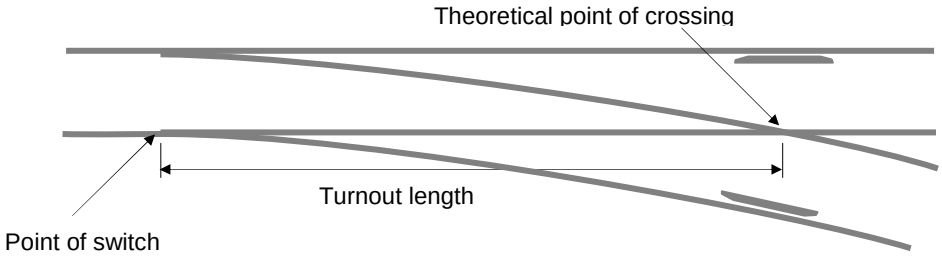


Figure 47 - Turnout length measurement

C11-6.2 `M' Dimension

The distance measured from the nose of the switch to the centre-line of the mainline checkrail. It is measured along the mainline. (See Figure 48).

The position of the centre bolt for the checkrails is one of the MOST IMPORTANT jobs in the setting up of a turnout, and perhaps the job that is most frequently incorrectly done.

C11-6.3 `T' Dimension

The distance measured from the nose of the switch to the centre-line of the centre bolt hole of the turnout checkrail. It is measured along the inner rail of the turnout. (See Figure 48).

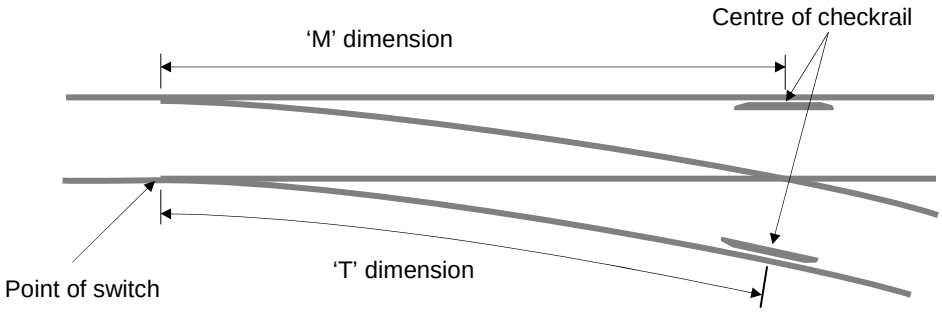


Figure 48 - M & T dimensions

C11-6.4 `TO' Dimension

The distance measured from the nose of the switch to the theoretical point of the “V” crossing. It is measured along the outer turnout rail. (See Figure 49).

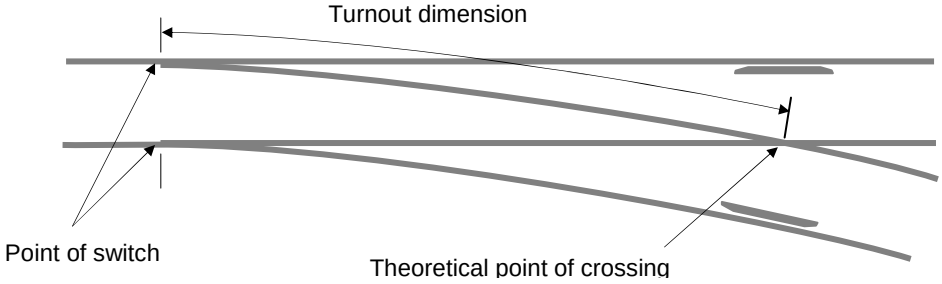


Figure 49 - Turnout dimension

C11-6.5 Turnout rail Offsets

These dimensions locate the correct alignment of the outer turnout rail in relation to the mainline. The turnout rail is divided into four equal arc lengths between the heel joint and the front leg of the crossing. Offsets are then measured at right angles to the mainline rail from these points. (See Figure 50).

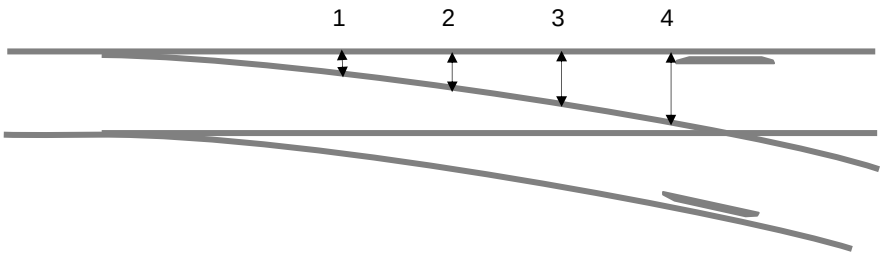


Figure 50 - Turnout offsets

It is very good practice to check these measurements while actually constructing the turnout, as measurements may be checked during each phase of the assembly. This allows errors to be isolated and corrected early with a minimum of effort.

Chapter 12 Checking and maintaining manual points levers

Civil staff are responsible for the installation and maintenance of manual points operating mechanisms at non-interlocked points.

Thornley levers, Ball levers (Hold down and Throwover) and Thompson levers are used to operate the switches in non-interlocked turnouts.

There are many sets of manually operated points in sidings and yards.

C12-1 'Thornley' levers

Most manual levers are 'Thornley' Levers. Installation and maintenance instructions for these are detailed in Chapter 13.

C12-2 Ball and Throwover levers

C12-2.1 Ball levers

Reversible

There are 2 types of reversible lever.

- Light type – suitable for switch blades up to 2500mm long and rail sections from 22kg to 31 kg.
- Heavy type- suitable for tracks of 31kg to 51kg.

The weight is lifted and thrown over. The quadrant plate then operates the trigger to which the drag rod is connected and the points are fixed to open or close the track required.

When points are trailed with these levers the points do not return to their previously set direction. They must be returned manually.

Non-reversible (monkey-tail)

The main purpose of non-reversible **levers** is to hold points closed to one direction.

- When the traffic is required for the other track the handle must be held down until the shunt is complete. When the handle is released the weight returns the points to the normal closed position.
- When the points fitted with these levers are trailed the weight returns the points to the set position.
- Used for tracks of 31kg to 53kg.

C12-2.2 Throwover levers

Throwover levers are designed to operate switch blades up to 2500mm long and rails from 22kg to 41kg.

The lever's action is positive and self locking.

The throw of the stand is adjustable and all parts are interchangeable.

Trailing of points operated by this lever is not recommended as it is self locking.

If special rods are fitted then either or both tracks can be trailed without the need to throw over the lever.

C12-2.3 Maintaining ball and throwover levers

To service ball and throwover levers:

1. Examine all parts, especially the trigger hole particularly, for any excessive wear.

2. Check lever tension by inserting a 400mm bar between the stockrail and the switch at a point just beyond separation of the switch and stockrail.

   Lever the bar against the switch to try and prise it open. The control lever should produce enough tension to make it difficult to open the switch.

   If Switch opens easily there is not enough tension to keep the switch closed under traffic.

3. If the lever is dead adjust the drag rod to take up the play.

4. If there is not enough adjustment on the drag rod, replace the worn parts.

5. Make sure the lever does not touch the end stop.

C12-3 Common maintenance requirements

There have been cases in the past where failures have occurred due to various items of points equipment (extension pieces, point rod brackets, etc) becoming loose due to the self-locking nut on the securing bolt having become slack due to vibration.

Investigation revealed that in some cases the securing nuts had been removed and re-used.

Whenever a self-locking nut has been removed from the securing bolt on points equipment, it must be replaced by a new unused nut.

Where Glenlock self-locking nuts have been used, the thread of the bolt can be damaged. When this happens the bolt is also to be replaced.

