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Inspection of Points and Crossings

ETP-03-01

Applicability

ARTC Network Wide

SMS

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1.0	03 Sep 24		Document renumbered from ETE-03-01 / Significant re write

Table of Contents

Mandatory requirements also exist in other documents.

Where alternative interpretations occur, the Manager Track & Civil Standards shall be informed so the ambiguity can be removed. Pending removal of the ambiguity the interpretation with the safest outcome shall be adopted.

1 Introduction

1.1 Background

The function of all P&C assemblies is common, i.e. to provide a safe, smooth, and low friction pathway for the transition of rolling stock from one track to another track, under given operating parameters. The purpose of P&C track inspection is:

- To ensure safety by checking on the integrity of the various components, their fit and function together to provide safe passage.
- To ensure there are no obstacles to smooth passage including obstructions, impacts to switch tips and crossing noses, and track geometry.
- To ensure low friction by checking that there is not abnormal wear and tear on rails and other components.
- To identify defective components and characteristics or accelerating condition deterioration so that maintenance interventions can be planned.

The variety of Points and Crossing (P&C) equipment in use on the ARTC railway network is wide. Each type of P&C assembly from each manufacturer has different components, different arrangements, and different fastening systems. It is not practical in this procedure to identify the peculiarities of each component, arrangement, and fastener, supplied by all P&C manufacturers.

For information about spare parts, and the assembly and disassembly of specific equipment the original equipment manufacturer (OEM) operating and maintenance manuals, and plans, should be referenced.

The ARTC Signalling standards prescribe signalling inspections for certain aspects of interlocked P&C operating mechanisms. These aspects are not included in the ARTC Track and Civil Code of Practice (CoP) and routine scheduled inspections. However, when a signalling defect or condition of concern is observed during a Track & Civil P&C inspection it shall be reported to the signalling maintainer and protective action taken if appropriate. These aspects include:

- Switch open throw dimension
- Open switch rail throat dimension
- Closed switch rail toe/stock rail gap dimension
- The 'fit' of the switches relative to the stock rails
- Spreader bar and drive rod condition, fastenings, and lubrication
- Switch slide plate lubrication

The Signalling Technical Maintenance Plan requires operation of the points during scheduled inspections to observe switch movement, and switch/stock rail fit.

1.2 Purpose

The purpose of this procedure is to provide guidance on the performance of General and Detailed inspection tasks for Points and Crossing (P&C) assemblies including:

- Turnouts
- Catchpoints
- Diamonds

1.3 Scope

The scope of General, and Detailed inspection of P&C assemblies is detailed in CoP ETS-03-00 Points & Crossings as well as the default responses for defects found.

The minimum frequency of routine scheduled General and Detailed inspection of P&C assemblies is detailed in the CoP and *ETP-00-03 Civil Technical Maintenance Plan* (TMP).

Additional inspection scope or increased frequencies may be authorised by local maintenance management in response to identified infrastructure condition or accelerated deterioration rates.

In the event of any discrepancy between the OEM documentation and ARTC standards regarding inspection tasks and frequencies, and defect responses, the ARTC standards take precedence.

The inspection of the operation of manually operated (non-interlocked) points is included in the Track & Civil P&C general and detailed inspections including: Thornley levers; Ball levers; Throw-over levers; and similar mechanisms.

1.4 Procedure Owner

The Manager Engineering Services is the Document Owner. Queries should be directed to standards@artc.com.au in the first instance.

1.5 Responsibilities

The Track Inspector (see section 1.9 Definitions) is responsible for the completion and reporting of General and Detailed P&C inspections in compliance with this procedure and the CoP.

The Area Manager (or equivalent) is responsible for the scheduling of inspections in compliance with the TMP, supervising the inspection performance and management of defects found.

The Corridor Manager (or equivalent) is responsible for oversight of the inspection process and for the adequate resourcing of the Area Manager (or equivalent) with personnel, skills, tools and equipment.

1.6 Subordinate Documents

The following documents are subordinate to this procedure:

- Form ETP0301F-01 for Turnouts
- Form ETP0301F-01a for Turnouts with housed points
- Form ETP0301F-02 for Diamonds
- Form ETP0301F-03 for Swing Nose

- Form ETP0301F-04 Recording of gauge, play and superelevation
- Form ETP0301F-05 for Dual Gauge Turnouts and Dual Gauge Separations
- Form ETP0301F-06 for Catch Points
- Form ETP0301F-07 for Turnouts with Spring Wing Crossings.

1.7 Reference Documents

The following documents reference, or are referenced by, this procedure:

- ARTC Track and Civil Code of Practice, ETS-03-00
- ETP-00-03 Track and Civil Technical Maintenance Plan

1.8 Tools and Equipment

The standard tools, calibrated as required, used in the measurement of required dimensions associated with P&C detailed inspection are:

- Appropriate Tape Measure
- Steel Rule
- Vernier Callipers
- Combination board

Other tools and gauges may be required for specific tasks as outlined.

> Warning: Signalling systems often use track circuits with the rail as a conductor, including high voltage impulse track circuits. There is risk of electric shock and malfunction of the signalling system. Where track circuits are used, insulated equipment (appropriate tape or track gauge) should be used when measuring between electrically isolated rails.

1.9 Definitions

The following terms and acronyms are used within this document:

Term or acronym	Description
ARTC	Australian Rail Track Corporation Ltd.
CER	Civil Engineering Representative
CoP	ARTC Track and Civil Code of Practice
OEM	Original Equipment Manufacturer
P&C	Points and Crossing assemblies
T&C	Track and Civil
TMP	Track and Civil Technical Maintenance Plan
Track Inspector	A person with competencies of Track Examiner & Certifier.
Track Plane	Surface defined by running face of rails (see Figure 13-1 Track Plane)

1.10 Organisation of this document

Points and crossings are combined to form assemblies, a turnout being the most common. Point or crossing inspection tasks are generally independent of the assembly in which they are found. For example, a V crossing in a turnout or a diamond. In this document explanation of inspection tasks for points and crossings are grouped by component independent of the assemblies.

Inspection forms and service schedules incorporate the tasks required to inspect points and crossings and combines them into an appropriate inspection regime specific to the assembly such as turnout, catch point or diamond.

Housed, conventional and undercut points have been considered in this procedure as variants of points with specific inspection tasks. V and K crossings are considered variants of crossings. Swing nose crossings have more in common with points than fixed crossings. To avoid confusion swing noses have been delt with as a separate component.

Overview inspection tasks has been included to capture items that are not specific to the points or crossing components or are generic.

Points and crossings have general and detailed inspection tasks from ETS-03-00. General inspection tasks are included in a detailed inspection. In this procedure the tasks are grouped logically by their relation to points and crossing components rather than by the inspection type. The service schedules show which tasks are applicable to both general and detailed inspections.

This procedure should be used as a reference to support general and detailed inspection tasks.

2 House Keeping

Tasks for both general and detailed inspection are listed in ETS-03-00 Points & Crossings Section 3.4.2 A Detailed inspection of P&C requires both visual inspection and measurement of specific dimensions or aspects detailed in the CoP with results recorded (see 12 Recording and Assessment).

Defects found are to be reported directly into Ellipse from the Work Order utilising the Field Worker application (or successors enterprise asset management systems) and are managed in accordance with the ETS-03-00 Points & Crossings Section 3.4 Inspection and Assessment. Defects Found Report Form AMT-FM-004 may be used if Asset Management System is unavailable, however records shall be uploaded once system becomes available.

A general inspection would not normally require switches to be thrown unless problems are suspected from observation. Switches may be thrown to see more of switch plates rollers and blade fit.

A detailed inspection shall require the switch and swing nose (if present) to be thrown unless clipped and booked out of service.

Rectification work should be programmed on a priority basis. Where the assessment responses include increased monitoring, knowledge of local factors that may affect the tracks deterioration rate and performance history is required. The increased monitoring frequency should be determined by these factors. This increased monitoring should be continued until rectification work is carried out.

If repairs cannot be made prior to the passage of the next train, the speed restriction, if applicable, should be implemented along with an appropriate increase in the monitoring until actions are taken to restore the track.

Where the condition identified is a hazard for the facing condition the speed restriction only needs to be applied to cover this facing movement.

If the cause of a defect is known and it is known that it will not deteriorate into an unsafe condition an alternate response is permitted with appropriate documentation and approval from the Civil Engineering Representative.

Mandatory responses to Points & Crossings conditions are found in ETS-03-00. Other sections of the ARTC Track and Civil Code of Practice will generally be applicable to turnouts.

3 Overview Inspection Tasks

Track Inspectors should keep a lookout for defects and conditions that may affect the integrity of the track structure or ability to guide rolling stock correctly, including the following components or aspects identified in the CoP:

3.1 Component Damage, Loose, Missing or Broken

A general overview of the assembly shall be undertaken to look for obvious signs of damage, loose missing or broken components. Points and crossings may be damaged from derailment, dragging equipment, vandalism or other causes. Particular attention should be paid to detect damage to components that may inhibit operation, including switch operating equipment, or could impact the safe passage of rolling stock.

Where a defect is identified that has a specific response, defined in either ETE-03-00 (Points and Crossings) or elsewhere in the track and Civil Code of Practice, then this response shall be applied. If there is no response defined for a particular defect type, then the response should be determined based on the Inspector's skill and experience and/or in collaboration with their manager, business units engineering support or subject matter experts, as appropriate.

Individual components should be assessed for the effectiveness of any bolts. Ineffective bolts include missing or broken bolts. Loose bolts should be tightened. Missing or ineffective bolts should be replaced.

3.2 Track Geometry

The general track geometry shall be assessed visually, and measurements should be made when a visual assessment suggests that geometry defects requiring a maintenance response are present.

For detailed inspections only, points and crossings where the AK Car does not routinely record through both legs manual measurements shall be recorded for the leg or legs that are not routinely recorded by the AK Car (normally the turnout leg). Additionally, any of the following configurations shall have manual measurements recorded for both legs if the AK Car does not routinely record through both legs:

- Crossovers between tracks which are not co-planar (having different rail levels or different grades)
- A turnout road (diverging track) out of a superelevated track.
- A turnout road (diverging track) leading to high trafficked or strategically critical locations where the two tracks are not co-planar and which have different rail levels or different grades.
- A turnout positioned such that it increases the consequence of derailment, such as on bridge or embankment or close to a heavily populated area.
- Any other turnout with grade/tight radius/unusual configuration with elevated risk nominated by asset management authority.

The asset management authority shall maintain a record of such configurations in the enterprise asset management system.

The measurements shall be recorded:

- for turnouts connected at a crossover, continuously in one direction from 6m in front of the toe of the points of the first turnout then via the connected turnout legs to 6m past the toe of points on the second turnout.
- for turnouts connecting to a diverging track, from the 6m in front of the points via the turnout leg to 20m past the clearance point.

The results of these manual track geometry measurements may be recorded either electronically utilising the electronic forms on the Asset Management System or directly onto ARTC standard form ETE0301F-04 Manual Recording of Gauge, Play and Superelevation in Turnouts, Diamonds and Slips.

Rail play is defined as any potential movement of the rail across the sleeper or bearers (usually timber) which will make the track gauge widen under load. This is added to the static gauge measurement to accurately reflect the track gauge under loaded conditions.

Turnouts and other points and crossing assemblies and associated drive lock and detection equipment can be susceptible to performance and reliability issues at geometry anomalies less than those found in ETS-05-00 and improved outcomes may be achieved by undertaking preventive maintenance before reaching intervention limits.

In particularly pumping track, top and alignment defects can put undue strain on drive lock and detection equipment causing subsequent detection failures. Similarly pumping faults and top can cause the switch point to rise and create a nose strike or split points hazard (pivot heel switches are particularly susceptible).

Inspections should look for evidence of track pumping. Suspected pumping issues particularly in the vicinity of drive lock and detection equipment may be further investigated using depression pegs.

3.3 Bearers and Fasteners

For points and crossing inspection bearers and fasteners includes all bearers and sleepers that form part of the points and crossing assembly, including the cant transition. It also includes all fasteners used to attach rail or other components to the bearers such as “e” and “fast” clips, screws spikes, dog spikes, and insulators. Plates supporting the rail seat whilst securing it to the bearers or sleepers like flat track plates and sleeper plates are included however those supporting special assembly components (switches/checkrails/crossings) like rail brace chairs and slide plates are not.

Visual inspection should identify fasteners loose, damaged, ineffective, incorrectly installed, incorrect type broken or missing.

Compressible washers such helix, double helix and conical washers should be inspected to ensure they are correctly compressed and unbroken.

Castellated nuts should be checked for presence of split pins, and the pins themselves for wear.

Check condition and security of any insulators and resilient pads. Plates where used should be inspected for cracks.

Steel troughs should be inspected for cracks in the vicinity of the connection to rail or points machines.

Switches using asymmetric rail section use special fastening. Fish tail shaped clips (sometimes referred to as Schwihag or IBAV clips) shall be inspected as part of visual inspection to determine they are present, installed correctly (i.e. not backing out or unclipped) and are not obviously broken.

Due to complexity of turnouts, some designs use special fasteners such as T bolts and swage fasteners (such as Huck bolts). Such fasteners shall be included in the inspection.

An ineffective bearer or fastening is one that does not provide either vertical, lateral, or longitudinal support to the rail.

Specific responses applicable to critical areas are detailed in ETS-03-00 Table 3-14, elsewhere in the assembly responses detailed in ARTC Track & Civil CoP Section 2 Sleepers and Fastenings, Section 2.3 are applicable.

The switch critical area extends from the weld or joint in the stock in front of the switch (or a minimum of three bearers ahead of the toe, whichever is greater) to a minimum of 6 bearers beyond heel or anti creep device. The crossing critical area extends for two bearers in front and behind the extent of the crossing and check rail assembly.

3.4 Ballast Condition and Profile

Ballast condition and profile should be determined visually for general inspection. For detailed inspection digging to bottom of sleeper may be undertaken to help better ascertain condition if required. If a more detailed assessment is required a crib may be dug out so the cross section may be viewed. Ballast must be replaced and appropriately packed.

Loose ballast on bearers can create a tripping hazard plus it has the potential to spill into voids around switch mechanisms creating an obstruction to their functionality. Visual inspection should therefore identify excess ballast on top of bearers or that is potentially fouling moving parts in the case of switches and swing nose crossings. Excess ballast and other debris should be removed from the vicinity of switch mechanisms.

Ballast has specific assessment and response actions. Refer to ARTC Cop Section 4 Ballast for further information.

3.5 Weld and Joint Condition

Mechanical rail joints should be visually examined for loose or missing bolts and signs of failure. Welded rail joints shall be visually inspected for signs of defects or failure. Refer to ETS-01-00 Rail Clause 1.4.

Insulated joints should be inspected for metal flow that may cause track circuit failure.

3.6 Broken Steelwork (crossing, points, rails)

Inspection should identify any broken steelwork. Broken point or crossing tip have specific responses (see corresponding sections). Broken rails will be managed per ETS-03-01 Rail, Clause 1.4.3. Broken steelwork not having specific classification in ETS-03-01 should be escalated to a CER to determine an appropriate response.

3.7 Rail Creep

As with plain track, points and crossings are subject to rail stress and strain through temperature variations and movement of rail.

Visual Inspection should look for the following signs that may indicate a rail creep or stress issue:

- Misalignment at the heel of switch
- Wear marks caused by rail moving through fasteners, particularly stock rails at switches. Movement can be identified by shiny marks on chairs and plates or the foot of the rail.
- Out of square switch
- Reduced clearance to or rubbing of drive lock and detection equipment.
- Unexpected position or binding of blade in at anti-creep device.
- On fabricated and swing nose crossings attention should be paid to pushing or pulling of point and splice rails and exposure of the tips to wheel flanges.

Measurements may be required to aid classification of condition.

At design stress free temperature, the blade should be centred in the anti-creep device. In cool weather as the rail behind the device contracts it is expected the blade at the anti-creep device to move away from the front of switch. In hot weather the blade at the anti-creep is expected to move towards the front of the turnout.

Rail creep not only indicates risk of misalignment and rail breakage but may also cause reliability problems for drive lock and detection equipment.

3.8 Rail Condition

Rail should be visually examined for defects including:

- Rail Breaks
- Surface conditions wheel burns, squats, RCF lipping and flow (see 14 Surface Condition Classification)
- Excessive wear.

Defects shall be classified per ARTC CoP ETS-01-00 Rail. For detailed inspection the condition should be rated.

Intervention limits for rail wear of stock rails is not normally met before other components require replacement.

For detailed inspection classification, the head height of the worst worn rail (which had full height upon manufacture) should be used. The location may be identified visually.

Where the head height is found to be approaching 24mm, or the side wear is suspected of exceeding limits, numerous measurements should be taken to identify if there are any wear faults.

3.9 Wheel Rail Interaction

Wheels leave evidence of contact such as contact bands on rail surfaces and marks from flange contact with gauge faces or switch and crossing tips. Abnormal contact may be a clue to identifying further issues with a turnout. Hence, careful observation of wheel contact is an important part of turnout inspection.

An irregular contact band may indicate poor geometry, overground welds or vehicle hunting. A dipped weld may be highlighted by a short widening of the contact.

Heavy contact on the back of check rails may indicate a tracking issue such as turnout close to a curve. NB: repairing of worn check rails (by replacement or adjustment) in such instances will likely improve reliability of the crossing nose before mandatory response actions are made.

Battered crossing noses may indicate wing rail wear or inadequate check rail effectiveness. Heavy contact on the wing may be the result of a low nose.

Flange tip impact marks on switch tips should be cause for concern and lead to investigation of back of switch to opposite stock dimension also blade closed gap tip height and width or switch tip wheel clearance. A wandering contact band on a blade may indicate a bent blade caused by a run-through or an obstruction preventing the blade from closing properly.

Flange tip marks in flangeways indicates inadequate depth.

Inspectors should pay attention to the evidence of wheel interaction and where identified as abnormal they should seek to understand how it has occurred and ensure potential contributing inspection parameters have appropriate responses applied.

There are sites on ARTCs network where wheel condition is monitored. Abnormal contact can be the result of abnormal wheels. Where abnormal contact is observed and cannot be explained by turnout condition it should be reported to area managers.

4 Points

4.1 Switch Opening

Open throw critical dimension helps control the hazard of wheel contact to the open switch tip.

Open throw dimension (sometimes referred to as switch blade open gap or toe opening) is the gap between the switch rail toe and stock rail when the switch is open.

This measurement should be taken using callipers or a steel rule, refer to the following Figures.

Figure 4-1 Switch Opening

Figure 4-2 Measuring switch opening with callipers

An alternative action to those specified in ETS-03-00 is to prohibit facing train movements.

As designed switches have a range of nominal openings. 120mm is common for new designs. The limits table is not provided for restoration to design.

Variance from design may indicate an issue that could impact reliability.

A limit of 10mm variance to design may be used as a trigger to request adjustment by signals fitters to improve reliability. This limit may also be used at supplementary drive positions.

4.2 Track gauge (at the switch tip)

Gauge should be measured using a track measuring gauge.

The gauge should be taken between the two stock rails in front of the switch tip.

For joggled switches the gauge immediately before the joggle switch shall be taken.

Figure 4-3 Track gauge at the switch tip

Track gauge at the switch tips helps control the risk of wheel climb in the instance of tight gauge.

Gauge variation from design is likely to impact drive lock and detection equipment performance. This should be considered in prioritising repair irrespective of speed restriction.

On timber bearers wide gauge or an increase in gauge over time may indicate a deterioration of bearers.

4.3 Back of switch blade to opposite switch gauge face at tip

Back of switch tip to opposite switch gauge dimension helps control the hazard of wheel contact to the open switch tip.

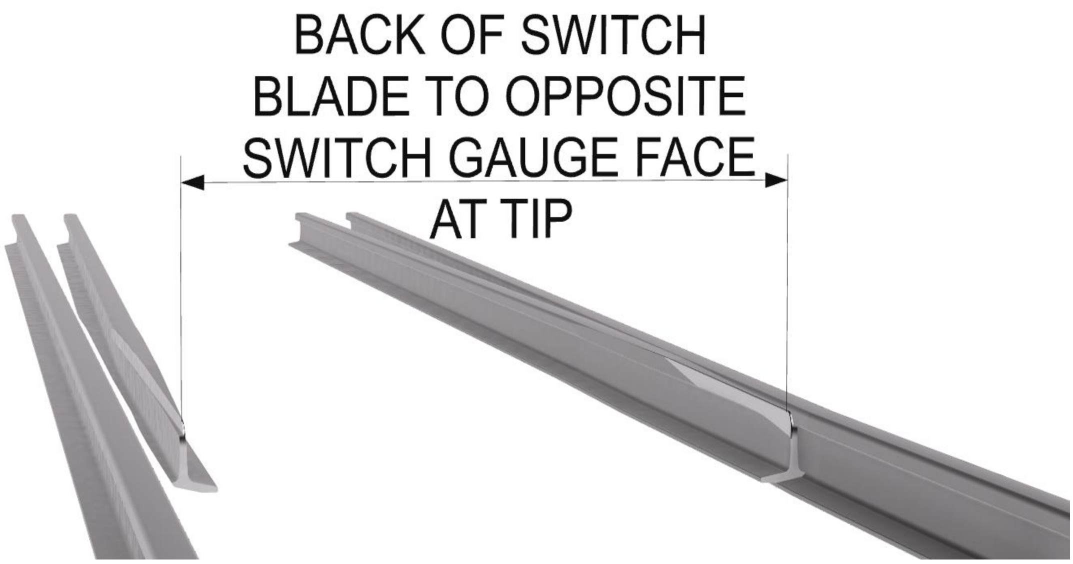
The measurement should be taken using a track gauge capable of this measurement.

Excepting joggled switches, the dimension may be determined by deducting the open throw measurement from the gauge at toe.

The dimension accounts for the combined effects of open throw and track gauge variation.

The measurement corresponds to minimum flange thickness and wheelset back-to-back dimension.

Figure 4-4



4.4 Back of switch blade to opposite switch rail at supplementary drive or stretcher

Back of switch rail to opposite switch rail is the dimension between the back of the open switch and gauge face of opposite blade.

The control helps manage the likelihood of stretcher and drive damage and subsequent consequences caused by back of flange contact.

The measurement should be taken using a track gauge capable of this measurement.

Spring assist assemblies are to be consider supplementary drives.

For stretcher bars not connected to a drive only: where the blade has not completed its travel the blade may be levered across to overcome friction and blade flex. It shall be allowed to spring back before any measurement is taken.

No attempt should be made to lever blades at supplementary drives or at stretchers where opposite blade is against stock or switch stops.

Back of blades should be visually inspected for evidence of back of flange contact.

Figure 4-5

4.5 Throat Opening (Back of switch rail to stock rail at the junction of heads)

Back of switch rail to stock rail dimension helps ensure there is clearance for a wheel flange.

Back of switch rail to stock rail (flangeway throat gap), is measured between the switch rail and stock rail when the switch is open.

This measurement should be taken callipers or a steel rule, refer to the following Figures.