C12-4 Cleaning and oiling points

Civil staff are responsible for cleaning and oiling non-interlocked points. There are 3 different methods:

- Oil
- Dry lube – spray on applicant
- Grease

Different areas use different methods after looking at cost and environmental considerations.

Points are generally lubricated every 2 weeks or if necessary after heavy rain.

To Clean and Oil Points:

- Clean switch plates of sand and foreign objects, using a scraper.
- Check workers are clear of moving parts before testing the operation of the points.
- Apply lubricant according to the MSDS. Avoid skin contact with the lubricant. Stand upwind of work area. Use aerosol in well ventilated area. Wear a mask when using aerosol.
- Wait for lubricant to dry, if applicable.
- Test operation of points, making sure workers are clear of moving parts.
- Wash hands after using chemicals.

Chapter 13 Installing and repairing Thornley levers

This chapter details the installation and maintenance procedures for Thornley Type 45 points levers.

C13-1 Manufacturer's manual

The necessary information for installation and maintenance is provided in the Manufacturer's Manual attached as Appendix B.

Note: The drag rod type used on RailCorp infrastructure is 22D68.

Appendix B also includes a parts listing.

C13-2 Maintenance tolerances

The switch opening must be maintained to a tolerance of 120mm ± 2mm.

C13-3 Maintenance of points mechanism

1. Check lever tension by inserting a 400mm bar between the stockrail and the switch at a point just beyond separation of the switch and stockrail.

   Lever the bar against the switch to try and prise it open. The control lever should produce enough tension to make it difficult to open the switch.

   If the switch opens easily there is not enough tension to keep the switch closed under traffic.

2. Place the lever in the dead centre position, so that the spring is not pulling it to one side or the other.

   - The points must be at the centre of the 'throw'. i.e. each switch is to be 60mm from its stockrail.
   - The throw of the points must not be less than 120mm.
   - If the 2 switches are not dead centre between the stockrails, make adjustments with the adjustable shackle length with locking nut, connected to the extended point rod.

3. The front rod must be straight. i.e. on the same plane through both rod clips and the extended end to the shackle pin.

4. Check that:

   - There is no movement between chairs and stockrail and chairs and sleepers.
   - Bolts are tight and switchblade has free movement.
   - Switchblades bear evenly on all chair plates.
   - Switchblades close firmly against the stockrail.
   - Chair plates are greased.
   - There are no obstructions to switchblade movement.

C13-4 Maintenance of lever

1. Keep internal mechanism greased at all times.

2. Lubricate all pins on the mechanism, and the pin on the adjustable shackle length, with machine oil.

The small set screw must be removed from the top of the main drive crank pin, when oiling, to allow oil to flow through the oilways.

3. Make sure side plates of the box are kept tight.

   Looseness may allow the thrust rack guide to be displaced and cause a breakdown of the lever function.

4. Spring tension in the lever box is usually pre-set but if more tension is required an adjusting screw is located at the back of the adjusting bracket.

   Do not over tighten this screw as it will crowd the tension spring and prevent the lever operating efficiently.

5. Drain out any water that enters the box through drain holes at the bottom of the lever box.

6. Check that no foreign matter has got into the box through the drain holes.

7. After inspection and maintenance make sure all screws are tightened.

C13-5 Dismantling the lever

If you are required to dismantle a Thornley lever refer to the procedure in Appendix B.

C13-6 Checking of points following derailment

If a derailment occurs through a set of points that are operated by a Thornley lever:

1. Check that the switches fit correctly to the stockrails.

   To do this, disconnect both point rods by removing the bolt that connects the rod bracket to the switch. Bar each switch independently against the stockrail.

   If necessary, crow the switch to make it fit correctly.

2. Re-connect the front and back rods and check that the throw of the points is 120mm.

   If it is not, adjust both front and back rods by means of the serrations provided.

   Set the correct throw on the front rod first. Take care that the square shank of the bolt is correctly seated in the slot of the underneath portion of the rod.

3. Centre the lever and a check that the switches are dead centre in this position.

Chapter 14 Installing VAE Expansion switches

There are two expansion switch designs to suit both standard track with 1:20 cant plates and vertical track with zero cant plates. There is a separate layout drawing specifically for each design.

C14-1 Delivery to site

The expansion switches are assembled at the manufacturer's works with the base plates positioned in accordance with the layout drawings.

When the assemblies are delivered take care to ensure the switch sets are unloaded on level ground or supported properly over the length of the switch assembly.

C14-2 Installation

Whether the expansion switch is to be assembled prior to installation or at installation it is imperative that the structure the base plates are assembled on is level.

In the case of the expansion switches being assembled in track check the following prior to installation:

- Check the level of the sleepers or bridge transoms. The support level must not vary by more than ± 2mm between sleepers or bridge transoms.
- Adjust the position of the base plates on the assembly to match the location of the support transoms.
- Locate the toe of the switch centrally as shown on the layout drawings when the rail temperature is at the neutral temperature of 35℃ ± 2°. Allowance needs to be made in the appropriate direction if the temperature is outside this neutral range.
- Once installation is complete, check the following:
  - All plates are level within ± 2mm (if not, pack plate or transom to correct.)
  - All fastenings are clipped and tight. There is a 1 - 3mm gap between the hold down clamp and the switch blade.
  - Ensure the two spring assemblies at the toe of the switch are set correctly and that there is a maximum of 0.5 mm opening at the toe on each side.

C14-3 Welding of switch rails

The asymmetrical switch rails have a 2.5m extension flashbutt welded to the end of the switch rail. The flashbutt is located approximately 600mm from centre of forged transition. The flashbutt weld is not obvious as it is normally fully ground flush with the rail and the switch is painted with a protective coating.

When the expansion switch is installed in track some rail will need to be trimmed from the end so that the joint will be located between transoms (or sleepers) for welding. **DO NOT** trim more than 300mm from the end without confirming the location of the flashbutt weld. The approximate location of the weld is shown in Figure 51, Figure 52 and Figure 53.