Figure 4-6 Measuring throat opening with callipers

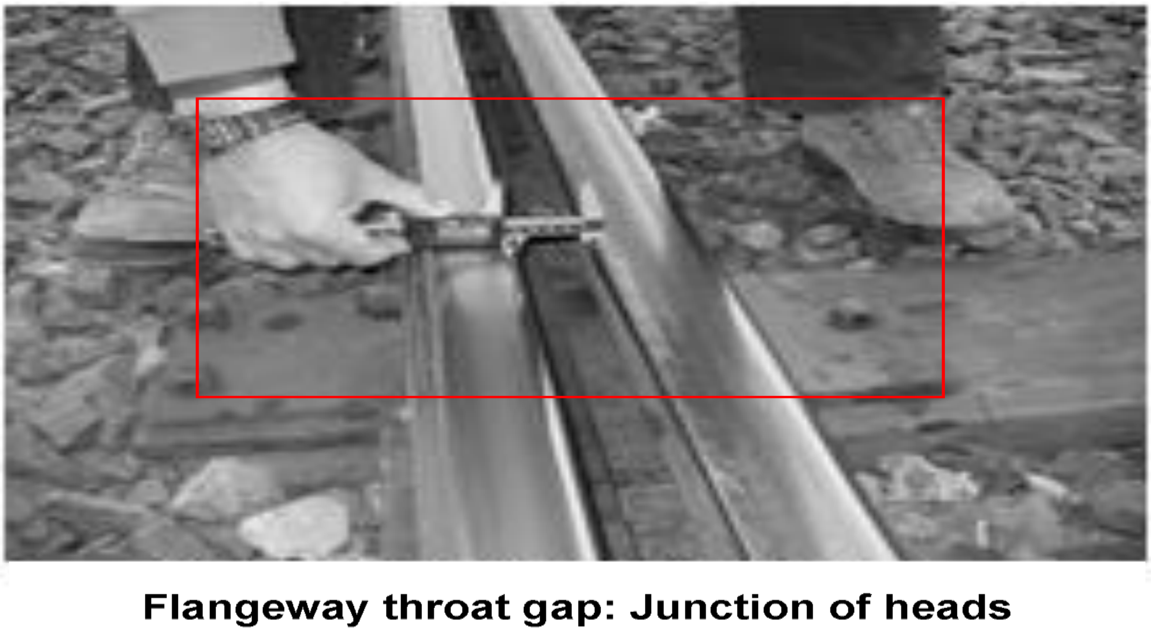
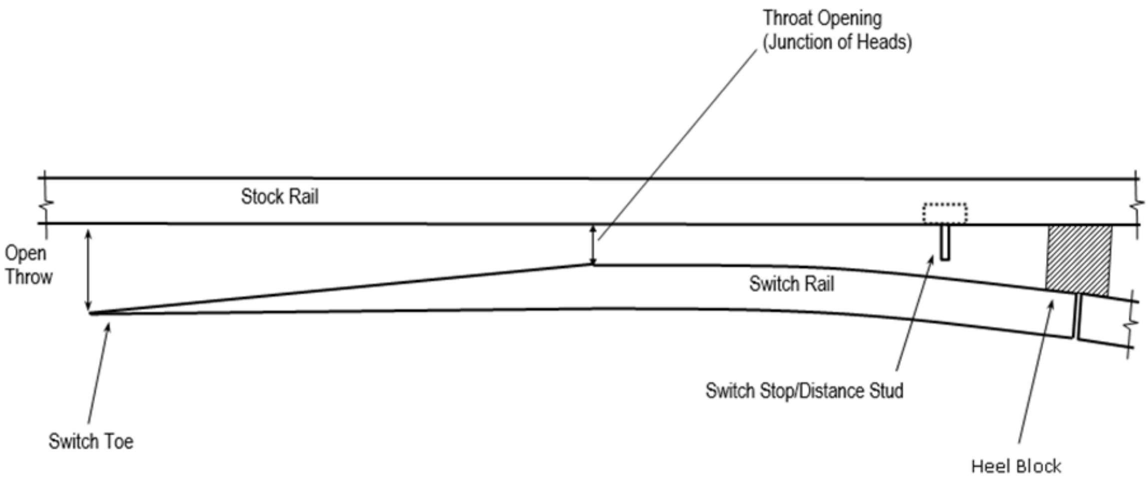


Figure 4-7 Throat opening at junction of heads



The measurement should be taken at the narrowest gap between the head of the stock rail and switch blade. Typically, the narrowest point is at the Junction of Heads. The junction of heads is where the switch rail attains full head width. Sometimes this is also called back of machining as it is where the blade machining on the rail head finishes.

4.6 Blade and stock condition

The blade and stock shall be visually inspected for defects such as RCF or squats, spalling metal flow and batter.

Check for wear and metal flow on the stock rails and switch rails, particularly any “lipping” that may prevent the switch closing completely. See Figure 14-1 Metal Flow Measurement. A steel rule or callipers may be of assistance.

Rolling contact fatigue (RCF) cracking and other surface defects on the gauge face of the switch blade can lead to sections of the rail head breaking out. See Figure 4-9 Figure 4-10. RCF and other surface defects shall be reported.

See Table 14-1 Surface Condition Classification for RCF, spalling and shelling.

Figure 4-8 RCF Cracking on Head of Tangential Switch Blade

Figure 4-9 Switch Rail Head Damage Resulting from RCF Cracking

The damage depicted in Figure 4-9 may be associated with condition depicted in Figure 4-14 Flow on stock below.

Figure 4-10 Damaged Stock Rail

Inspect stock rails for side wear (particularly similar flexure turnouts where the outside rail nominally the 'high rail' is the stock rail and can be subjected to accelerated curve wear). Side wear on the stock below the blade can expose the tip to wheel strike risk. Check tip height, width, wheel clearance and gauge face angle. Tangential asymmetric or undercut switches should not sit high of the machined section of stock rail as shown in Figure 4-11.

If the top of the switch blade has been bent towards the stock (see Figure 4-12) the switch tip wheel clearance shall be checked and response applied. If there is sufficient material the condition may be repair by grinding.

A stock rail with flow toward the gauge corner can prevent a switch blade from closing properly. When the switch blade is closed lateral loading can cause the top of the blade to bend, resulting in subsequent fracture (see Figure 4-13). Stock rails should be ground to remove flow before this situation occurs, which may otherwise require Stock Rail and Blade Replacement.

Figure 4-11 Side wear below switch blade

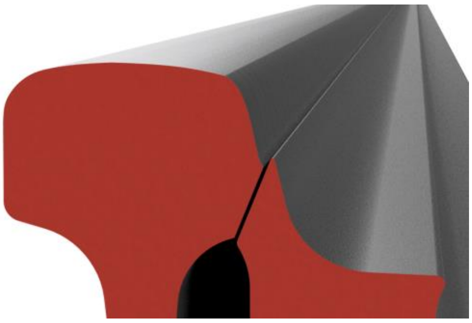


Figure 4-12 Bent tip from flange contact

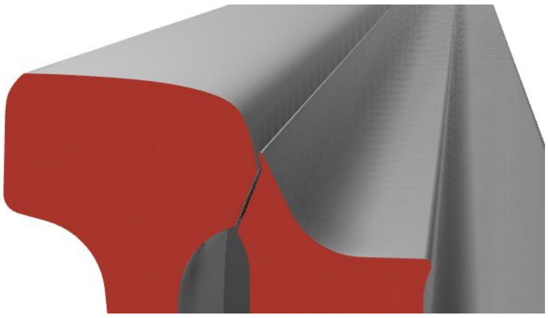


Figure 4-13 reground switch blade

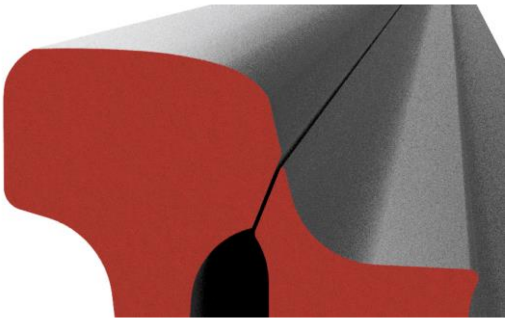
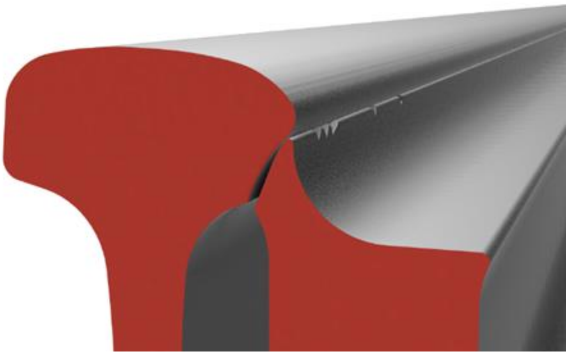


Figure 4-14 Flow on stock



4.7 Switch Alignment

A bent switch blade refers to a switch blade that has suffered damage from a run through or derailment. Such switch blades may be suitable for temporary repair and re-installation to a geometry suitable for train movements at a reduced speed. The switch blade may have been, bent, twisted or have suffered wheel damage. It should be repaired to a condition suitable for the reduced speed of operation both in terms of geometry and structural integrity. The reduced speed of operation should not exceed 40km/h.

Figure 4-15 Bent blade telltale signs.

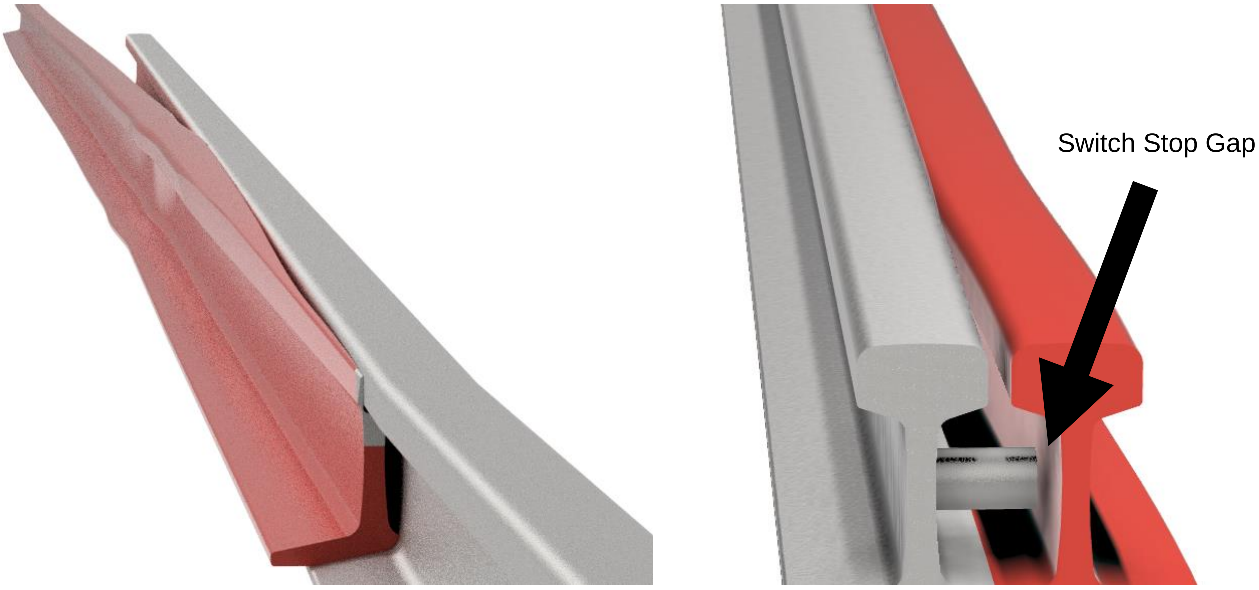


Figure 4-15 shows exaggerated telltale signs of a bent blade such as a uneven gap between the blade and stock, irregular shape and gap to switch stops.

4.8 Switch blade closed gap

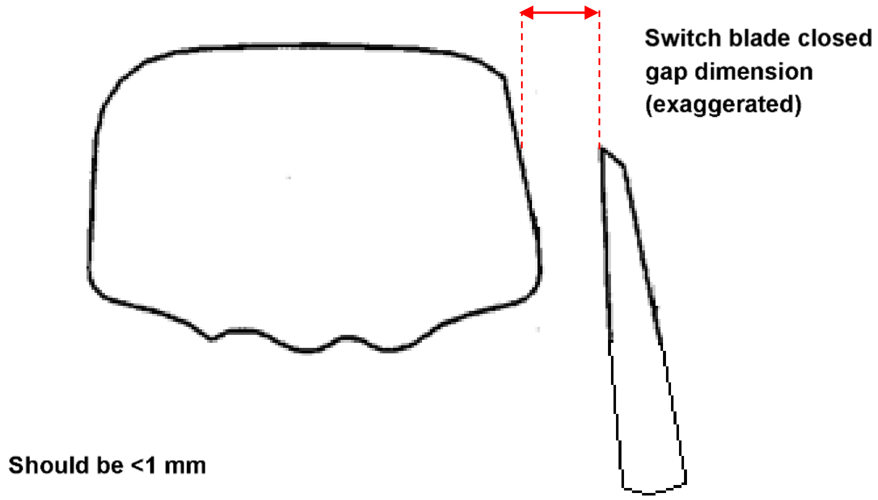
The switch blade closed gap should be measured for both switches between the switch tip and stock rail when the switch is in the closed position.

This measurement should be taken using a steel rule, refer to the following Figure.

The limit helps control the hazards of wheel strike to the switch blade and transfer of excessive forces to the drive locking and detection equipment.

The limit shall also be applied at supplementary drives.

Figure 4-16 Switch blade closed gap



Where the stock is side worn below the height of the switch the top edge of blade becomes further exposed to the wheel that may cause a derailment hazard. Additionally, the blade can become vulnerable to being bent or broken which may also create a derailment hazard.

Where large gaps are present switch blades should be inspected for damage, such as bends from run through.

4.9 Switch Width at the Tip

This measurement is only applicable to conventional switches.

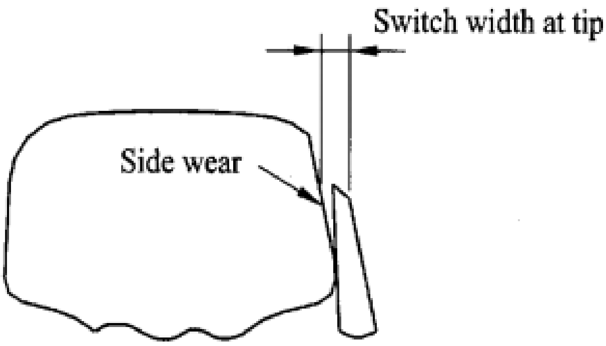
Switch width at the tip should be measured with the ARTC conventional switch tip gauge, but may be measured with a steel rule.

The gauge measures against an angle to represent the wheel flange.

Switch width at the tip is the width exposed to the wheel and includes effects of side wear on stock rails and closed gap between switch and stock rails.

Figure 4-17 Conventional Switch Tip Gauge Measuring 4mm tip width.

Figure 4-18 Switch tip width measurement when not using gauge.



Switch width at the tip is a control to limit wheel strike and associated derailment hazard.

Any signs of wheel impact on the switch tip are to be reported. (Note that a straight edge is needed to measure the exposed switch tip width where joggled stock rails and heavy duty switches are used.)

4.10 Switch Height at the Tip

This measurement is only applicable to conventional switches.

Switch tip height is the distance from the crown of the stock rail running surface to the top of the switch rail, it should be measured 50mm back from the switch tip at the top of the arc at the switch nose, using the ARTC conventional switch tip gauge. NB: If measured with a steel rule, different thresholds apply.

The gauge measures against an angle to represent the wheel flange. A thin sheet of paper is useful in determining the contact point.

Switch height at the tip is a control to limit wheel strike and associated derailment hazard.

NB: rail profiling through turnouts may reduce the switch tip height, making switch grinding of the blade necessary to restore height

Figure 4-19 Conventional Switch Tip Gauge Measuring 14mm tip height.

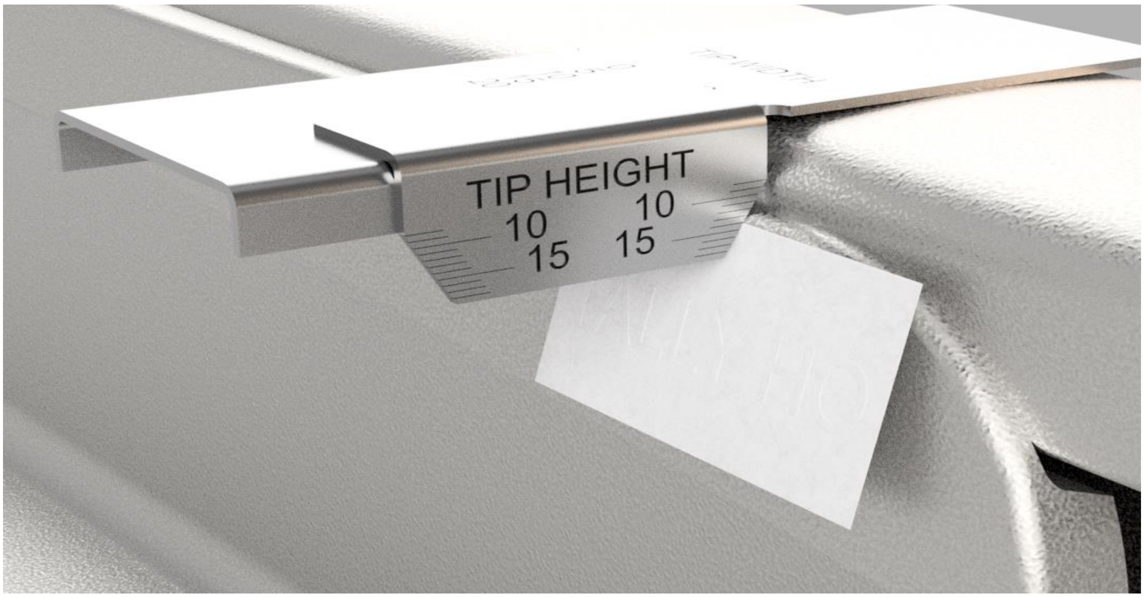
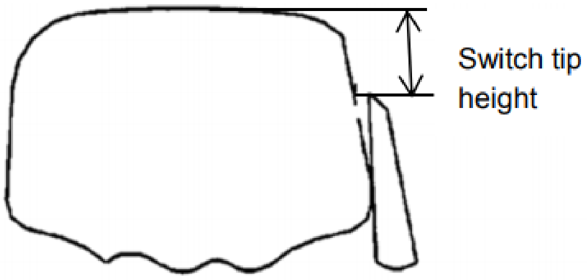
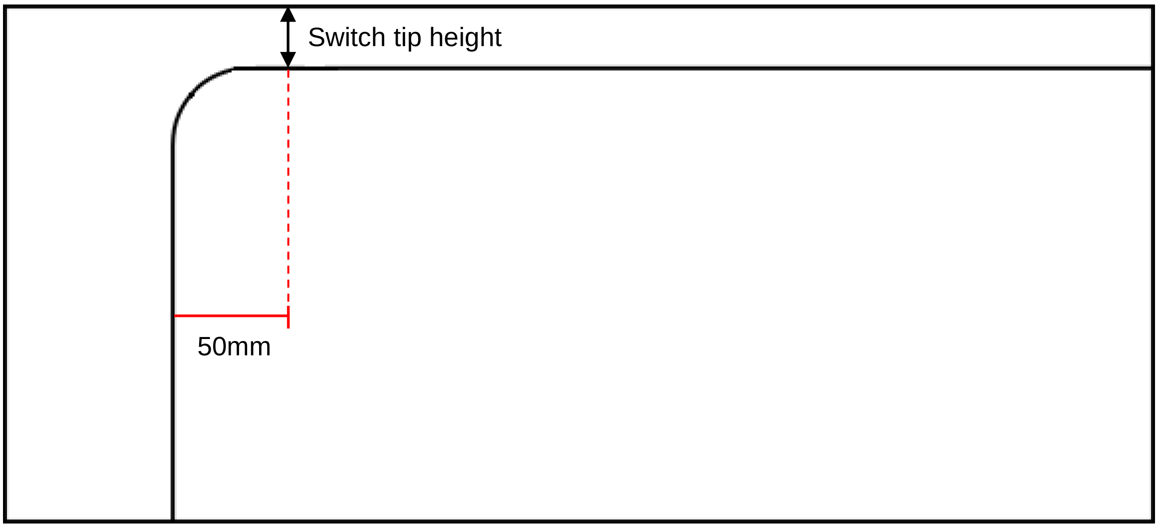


Figure 4-20 Switch tip height measurement when not using gauge.





4.11 Switch Tip Wheel Clearance

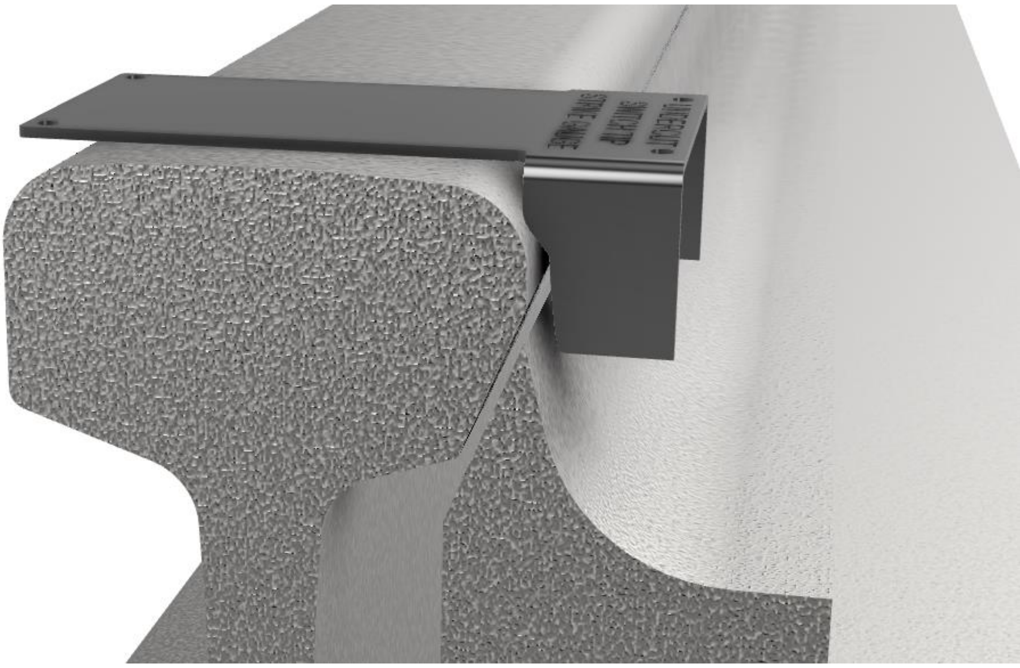
This measurement is applicable to undercut switches.

For general inspections the blade should be examined for damage or contact near the tip that indicates a striking risk.

For detailed inspections the gauge shall be used and the clearance measured.

With the undercut switch tip strike gauge level to the track plane and placed 50mm behind the toe of switch the clearance between the gauge and blade should be measured using a tapper or feeler gauge.

Figure 4-21 Use of switch tip strike gauge



This control helps manage the hazard of wheels striking and or climbing switch tips on facing movements as well as prevention of blade damage.

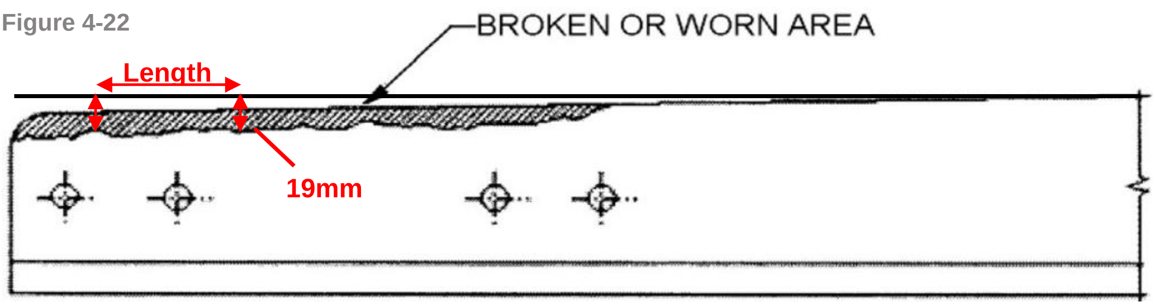
4.12 Switch blade damage

Switch blade damage is classified as anywhere along the blade where it is intended to fit up to a stock rail and, deeper than 19mm from the running surface.

"Length of damage" applies to the sum of consecutive areas of damage.

Damage deeper than 19mm from the stock rail running surface should be measured with a steel rule and tape measure, refer to the following Figure.

Figure 4-22



The damage is measured from the top of the stop rail. The blade shall be against the stock when the measurement is made.

The wheels flanges are below the track plane for a length. This makes it impossible for wheels to move into short voids. A length of damage can be tolerated due to this action. Successive damage should generally be measured together (from start to finish) unless the damage is adequately separated, and the intervening blade is in good condition such that it is possible to be confident the wheel cannot move into the gap.

When a worn switch at the end of its service life is being replaced a new switch and stock rail set should be used.

Switch blade damage measurement and response is a control to manage the risk of wheel climb and derailment.

Switch blade damage deeper than 19mm from the stock rail running surface and >100mm in length is to be measured and reported.

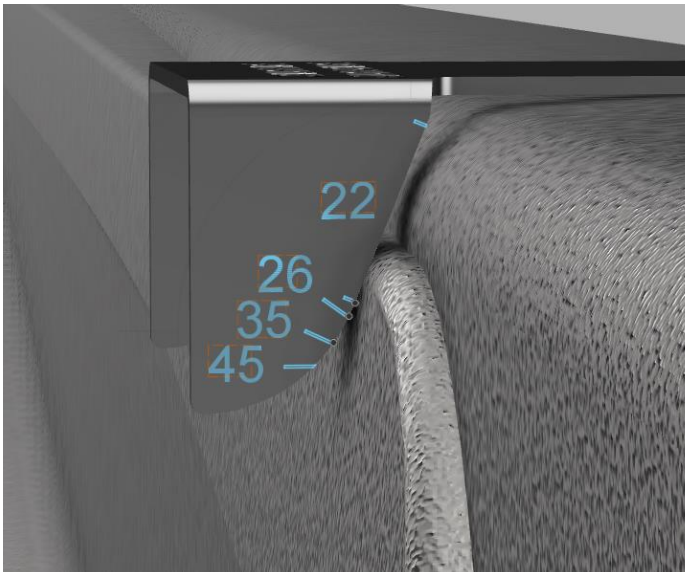
4.13 Stock or switch rail gauge wear face angle

The stock or switch rail gauge face wear angle is the angle of wear imposed on the stock or switch rail due to wheel contact. The angle is measured at the point of wheel flange and rail contact.