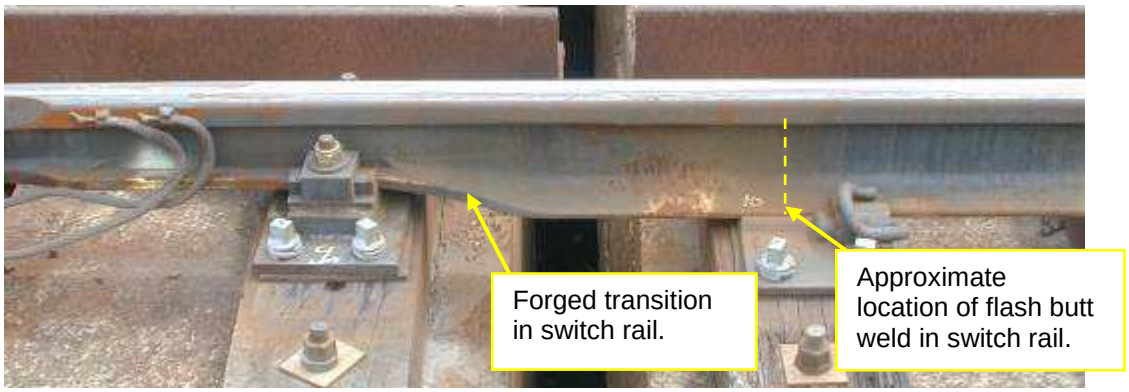


Figure 51 – Location of flashbutt weld

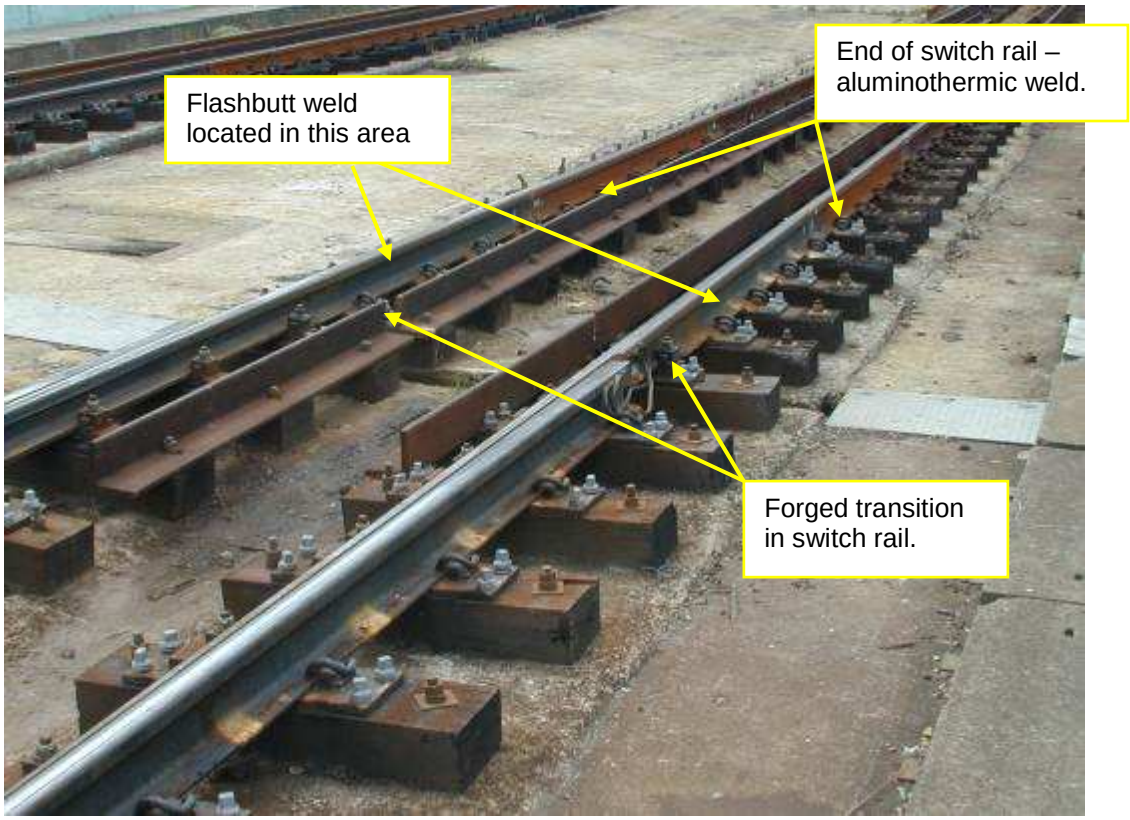


Figure 52 – Location of flashbutt weld

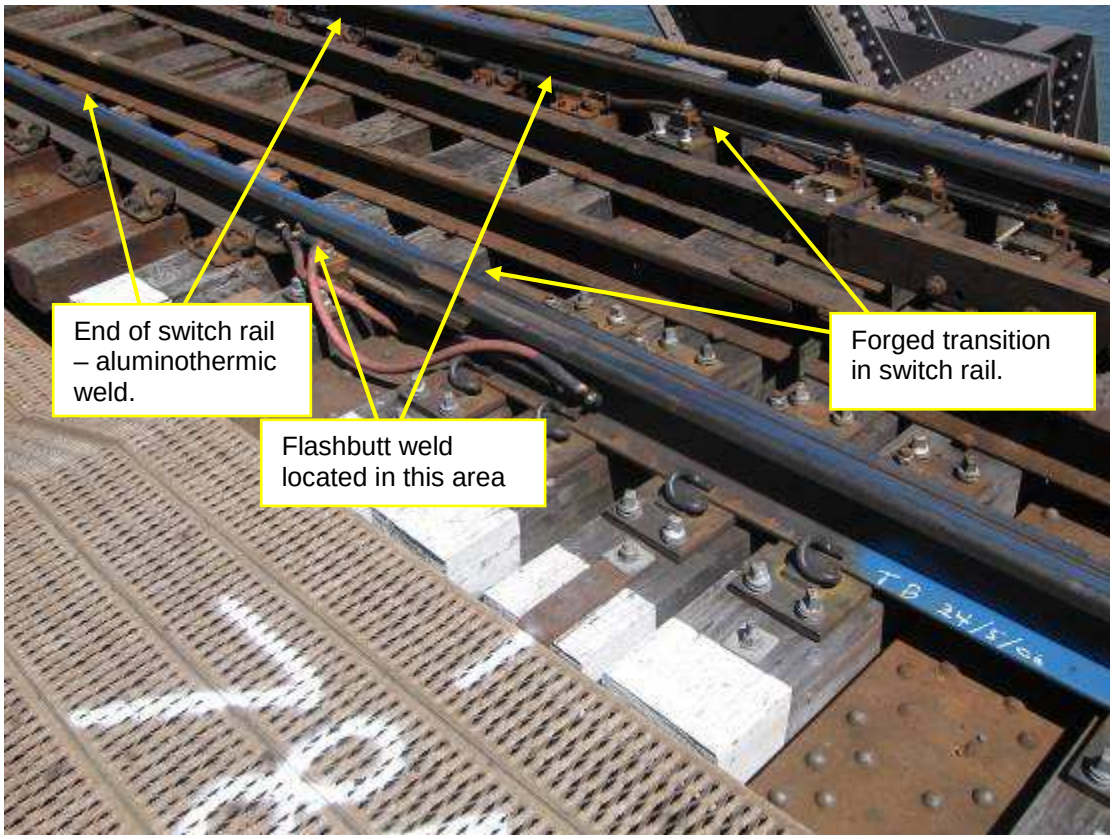


Figure 53 – Location of flashbutt weld

Chapter 15 Field Marking of Crossings

This chapter details the requirements for marking of crossings after installation or repair.

C15-1 General

Welders are required to mark 'V' and 'K' Crossings when new crossings have been installed or when they have been repaired. The markings are to be placed on the wingrails (see Figure 54) and are to include the following:

- Whether installed or repaired.
- Date of installation or repair.
- Welders initials.

C15-2 Marking details

I - (for installation), installation date, initials, OR

R - (for repair), repair date, initials.

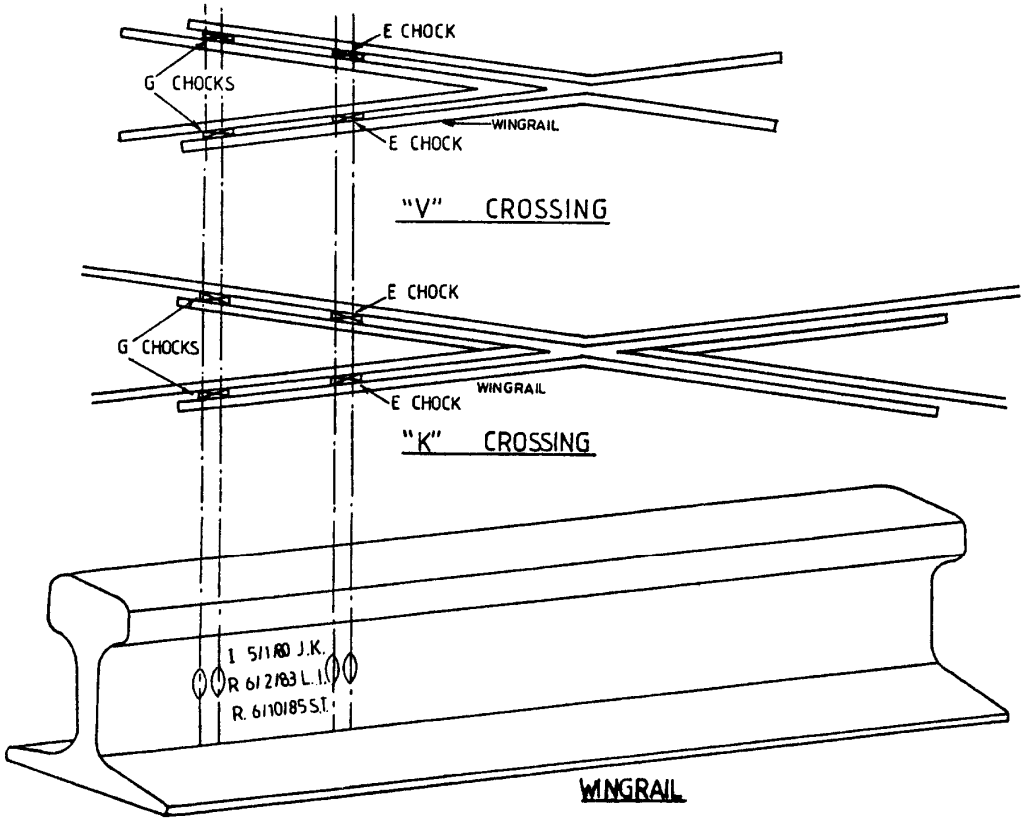


Figure 54 – Marking of crossings

Chapter 16 Storage and handling of turnout components

C16-1 Storage

Turnout components should always be stored with the rail sitting vertically.

C16-1.1 Stacking

The stability and security of a stack is determined partly by the quality of the base preparation. The base should be level, free from projections and preferably on concrete. If an earth base is to be used it should be well drained and of an inert material.

For ease of further lifting, items should be place on dunnage with non-metallic top surfaces (timber), at suitable heights and at a maximum spacing of 2m. When items are stacked on top of each other they should be separated with timber dunnage at the same centres as of that used below the item. Keep the lifting points clear so that slings may be inserted.

Base supports and dunnage should be evenly spaced along the material's length, taking extra care to support the ends. Material on the bottom layer should be carefully aligned and care taken to avoid overlapping.

For long term storage (greater than 10 days) additional supports should be provided.

C16-2 Handling

C16-2.1 General

When dealing with switches and crossings it is acknowledged that it can be difficult to determine lifting points for the units.

Carry out a thorough investigation to ensure as much information is gathered as possible.

Only attempt lifts once weights are know and centres of gravity can be accurately estimated.

Always use lifting beams or appropriate lifting techniques and be overly generous with the number of lifting points.

Lift slowly to determine how evenly the load is being lifted, adjust position and number of lifting points as necessary.

Lifting points should be marked on components and used.

Rail straightness and surface quality are particularly susceptible to damage during lifting operations. The correct profile handling/clamping device should be used to match the rail profile.

C16-2.2 Lifting of assemblies and components

To ensure safe handling; prevent damage to components; and ensure geometry is not compromised, lifting beams and/or two cranes should be used for lifting. There should be a minimum of two lifting points within the machined area of switches and switch assemblies, with additional lifting points to adequately support the rail.

Rails should be lifted with the railhead uppermost. Single point lifting is not recommended on assemblies over 6m long.

Further details for specific components may be found in the appropriate sections below.

C16-2.3 Switches and crossings

Switch and crossing components are regularly damaged through incorrect handling; these components typically also have very long lead times. It is therefore vital that they do not get damaged during delivery, offloading, storage or when being moving into position.

During handling, the movement speed and displacement of crossings, particularly with welded legs should be controlled to avoid swinging and deformation of the welded legs.

Lifting of switches and crossings should always be vertical to avoid side loads on clips, housings and other components, if these are attached.

Prior to handling units, check the integrity of all clips and fastenings and ensure no loose items are present.

C16-2.4 Glued Insulated joints (GIJs)

Glued Insulated joints can be damaged through incorrect lifting and it is vital that all movements of GIJs are performed using spreader beams with the GIJ lifted at appropriate points depending on its length.

Lifting of GIJs should be undertaken using an appropriate lifting beam (a minimum of a two point lift) to ensure that no forces are applied to the joint or its components.

C16-2.5 Plain Rails

C16-2.5.1 General

Whilst plain rail may be seen as a sturdy and almost indestructible material, it is all too easy to damage it. Crippling is the main concern with regards to plain rail. To avoid this it is important to ensure suitable equipment is made available when handling rail.

Barely visible straightness deviations render a rail unacceptable. Therefore during all rail handling, stacking and transportation operations, special care should be taken to avoid loss of straightness.

Surface abrasions of less than 0.75mm in depth are known to cause rail fracture in service.

Rail steel is very thermally sensitive and is likely to develop metallurgical defects if exposed to localised heat. Rail should not be stored in locations where it can be exposed to heating, welding and flame cutting on or adjacent to rails. Contact with electric arcs and metal splash should be avoided

The maximum lifting stress should not exceed 150 N/mm^2.

C16-2.5.2 Short lengths (up to 40m)

The cantilever action of excessive rail end overhang beyond the outer lifting points can cause high stressing and permanent bending of the rails. The overhang beyond the outer lifting point should be less than one half the distance between lifting points, as in Table 16 below:

Rail Length up to (metres)	Number of Lifting Points	Distance between points (metres)	Maximum rail end overhang (metres)
12 - 13	2	6	3.0 – 3.5
18	2	9	4.5
36	4	6 & 12	3
40	4	7 & 13	3 – 5

Table 16 – Rail lifting points and end overhang

C16-2.5.3 Orientation of rail

Rail should always be lifted in the head upward position. If a rail to be lifted is not in the head up position, turn it using a rail turning bar and hold it in place with wedges or chocks (if required) to ensure it remains upright when attaching the lifting device.

The lift should always be vertical and rail should not be dragged.

Rails to be lifted should always be marked with the lifting points and the lifting device attached within 25 mm of the marked lifting point. The lifting device should always be located over the centre of the length of the rail to be lifted.

Rails being lifted should be checked for balance after raising a few centimetres.

C16-2.5.4 Preferred methods of lifting

Various methods are used for lifting rail, but the preferred methods are those which do not cause damage to the rail and are safe. These include fabric strap lifting slings and specialised rail handling equipment such as rail handling beams and rail lifting clamps.

The use of log grabs or chains around the rail is unacceptable.

C16-2.5.5 Single point lifting

This form of operation is hazardous to personnel and incurs a high risk of bending and surface damage and should be avoided.

For single point lifting, lift a maximum length of 6m for plain un-machined rail.

C16-2.6 Protection of surface finishes and coatings

Due care should always be paid to the surface condition and coatings apparent on materials, goods and manufactured items to be moved. Wherever practicable fabric slings should be used when lifting items with machined finishes or special surface finishes or coatings.

Items in this category should not be handled / lifted together to prevent the risk of contact on such surfaces. Care should be taken during lift and deposition to prevent contact with objects in the vicinity, and the ground.

Fabric webbing belts should be used to secure items during transit.

Appendix A Checklist for turnout work

CHECKLIST FOR SIGNALS REQUIREMENTS FOR SWITCH, STOCKRAIL OR WHOLE OF TURNOUT RENEWAL WORKS.

New Turnout Requirements

New turnout trackwork is *(tick apprpriate box)*

Existing design in same location ☐ New design in same location ☐ New design in new location ☐

Signalling equipment is same as previous	YES ☐ NO ☐

Specify existing equipment: _____
Specify proposed equipment_____

Is the turnout design non-standard?	YES ☐ NO ☐

If YES to above then pre-assembly must be carried out including signalling equipment
If NO a signalling design assessment is required – refer to Signals Engineering.