The measurement should be taken along the first 2m of the switch blade and any other arears that are suspected of having a poor gauge face angle. The worst measurement shall be recorded. The measurement shall be taken using the ARTC gauge face angle gauge.

Whilst keeping the top of the gauge parallel to the track plane, slide it towards the gauge face until contact is made. The gauge face angle is determined by the contact point.

Figure 4-23 Gauge face angle inspection (showing 22 degree contact)



A sheet of paper is useful in determining the contact point.

Gauge face angle measurement and responses help manage the risk of wheel climb derailment.

4.14 Fixed and pivot heel blocks including bolts

Visual inspection should be made to fixed heel blocks (flexible switches), pivot heel blocks (jointed heel), stress transfer blocks.

Inspection should identify loose, missing, or ineffective bolts as well as damaged, cracked broken or missing blocks.

Ineffective bolts include missing or broken bolts.

Loose bolts should be tightened. Missing or ineffective bolts should be replaced.

Pivot heel blocks generally may be made up of connections which require some bolts to be not fully tightened providing for design switch movement.

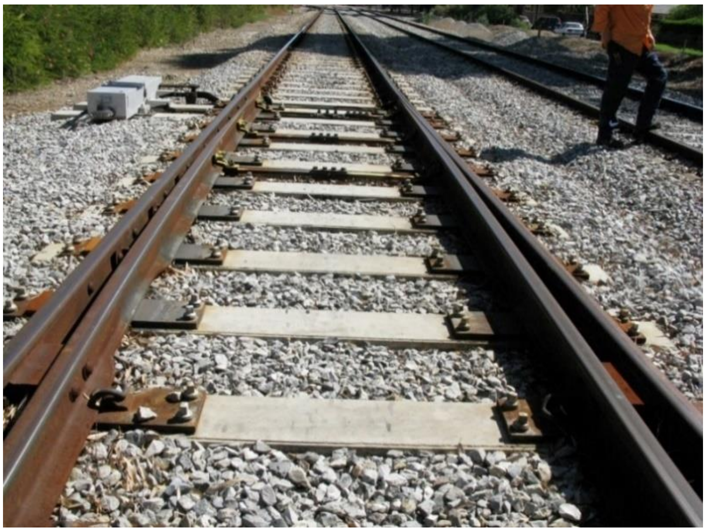
In flexible switches the heel block bolts need to be tight.

Tighten and/or report any loose or ineffective bolts.

Pumping at pivot heels can cause the switch tip to rise creating a derailment risk. See switch support.

Figure 4-24 Pivot Heel Switch

Figure 4-25 Fixed Heel Switch



4.15 Anti creep device including bolts

Visual inspection shall check blocks for damage, cracks and identify if any are missing or loose.

Bolts (including nuts washers hucks etc) shall be checked to see if they are loose, missing, or ineffective.

Ineffective bolts include missing or broken bolts.

Loose bolts should be tightened. Missing or ineffective bolts should be replaced.

Loose fasteners may be evident by uncompressed spring washers or rust bleeding or movement when tapped.

Anti creep devices are provided to allow movement of the blades without causing misalignment of the track. At extremes however they will limit movement to allow the switches to function correctly. A broken, missing or ineffective anti creep device may allow rail to move further than intended. In turn this may cause problems for drive lock and detection equipment.

Broken or damaged anti creep device may indicate an issue with rail creep. Refer to rail creep section.

Figure 4-26 Anti Creep Device

4.16 Rail brace/chair Slide Plates and Rollers

Visual inspection shall check switch braces/ chairs/ slide plates and rollers for damage, cracks and identify if any are missing or loose.

Chair or brace bolts (including nuts washers hucks etc) shall be checked to see if they are loose, missing, or ineffective.

Ineffective bolts include missing or broken bolts.

Loose bolts should be tightened. Missing or ineffective bolts should be replaced.

Rail Braces also referred to as chairs require additional attention to other base plates. As they function as bracket, they are susceptible to cracking, also they have fasteners attaching them to the rail.

Only some designs of switches use rail braces or chairs.

4.17 Switch stops

Visual inspection should identify whether switch stops are present, free of obvious damage, and secure, particularly clusters of 2 or more consecutive.

Switch stops are provided to support the rail laterally. Ineffective or missing switch stops may allow the gauge to spread or the rail to roll, both of which pose derailment hazards.

Switch stop clearance should be visually inspected.

Excess clearance between a switch stop and the switch indicates potential for switch stop damage or rail misalignment. Where there is a gap between the blade and the switch stop, the blade is to be forced back against the switch stops to confirm they are functioning appropriately, and the switch blade is to be checked for excessive bowing.

4.18 Spreader bar

Visual inspection should identify whether spreader bars are present, free of obvious damage, and secure, clearance from underside of rail and their insulation condition.

Spreader bars help maintain openings and holding blade against stock and stops. In some instances, they pass under the rail foot to prevent the blade from lifting.

Spreader bar inspection includes their brackets, fastenings and method of adjustment if provided.

Some spreader bars are insulated. Here wear can cause track circuit detection problems.

4.19 Switch Support

Visually inspect the gap between the switch and its support plates when closed.

Any gaps greater than 1mm at drive points or 2mm elsewhere should be measured and recorded worst value.

Switch blades should be supported on all slide plates.

Score marks may indicate a slide plate/ bearer is high, whereas untouched lubrication may be due to the plate/bearer being low.

Special attention should be given to scenarios that may cause the switch tip to rise when the blade is under load. As an example, pivot heel switch blades supported in the middle and at neither end can rise significantly at the tip when depressed at the heel. The movement not only creates a derailment hazard at the tip but is also likely to make the heels bolts fail.

Many blades are prevented from moving vertically by engagement with sloping faces on the stock rail or by their drive bars having minimal clearance to the stock rail foot. Lack of even switch support can cause drive issues that may cause drive lock and detection problems.

More than 1-1.5mm vertical clearance between the switch and plate at the "A" or "B" bearer can lead to lock and/or detection failures since the switch will move sideways as well as down under load and may not always drive to a consistent position against the stock rail. Uneven bearing on plates through the length of the switch, in particular on the longer switches, leads to high frictional loads, scoring on those few plates on which the switch is bearing, and failure of the switch to lay correctly up to the stock rail. As there will be lateral movement when the switch is under load, detection failures can result.

5 Housed Points

Housed points refer to the use of heavy duty switches and joggled stock rails where a special housing is provided to act as a check rail (refer to Figure 5-1). Where housed points are provided the switch/stock rail aspects are to be inspected as in 4 above. The housing is to be examined in the following manner using a housed points gauge (refer to Figure 5-2), ruler, or appropriate tape measure as required.

Figure 5-1 Standard Housing

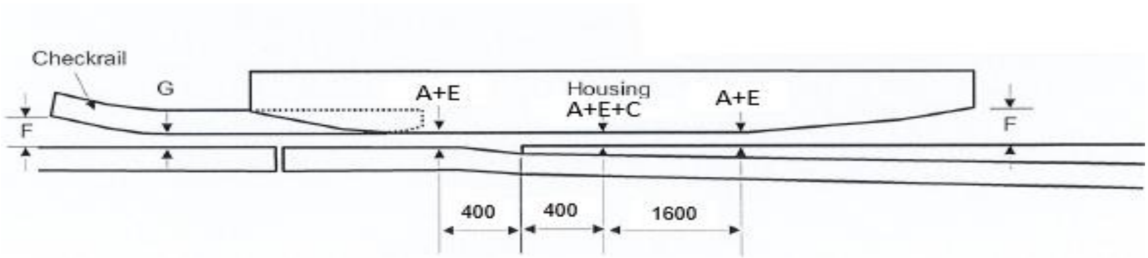
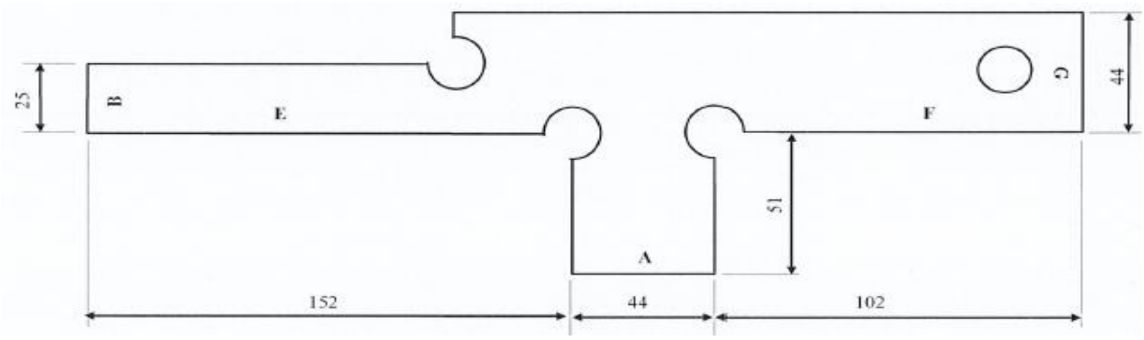
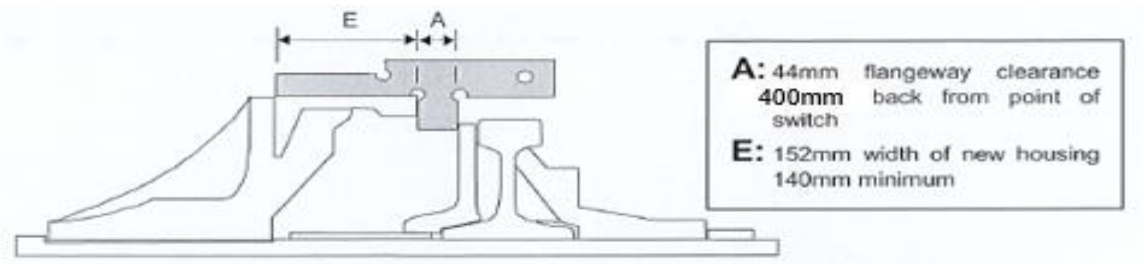


Figure 5-2 Housed Points Gauge



5.1 Housing width and flangeway clearance

Figure 5-3 Check with gauge for housing width and flangeway clearance



Housing width and flangeway clearances must be checked at a point 400mm in front of the nose of the points and at points 400mm and 2m along the switch behind the nose. This check is achieved by positioning the gauge with the long edge marked 'E' across the top of the housing with the lug marked 'A' positioned in the flangeway at each of the check stations with the leading edge of 'A' lug butted hard up against the contact face of the housing, refer Figure 5-3.

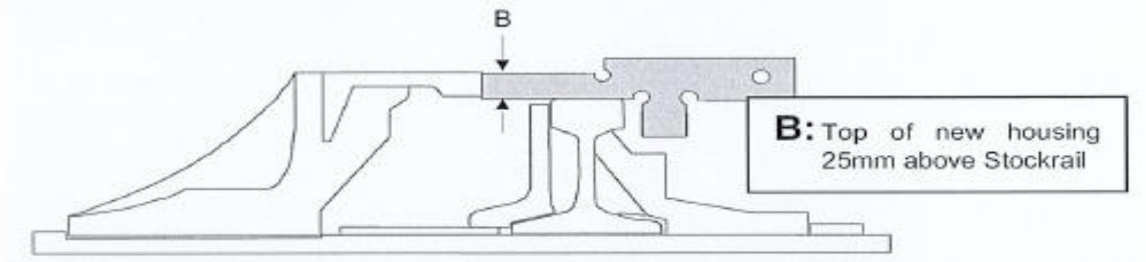
If the 'A' lug will not fit between the switch/stockrail and the contact face of the housing this indicates that the flangeway clearance is narrow and is to be measured and recorded. The width is still to be checked by tilting the gauge whilst maintaining contact between the 'A' lug and contact face, if the 'E' edge of the gauge fails to reach the back edge of the housing then the contact face is to be checked for metal flow, which could be the cause of the narrow flangeway and the housing width measured to ensure it is no wider than the 152mm design width.