Is the position of insulated joints the same as previous?	YES ☐ NO ☐
Is the hole drilling standard?	YES ☐ NO ☐

Switch/ StockRail Replacement

Is the signal requirements for connection of point equipment to bearers and stockrails different to existing?	YES ☐ NO ☐

Track maintenance required

• Pack heel	YES ☐ NO ☐
• Correct out of square	YES ☐ NO ☐
• Correct vertical alignment	YES ☐ NO ☐
• Adjust switch to fit correctly to stockrail from the tip to the lock position (especially for clawlocks)	YES ☐ NO ☐
• Correct tip of switch positioning relative to the timbers so signalling equipment is not obstructed	YES ☐ NO ☐
• Drilling of holes required	YES ☐ NO ☐

Other maintenance required. Specify: _____
_____

Is the hole drilling standard?	YES ☐ NO ☐

Track activities have been agreed by Track Representative:

Position or Title (print) _____	Name (print):_____
Date: (print):_____	Signature:_____

Signal requirements have been agreed by Signal Representative

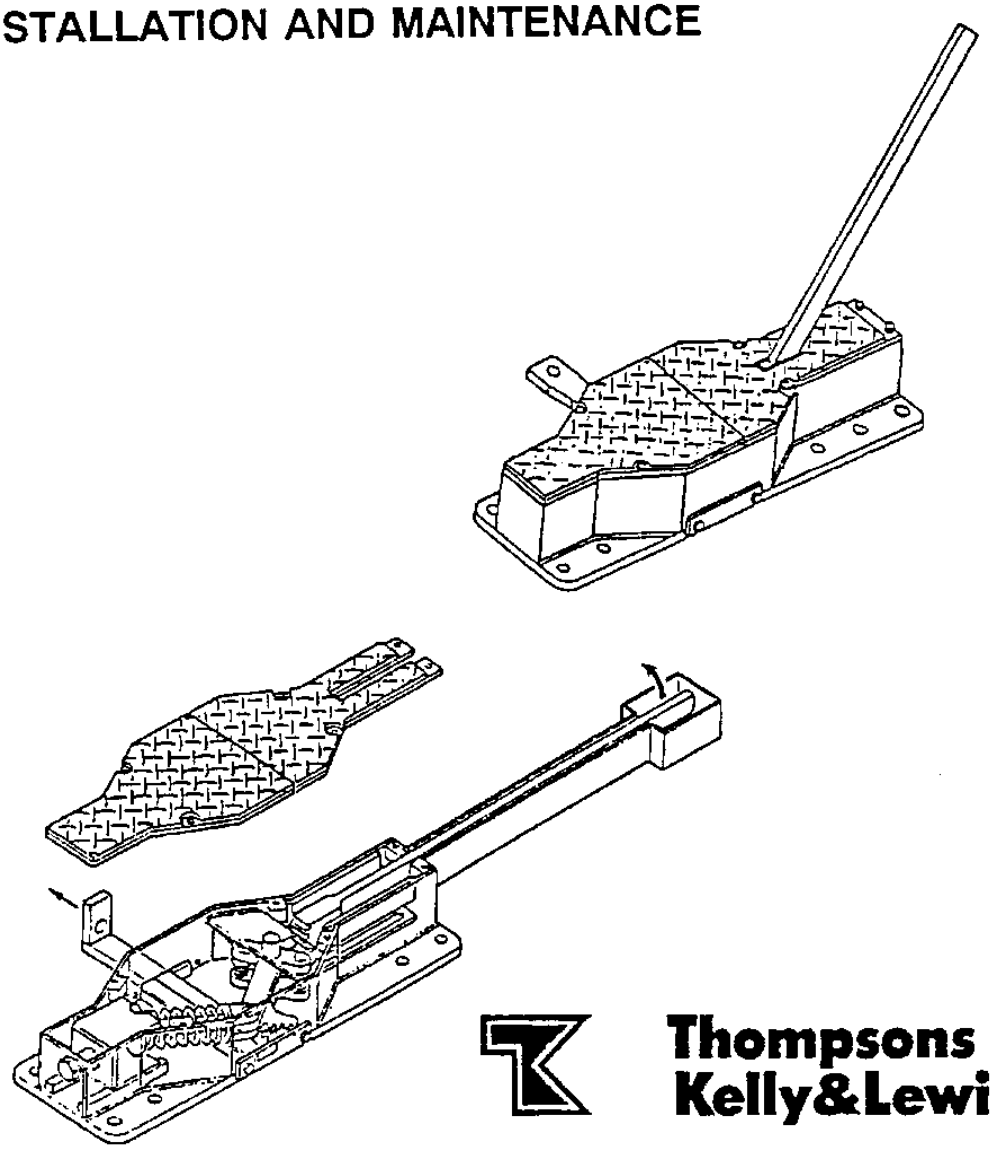
Position or Title (print) _____	Name (print):_____
Date: (print):_____	Signature:_____

Appendix B Thornley Type 45 lever

THORNLEY

TYPE 45 LEVER

INSTALLATION AND MAINTENANCE



Thompsons Kelly&Lewis

Railway Products Division

Date of Issue: November 1993

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Installation & Maintenance
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During the installation of Thornley Type 45 levers, it is essential that certain conditions prevail to ensure satisfactory operation with minimum maintenance.

1. All trackwork in the switch area has to be maintained to a high degree of efficiency.

2. Chair plates have to be checked to ensure there is no movement between chairs and stockrail, also between chairs and sleepers.

3. Surveillance should be maintained at all heel joints to ensure all bolts are tight and the switchblade retains a free movement during operation.

4. Switchblades should bear evenly on all chair plates.

5. Switchblades should close firmly against each stockrail with no clearance at the point or at the end of head machining.

6. Chair plates should be kept greased at all times to ensure free sliding movement of the switchblades.

7. Obstructions such as blue metal pieces should be kept clear of the switchblade movement.

8. Point rod should be installed and adjusted to give a straight line through the point rod and a minimum throw at the switch points of 120mm.

9. Gauge rods should then be installed and adjusted so that there is no distortion at the switchblades.

10. It is imperative that switch bracket bolts be kept tight at all times.

11. When installing the Thornley Type 45 lever, it is most essential that the point rod, connecting drag rod and the thrust rack of the lever be kept in a straight line.

    If this is not done a jack-knifing effect will occur and damage the mechanism of the lever.

12. The position of the lever is governed by the type of connecting drag rod used, as shown on our attached sketch, where the distance from the lever base to the running edge of the nearest stockrail is marked dimension 'A', which is:

For type 22D66	1140 mm
For type 22D67	1270 mm
For type 22D68	1400 mm

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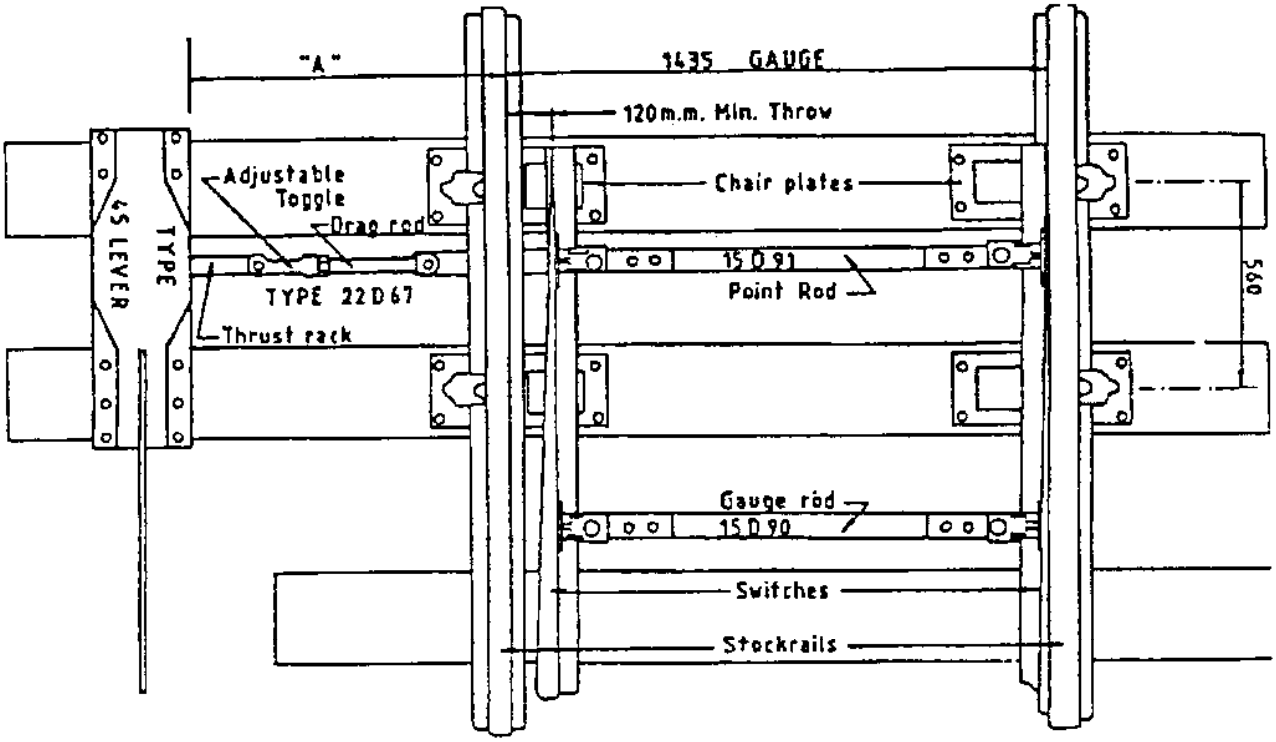

FOR TYPE 22D66 "A" = 1140
FOR TYPE 22D67 "A" = 1270
FOR TYPE 22D68 "A" = 1400

13. The adjustable connecting drag rod is then adjusted so that when the operating lever thrust rack is in its central position, each switch has an opening of 60 mm.

This will give an even pressure on both switch blades when in their operating position.

14. When centralising the lever thrust rack, **do not remove the lid through which the handle protrudes as this may disrupt the meshing of the handle quadrant with the lever rack.** Removing the small lid is sufficient to observe the centralising of the thrust rack and also gives access to lubricating the internal mechanism of the lever box.

If the large lid has to be removed at any time, it is essential that it is replaced in the right position to give proper meshing of the handle and rack. It is usually placed approx 10 mm closer to the small lid and then pulled back against the tension of the lever rack return spring before bolting down. If this is not done, the lever box will not function properly.

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15. To maintain efficiency with the Thornley Type 45 lever, it is imperative that the internal mechanism is kept greased at all times.

Make sure the side plates of the box are kept tight, as any looseness in this area may allow the thrust rack guide to be displaced and cause a breakdown in the functioning of the lever.

Usually the spring tension in this type of lever box is pre–set, but if more tension is required, an adjusting screw is located at the back of the adjusting bracket. Do not over tighten this screw, as it will crowd the tension spring and impede the efficient operation of the lever.

There are drain holes in the bottom of the lever box to allow any water which may enter the box to escape.

During inspection and maintenance, ensure that no foreign matter has entered the box through these holes.

After inspection or maintenance always ensure that all screws are tightened.

The Thornley Type 45 lever is a very efficient machine, particularly in the area where trailing through operations occur, but remember at all times, it cannot overcome all the pitfalls of a badly maintained track.

If you want your switchblades to function properly, keep your lever maintained properly and, if you want your lever to function properly, keep your switchblades maintained properly. One cannot work efficiently without the other.

Heavy work will cause a strain on the best of equipment and any parts which may fail can be replaced immediate, as a comprehensive range of parts are kept in stock at all times.

To dismantle the Thornley Type 45 lever, the following procedure should be followed:

- Remove the retaining split pin from the clevis pin attaching the connecting drag rod to the lever thrust rack.
- Depress the lever handle to release the spring tension on the thrust rack and remove the drag rod clevis pin.
- Remove the lid securing bolts (CS00599) from the small spring end lid (TH18306) and remove this lid.

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- Remove the securing bolts (CS00599) from the guide cover plate (TH18309–6) and side cover plate (TH18309–5) and remove these two plates.

- Slide the thrust rack guide (TH183024) out through the side of the lever box and this will then allow the thrust rack (TH183025–1) to be removed.

- With an M24 spanner screw the adjusting bracket screw (CS00617) clockwise into the adjusting bracket (TH183013–7) to release all tension off the main spring.

- This will allow the removal of the adjusting bracket (TH183013–7), toggle guide washer (TH183018–7), toggle assembly (TH183016) and the main spring (TH183016–1).

- Remove the securing bolts (CS00599) from the lever handle lid (TH18307 or TH183021) and the lid with the lever handle can then be removed.

- Detach the lever handle assembly (TH183020) by removing the lever pin (TH183018–6) and this will leave the lever handle lid (TH18307 or TH183021) detached.

- Extract the main pin (TH183018–2) with an upward pressure and the bell crank assembly with the trip rods attached can then be removed.

- Extract the trip rod pins (TH183018–5) from this assembly and the trip rods (TH183014–1) and (TH183014–2) with the trip rod springs (TH1830A–3) can then be detached, noting that the trip rod springs are underneath the trip rods for reassembling.

- The lever rack assembly (TH183013) can then be removed, which then allows the lever rack return spring (TH183016–2) together with the lever rack return pin (TH183018–4) to be removed.

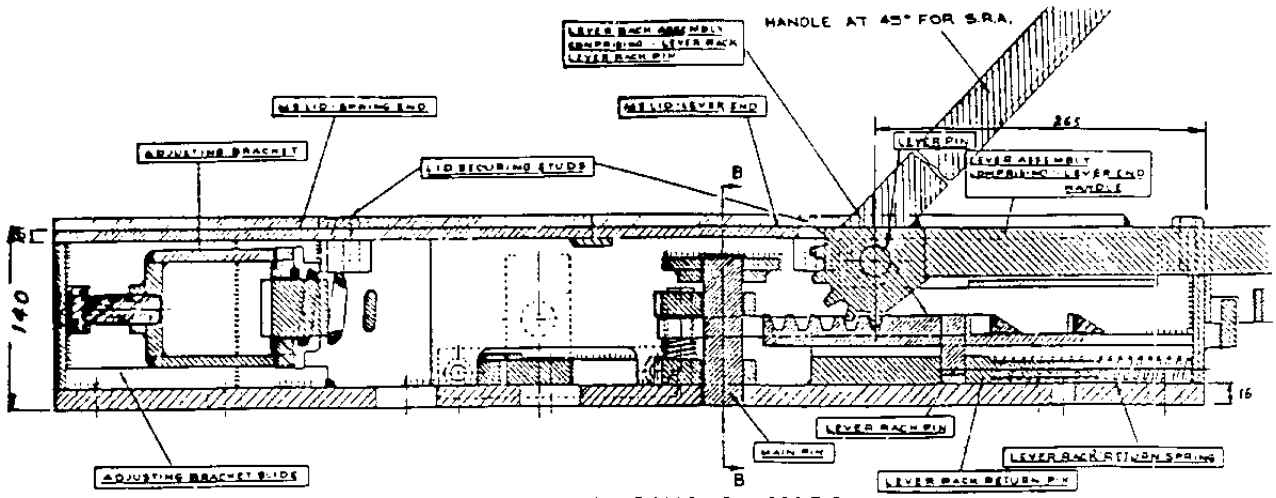
- All parts should then be thoroughly inspected and cleaned.