If the 'A' lug has more than 2mm gap to the running face of the switch/stockrail this indicates that the flangeway clearance is wide and is to be measured and recorded. If the 'E' edge of the gauge overhangs the back of the housing by more than 2mm the housing width is to be measured and recorded. The serviceable width of the housing is limited by the shimming adjustment available (about 10mm). The housing shall be replaced when width is less than 140mm with priority dependent upon flangeway clearance. The housing shall also be replaced if the width is greater than 156mm and this can't be reduced by grinding off metal flow.

Measured parameters shall be actioned in accordance with the responses detailed in ARTC CoP ETS-03-00 Points and Crossings, Clause 3.4.3.3, Table 3-16 Housed Points Assessment.

5.2 Top of housing above stockrail

Figure 5-4 Check with gauge for height of housing above rail level

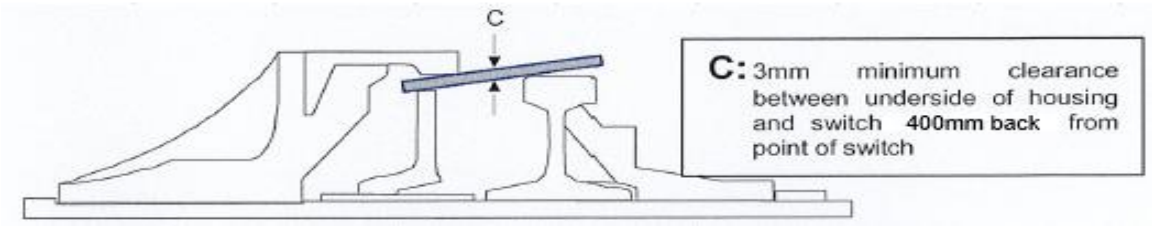


The height of the housing above the stock rail is checked by placing the gauge across the running surface of the stock rail and observing the height of the upper surface of the housing in relation to the gauge (refer to Figure 5-4). If the housing is found to be above the level of the gauge, the actual height of the top of the housing above the top of the switch/stockrail is to be measured and recorded on the inspection form.

The measured height of the housing above the switch/stockrail shall be actioned in accordance with the responses detailed in ARTC CoP ETS-03-00 Points and Crossings, Clause 3.4.3.3, Table 3-16 Housed Points Assessment.

5.3 Vertical clearance between Switch tip and Housing

Figure 5-5 Check with gauge for switch clearance



The 3mm clearance allows free movement of the switch. Speed restrictions will not have any impact on this clearance.

The minimum priority set should be P2. More urgent attention may be required if point operation is affected.

The clearance between the underside of the housing and the top of the switch is to be checked by inserting the gauge turned on its flat side between the housing and the switch (refer to Figure 5-5). The switch must be in the open position when this check is being made. Clearance should be checked at various points along the length of the switch. If the gauge cannot be inserted, the clearance is insufficient, is to be noted on the inspection form and shall be actioned in accordance with the responses detailed in ARTC CoP ETS-03-00 Points and Crossings, Clause 3.4.3.3, Table 3-16 Housed Points Assessment.

5.4 Flare at end of housing and check rail

The impact of the wheels on the flare should be assessed and a priority given based on this. Normally the flare will “wear in” to give minimal impact. Care should be taken when shimming the housing not to create an impact point on the flared ends.

The flare at the leading and trailing ends of the check rail and housing are to be checked. This is done by positioning the end of the housed point gauge marked 'G' against the running face of the approach rail (stock rail) at the check rail end and the switch at the housing end then observing how the edge of the 'A' lug on the long end of the gauge marked 'F' aligns with the contact edge of the flare. If the 'A" lug aligns with or falls short of the flare, there is adequate clearance so no further action is required. If however, the 'A' lug over laps the flared end the flare may be insufficient so the distance from the running face to the contact face of the flare at the end is to be measured and recorded on the inspection form.

Flangeway clearance along the check rail is to be checked by inserting the 'G' end of the gauge between the check rail and adjacent running rail from the end of the taper towards the housing overlap. If the 'G' end will not fit between the two rails this indicates that the flangeway clearance is narrow and is to be measured and recorded. If the 'G' end has more than 2mm gap to the running face of the two rails this indicates that the flangeway clearance is wide and is to be measured and recorded.

Measured parameters shall be actioned in accordance with the responses detailed in ARTC CoP ETS-03-00 Points and Crossings, Clause 3.4.3.3, Table 3-16 Housed Points Assessment.

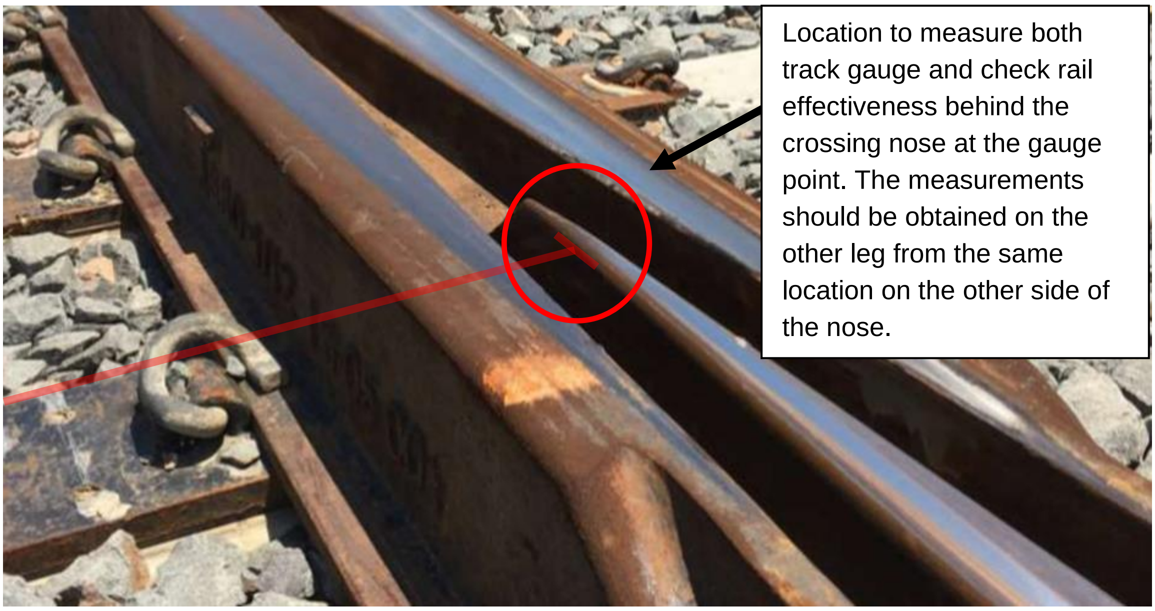
6 Fixed Crossings

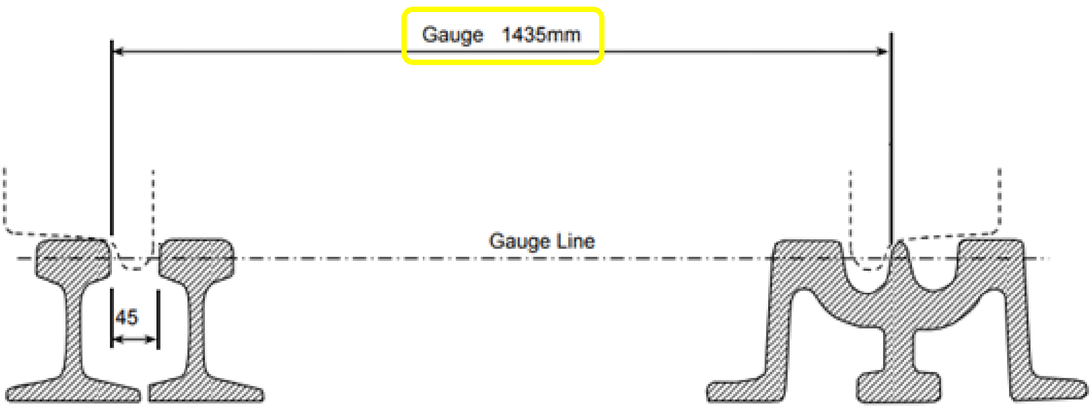
6.1 Track gauge (at the crossing nose)

Track gauge at the crossing nose should be measured behind the crossing nose to the corresponding running rail. It is measure 16mm below the track plane. A track gauge is the preferable tool for measurement. Track gauge at each V crossing is measured twice. In a plain turnout it is measured for the mainline and the turnout road (see service schedules).

Refer to the following Figures.

Figure 6-1





Note: wide gauge at the crossing has potential to foul wheelset back to back dimensions.

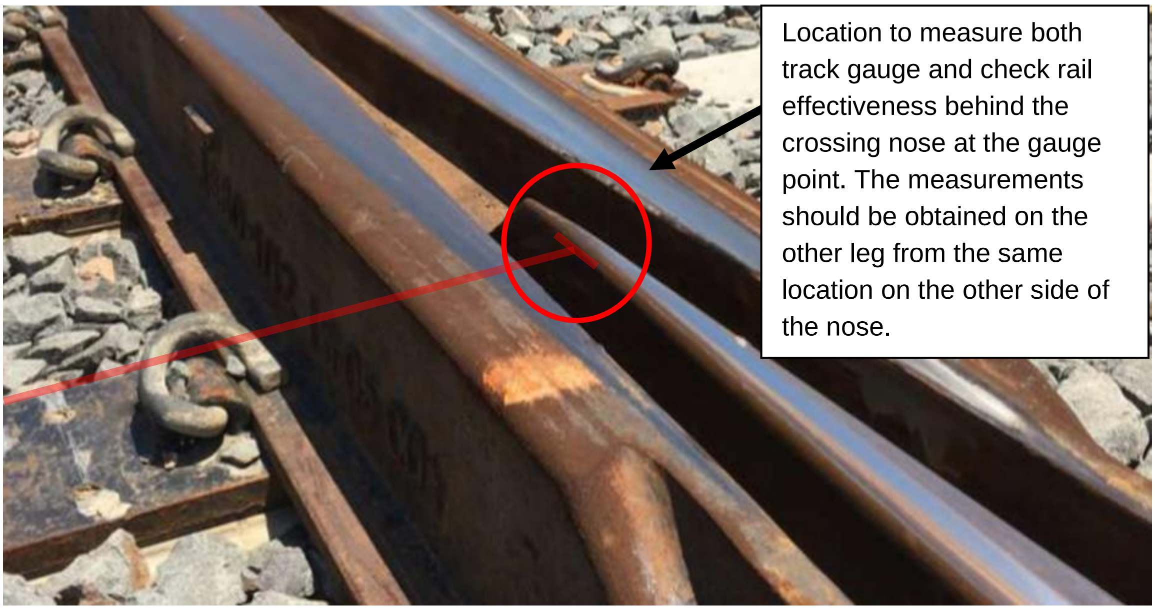
6.2 Check Rail Effectiveness

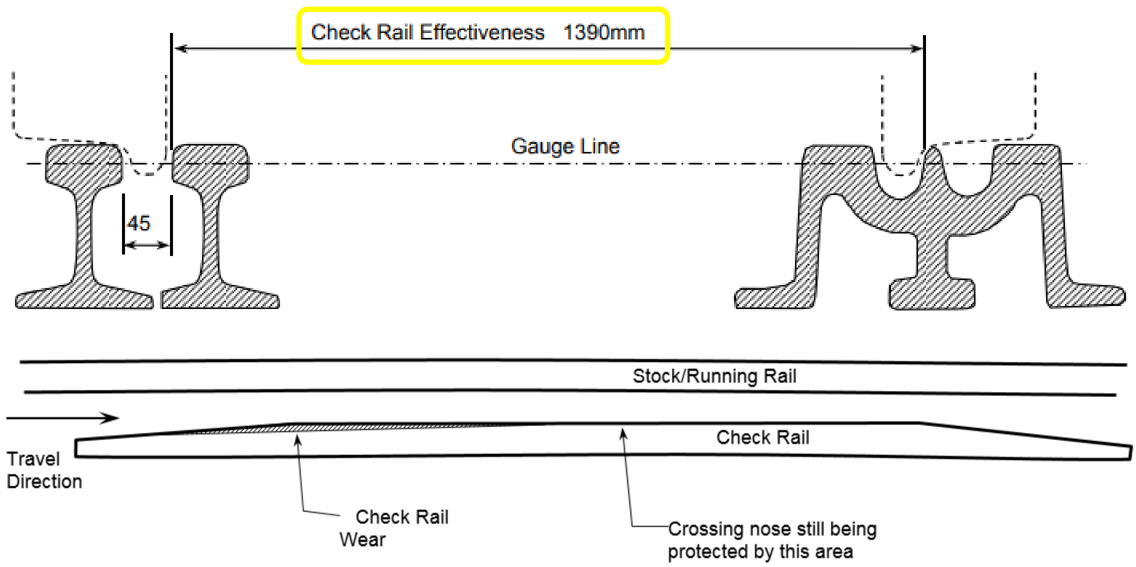
Check rail effectiveness is measured from behind the crossing nose to the checking face of the check rail. It is measured 16mm below the track plane

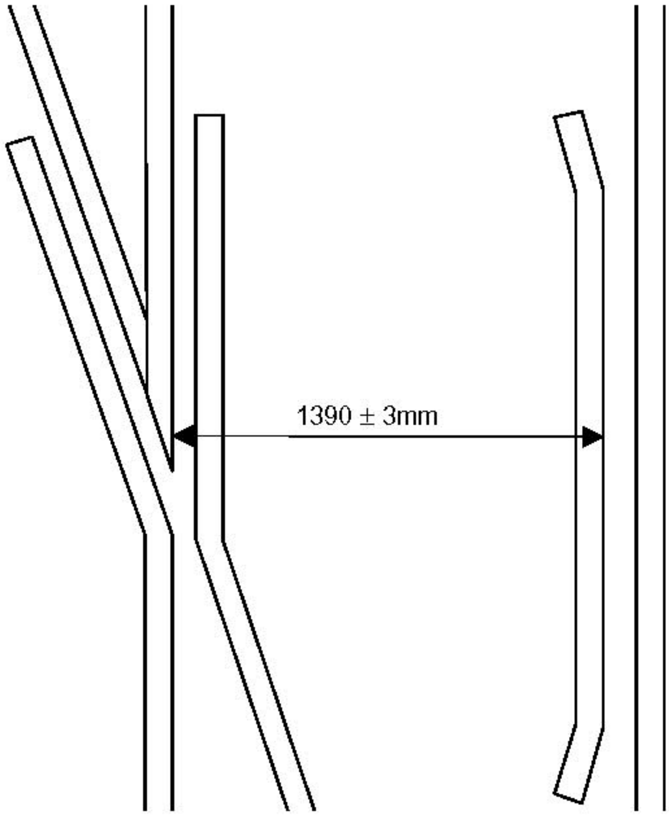
A track gauge is the preferred tool for measurement however an appropriate tape measure may be used if a points and crossing track gauge is not available or is obstructed (such as by raised check rails).

Check rail effectiveness at each V crossing is measured twice. In a plain turnout it is measured for the mainline and the turnout road (see service schedules).

Figure 6-2







The check rail effectiveness measure is a control to prevent wheel flanges from striking the nose. Insufficient effectiveness may lead to wheel flanges striking the nose.

Any wheel flange contact with the crossing nose is a reportable condition and could indicate an out of tolerance check rail effectiveness dimension possibly caused by wear on the check rail or broken check rail bolts.

Visual inspection of the nose should be made for signs of heavy flange contact which may indicate poor check rail effectiveness.

Restoring check rails effectiveness to as new condition can reduce wheel impact as it transfers from the wing to the nose or vice-versa. This may be an appropriate strategy to extend nose life however may result in increased check rail wear.

Excessive check rail effectiveness can cause interference on the wheelset back-to-back dimension (this is uncommon).

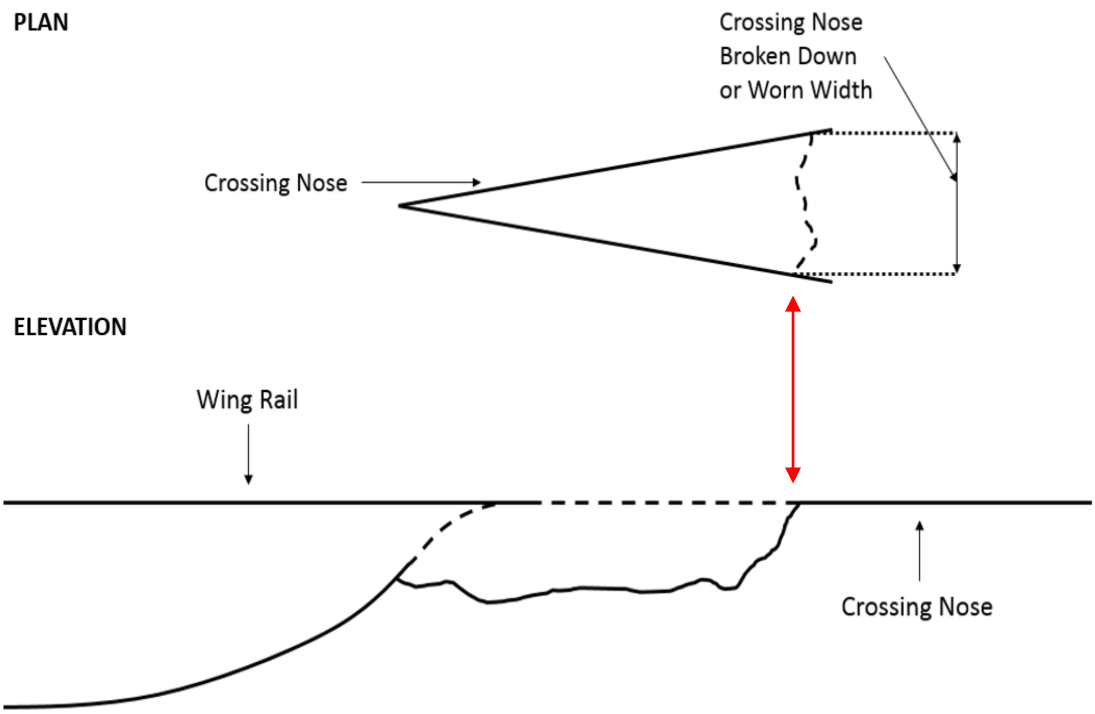
6.3 Crossing nose break width

Crossing nose break width, is the width of fracture of the crossing nose due to wheel impact, it is measured across the width of the fractured section, refer to the following Figure. Crossing nose break width should be measured with a steel rule or callipers.

If the nose of the crossing is broken the width of the break is to be measured and recorded.

If there is no break record 0.

Figure 6-3

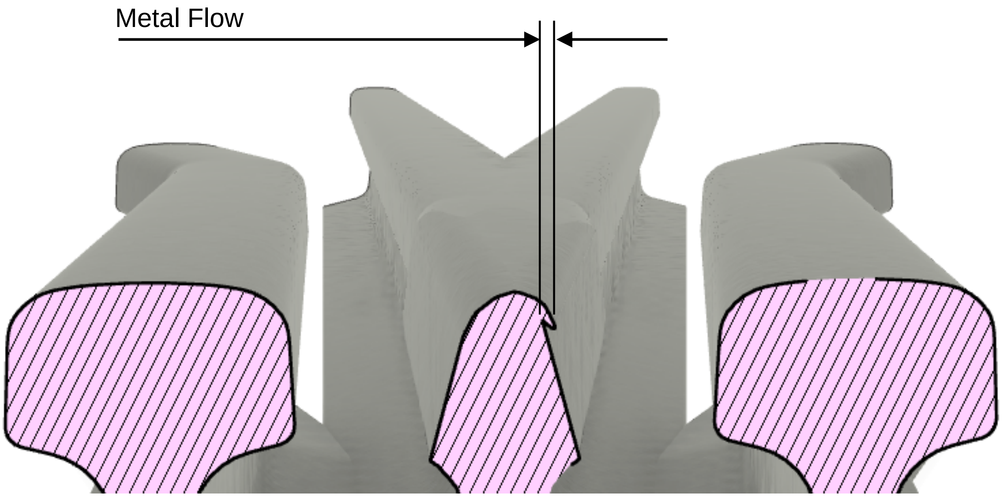


6.4 Crossing nose condition (cracks and breakouts on crossing)

The crossing shall be visually inspected for defects such as RCF or squats, spalling metal flow and batter.

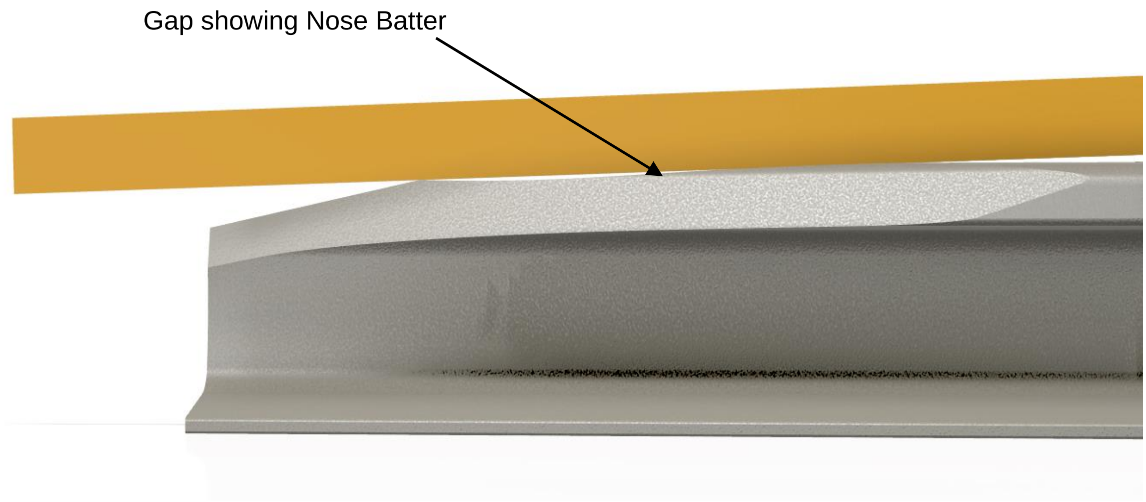
See Figure 14-1 Metal Flow Measurement. A steel rule or callipers may be of assistance.

Figure 6-4



The crossing nose slope can become hollow due to wheel transfer/ batter. It can be measured using a welder's straight edge placed longitudinally along the crossing ramp and using a gap gauge. Alternatively, batter may be estimated. Also refer Figure 6-8.

Figure 6-5 Crossing nose batter



Crossing nose surface condition is to be visual inspected for RCF and or spalling. See Table 14-1 re classification of RCF, spalling and shelling.

Crossings, particularly the castings shall be visually inspected for cracks.

Cracks in cast crossings are classed as follows:

"Cracked: non critical" means cracks longitudinally or vertically that may eventually cause a crossing to need repair.

"Cracked: critical" means cracks longitudinally or vertically that may lead to a piece of crossing eventually lifting or breaking out and affecting the running surface integrity.

"Cracked: fully" (not affecting the running surface)" means a crack that runs the full section of the crossing such that the crossing is in two pieces, all fastenings are secure and does not impact on the running surface.

"Cracked: fully (affecting the running surface)" means a crack that runs the full section of the crossing such that the crossing is in two pieces and fastening are not secure or the break affects running surface integrity.

Crossing nose condition controls are targeted to support reliable ongoing life of the crossing. Maintaining the crossing in an improved condition will extend its useful life.

6.5 Crossing flangeway

Flangeways should be visually inspected for blockages and cleared where blocked.

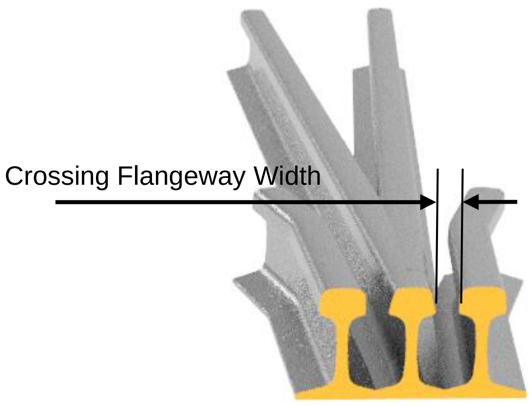
Any evidence of flange tip running on steelwork requires further investigation to determine cause.

Each V crossing has two flangeways. All crossing flangeways are to be inspected.

Crossing flangeway width is not normally measured during general or detailed inspection. If a defect is suspected, it should be measured with callipers though it may be measured with a tape or steel rule. It is the distance between the crossing nose and the wing rail 16mm below the track plane.

Spring wing crossings shall be jacked open per manufacturer's instructions to facilitate measurement.

Figure 6-6 Measuring Flangeway Width



6.6 Crossing spacer blocks and bolts

Visual inspection shall check crossing blocks for damage, cracks and identify if any are missing or loose.

Crossing bolts (including nuts washers hucks etc) shall be checked to see if they are loose, missing, or ineffective.

Ineffective bolts include missing or broken bolts.