- Any damaged parts should be replaced.

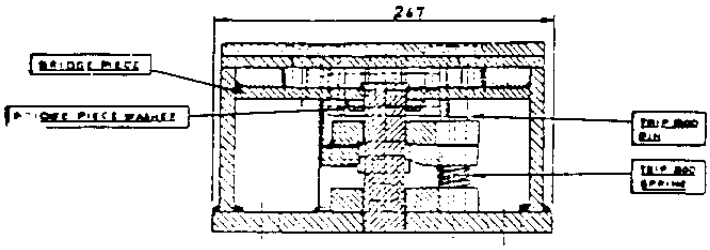
- To reassemble, follow the reverse of the dismantling procedure, ensuring that plenty of grease is used on all moving parts.

  Please note that the trip rods (TH183014–1) and (TH183014–2) are slightly concaved to ensure that the ends are bearing hard on the lever rack.

  Do not straighten these rods.

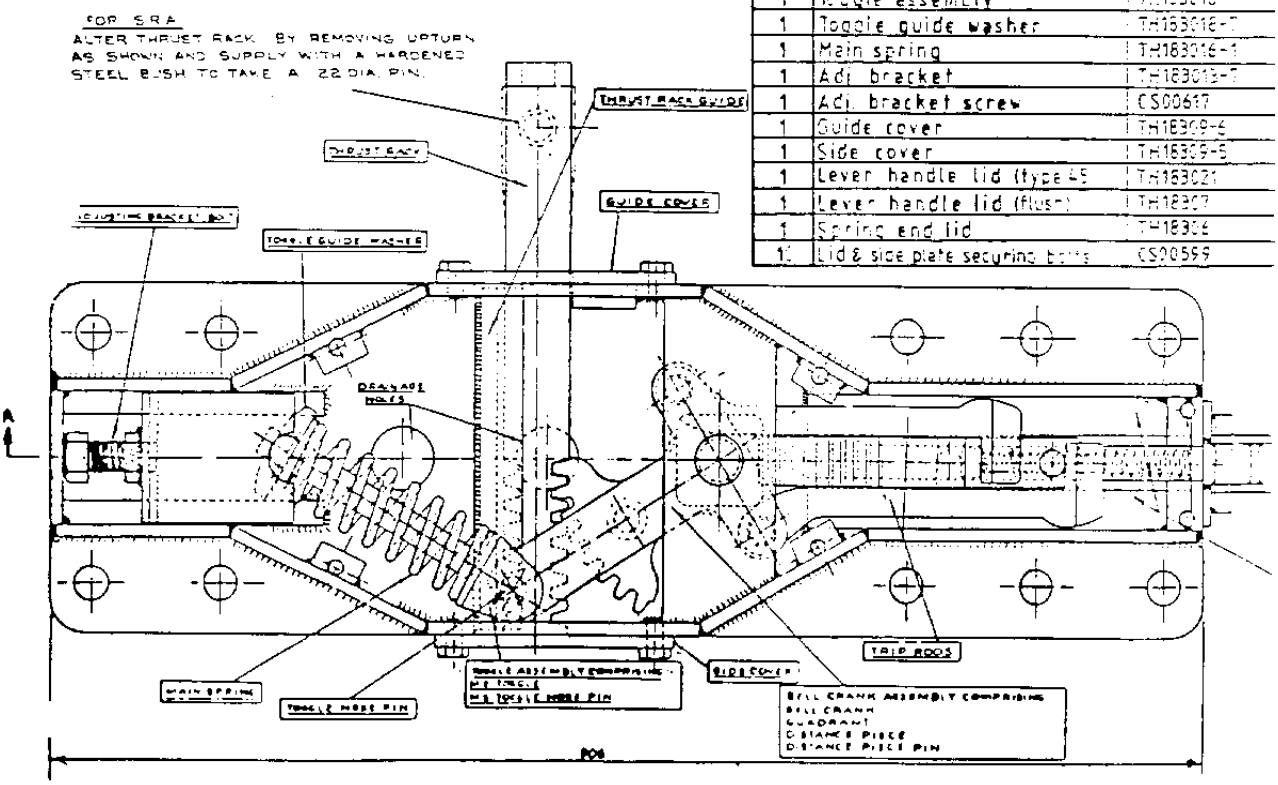


SECTION A-A WITH M.S. LID IN POSITION



SECTION B-B WITH M.S. LID IN POSITION
BUT WITH TROUGH REMOVED FOR CLARITY

Req'd	PART	PART No
1	Lever handle assembly	TH183020
1	Lever pin	TH183016-6
1	Lever rack assembly	TH183013
1	Lever rack return pin	TH183018-4
1	Lever rack return spring	TH183016-2
1	Left hand trip rod	TH183014-2
1	Right hand trip rod	TH183014-1
2	Trip rod pins	TH183018-5
2	Trip rod springs	TH183016-3
1	Bell crank assembly	TH183017
1	Main pin	TH183018-2
1	Thrust rack	TH183023-1
1	Thrust rack guide	TH183024
1	Toggle assembly	TH183016
1	Toggle guide washer	TH183016-7
1	Main spring	TH183016-1
1	Adj. bracket	TH183013-7
1	Adj. bracket screw	CS00617
1	Guide cover	TH18309-6
1	Side cover	TH18309-5
1	Lever handle lid (type 45	TH183021
1	Lever handle lid (flus-	TH18302
1	Spring end lid	TH18306
1	Lid & side plate securing bolts	CS00599



PLAN WITH M.S. LID REMOVED

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To assist in obtaining parts, the following is a list of all parts of the Thornley Type 45 lever, as shown on Drawing No. S-1-830.

Part No.	TH183020	Lever handle assembly
	TH183018-6	Lever pin
	TH183013	Lever rack assembly
	TH183018-4	Lever rack return pin
	TH183016-2	Lever rack return spring
	TH183014-2	Left hand trip rod
	TH183014-1	Right hand trip rod
	TH183018-5	Trip rod pins
	TH183014-3	Trip rod springs
	TH183017	Bell crank assembly
	TH183018-2	Main pin
	TH183025-1	Thrust rack
	TH183024	Thrust rack guide
	TH183016	Toggle assembly
	TH183018-7	Toggle guide washer
	TH183016-1	Main spring
	TH183013-7	Adj bracket
	CS00617	Adj bracket screw
	TH18309-6	Guide cover
	TH18309-5	Side cover
	TH183021	Lever handle lid (type 45)
	TH18307	Lever handle lid (flush)
	TH18306	Spring end lid
	CS00599	Lid and side place securing bolts

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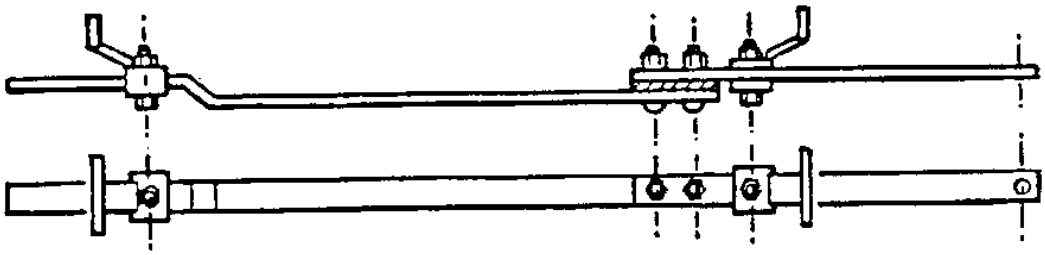
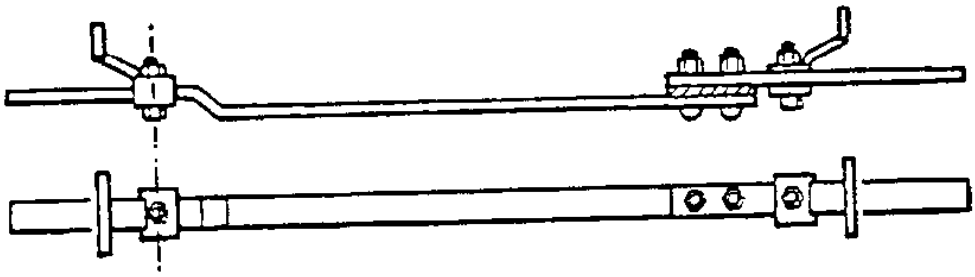
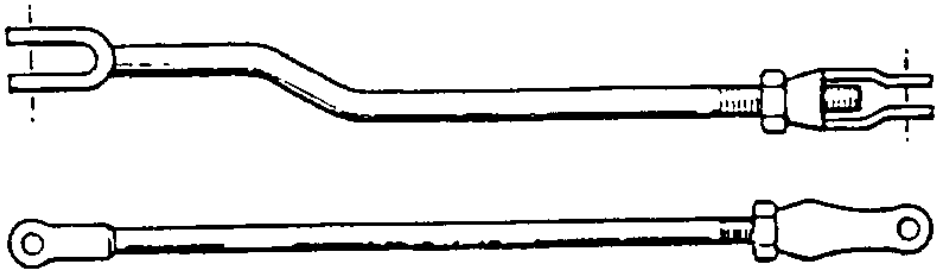
POINT ROD, GAUGE ROD AND DRAG ROD USED WITH TKL TYPE 45 LEVER



SRA Type 15D91 Point Rod



SRA Type 15D90 Gauge Rod



Type No. 22D67

Appendix C Non-Conformance Report

Non-Conformance Report

NCR No: ..... **Date:** .....

Non-Conformance Description

Send to: Track Service/Supply Contracts Manager/ Logistics

Business Unit: ..... Manager/Supervisor: .....

Part Description: ..... Supplier: .....

Part No: ..... Supplier Contact Name: .....

Non-Compliance Details: .....

.....

.....

Inspection/ Tests Conducted: .....

.....

.....

Recommendation: .....

.....

.....

.....

Name/Position: Phone No Date:

2. Track Services Assessment

Send to: Originator / Supply Contracts Manager / Logistics; Issue an CAR

A ☐ Acceptable

B ☐ Acceptable with repairs

C ☐ Acceptable without repair to Engineering concession

D ☐ Not acceptable - Corrective Action Report has been initiated CAR No

Comments: .....

.....

.....

Name/Position: Phone No Date:

3. Originator

Action to be taken:

A Place in service

B Return to Supplier for repair

C Quarantine the stock

Comments: .....

.....

Name/Position: Phone No Date:

Appendix D Crossing Fail Form

Crossing Fail Form

Form CF1

DATE OF FAILURE | CROSSING DEFECT | BROKEN CROSSING

LOCATION

REGION: Central | Illawarra | West | North | Infrastructure Facilities | KILOMETRES

BASE CODE /TRACK: BASE CODE | LINE | DN | SINGLE TRACK | Main | Suburban | Local | Relief | Through | Refuge | Loop | Platform Rd | Siding | RAIL: UP | DN

DETECTION

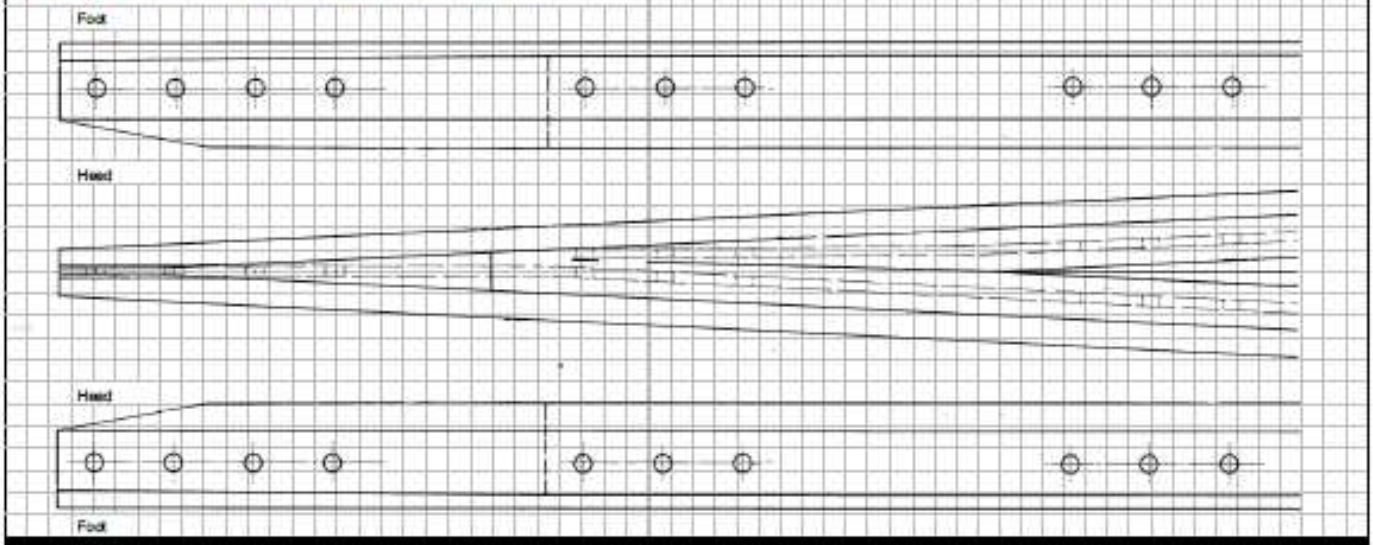
HOW FOUND: Derailment/ Mishap | Visual | Rail Flaw Detection Car | Manual Ultrasonic Test | Train Crew | Other

For Broken Crossings: WHEN FOUND hrs | REPORTED TO | WHEN REPORTED hrs

If defect at WIREFEED weld: AGE OF WELD IN YEARS | OR WEEKS | WELD NUMBER | WELDER'S LICENCE NO

POSITION SKETCH

Show position and direction of defect, visible crack or break



CROSSING

RAIL SECTION: 60HH | 60 | 53 | 47 | OTHER

CROSSING MANUFACTURER: PRE | BRFC | VAE | COGIFER | OTHER

CROSSING TYPE: FABRICATED | MANGANESE NOSE | CHROME VANADIUM | MONOBLOC | OTHER

V or K CROSSING: V | K | DETAILS STAMPED ON WING

CROSSING CONDITION

NOSE CONDITION: GOOD | FAIR | POOR | WORN | BATTERED | WIREFEED WELDED

WING CONDITION: GOOD | WORN | OTHER

TRACK CONDITION

GEOMETRY: TOP: GOOD | POOR | PUMPING | BALLAST: GOOD CONDITION | POOR CONDITION

ALIGNMENT: GOOD | POOR | BEARERS: TIMBER | CONCRETE | GOOD | FAIR | POOR

LAST KK TEST DATE: D M Y | WAS DEFECTDETECTED | YES | NO

TEAM MANAGER Signed:..... Date: ...../...../.....