Loose bolts should be tightened. Missing or ineffective bolts should be replaced.

Loose fasteners may be evident by uncompressed spring washers or rust bleeding or movement when tapped.

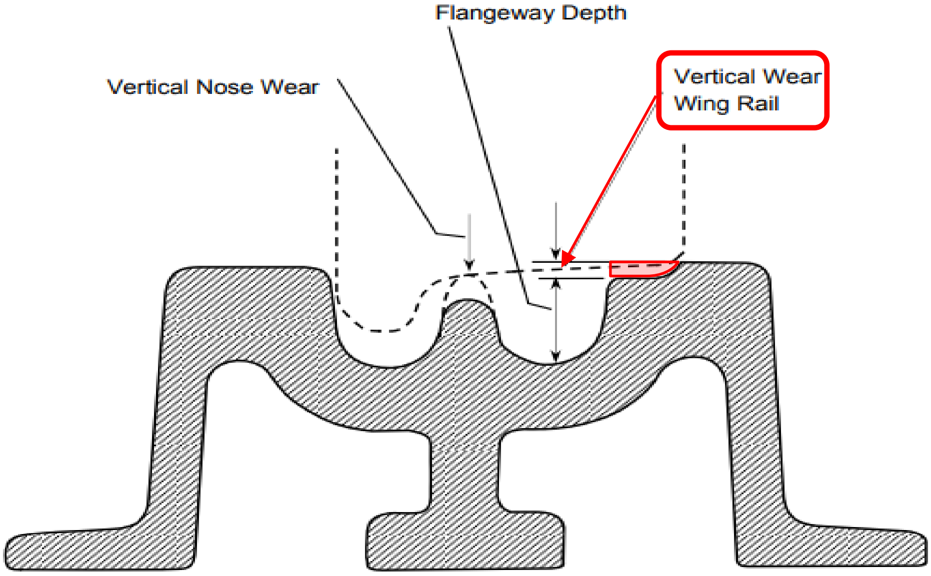
Loose fasteners are often the result of wheel impact. Maintaining crossing in good condition may reduce occurrence of loose or failed fasteners.

6.7 Wing rail vertical wear

Wing rail vertical wear is the wear on the wing rail from wheel tread contact. Typically this is measured using callipers or steel rule whilst a straight edge is positioned across the worn section from the unworn wing. The largest wear is to be recorded and actioned in accordance with the responses detailed in ARTC CoP ETS-03-00 Points and Crossings, Clause 3.4.3.4, Table 3-17 Fixed Crossing Assessment.

On a K crossing the field side of the wheel is supported by the knuckle at the transfer point, rather than the wing as is the case with a V crossing. On a K crossing vertical knuckle wear is measured in place of vertical wing wear. See figures below.

Figure 6-7 Wing rail vertical wear



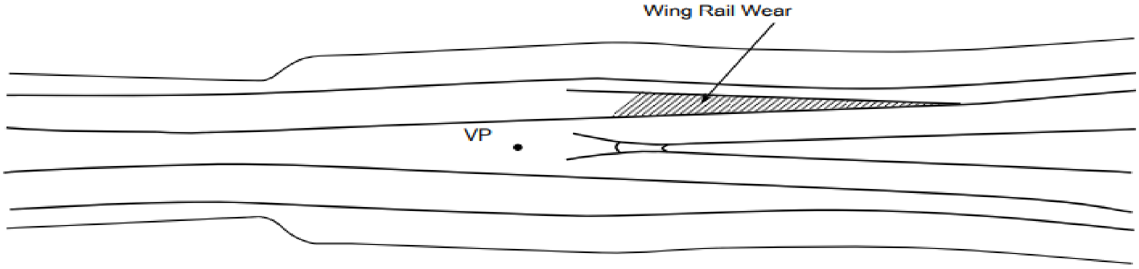
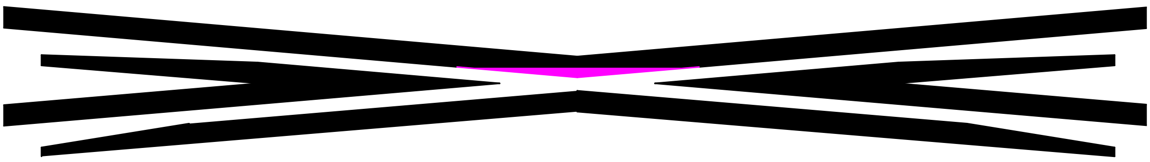
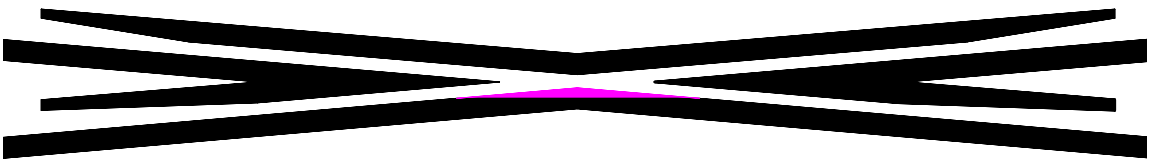


Figure 6-8 Damage to wing rail from wheel transfer

Figure 6-9 K crossings at a diamond with knuckles highlighted in magenta.





6.8 Wing Rail Condition (metal flow, cracks and breakouts on wing rail)

The wing shall be visually inspected for defects such as RCF or squats, spalling and metal flow.

See Figure 14-1 Metal Flow Measurement. A steel rule or callipers may be of assistance.

Wing Rail surface condition is to be visual inspected for RCF and or spalling. See Table 14-1 re classification of RCF, spalling and shelling.

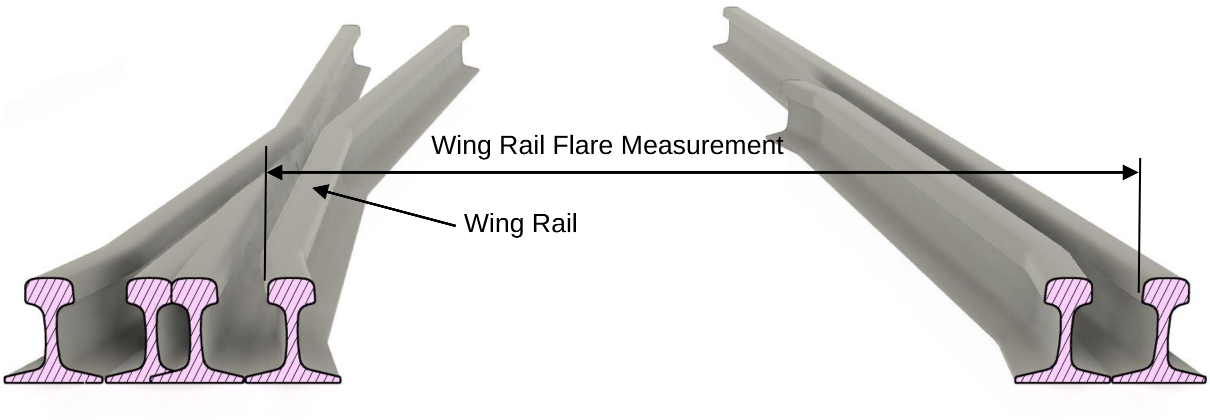
Wing rail condition controls are targeted to support reliable ongoing life of the crossing. Maintaining the crossing in an improved condition will extends its useful life.

6.9 Wing Rail Flare

Wing rail flare is measured at the end of the wing opening. It is the distance from the opposite rail to the wing rail 16mm below the track plane. Each crossing has two wing rails.

Wing rail flare measurement controls the risk of back of flanges striking the wing for trailing movements. Visual observation should identify the distance of back of flange contact to the end of the wing. Contact marks indicate the proximity of back of wheel flanges to the end of the wing.

Figure 6-10 Wing rail flare measurement



6.10 Check rail flangeway

Flangeways should be visually inspected for blockages and cleared where blocked.

Any evidence of flange tip running on steelwork requires further investigation to determine cause.

Check rail flangeway may be derived from deducting check rail effectiveness from gauge or measured directly.

If measured directly. Check rail flangeway width should be measured with callipers though it may be measured with a tape or steel rule. Check rail flangeway width should be measured between running face of the check rail carrier and contact face of check rail along the checkrail at the point where the track gauge and check rail effectiveness were measured. Refer to following figures.

Figure 6-11

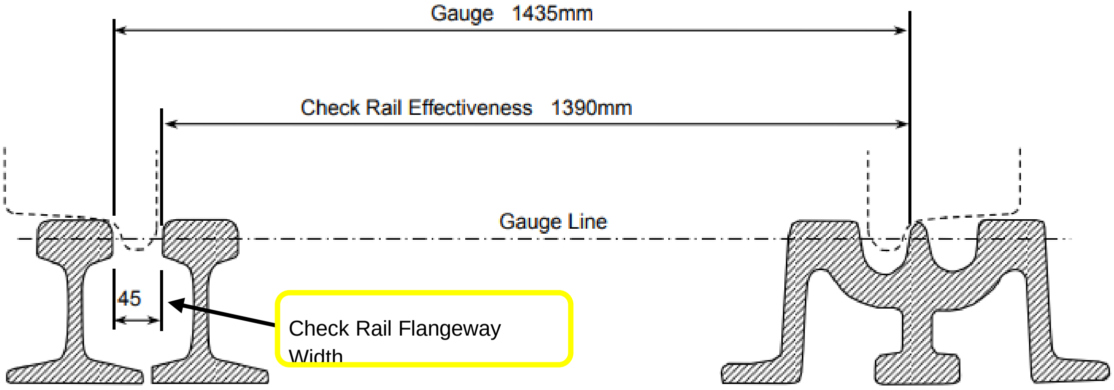


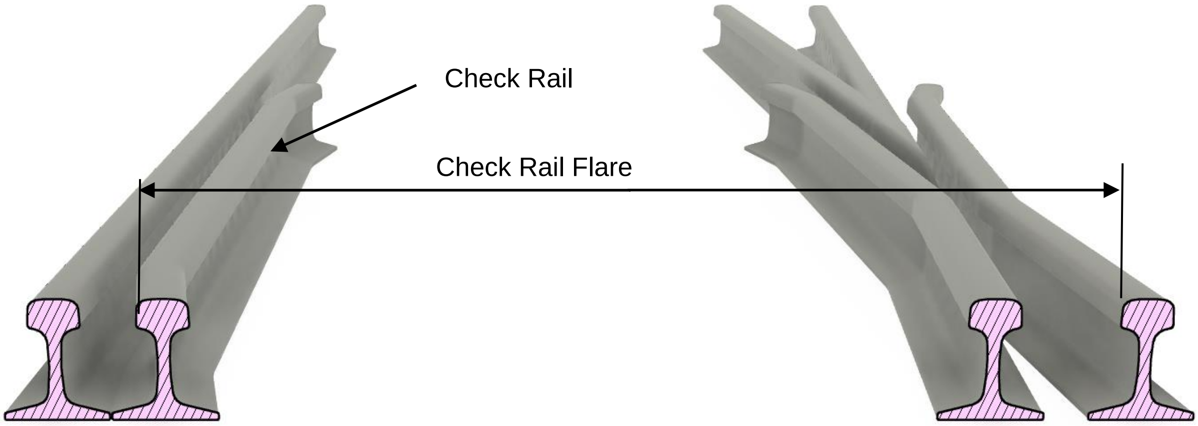
Figure 6-12 Measuring check rail flangeway width

6.11 Check rail flare

Check rail flare is measured at the end of the check and is the distance from the check to the opposite running rail 16mm below the track plane. It is preferably measure with a track gauge capable of the measurement but may be measured with an appropriate tape. Each check rail has two flares.

Check rail flare dimension controls the risk of back of flanges striking the check rail. Visual observation should identify the distance of back of flange contact to the end of the check rail. Contact indicates the proximity of back of wheel flanges to the end of the check rail.

Figure 6-13 Check rail flare measurement



6.12 Check rail spacer blocks and bolts

Visual inspection shall check blocks for damage, cracks and identify if any are missing or loose.

Check rail bolts (including nuts washers hucks etc) shall be checked to see if they are loose, missing, or ineffective.

Ineffective bolts include missing or broken bolts.

Loose bolts should be tightened. Missing or ineffective bolts should be replaced.

Loose fasteners may be evident by uncompressed spring washers or rust bleeding or movement when tapped.

7 Swing Nose Crossings

Swing nose crossing in many aspects are more similar to switches than fixed nose crossings. The procedures within this section shall be used at swing nose crossing instead of those for fixed nose crossings.

Spring wing crossings shall generally be assessed as fixed nose crossing.

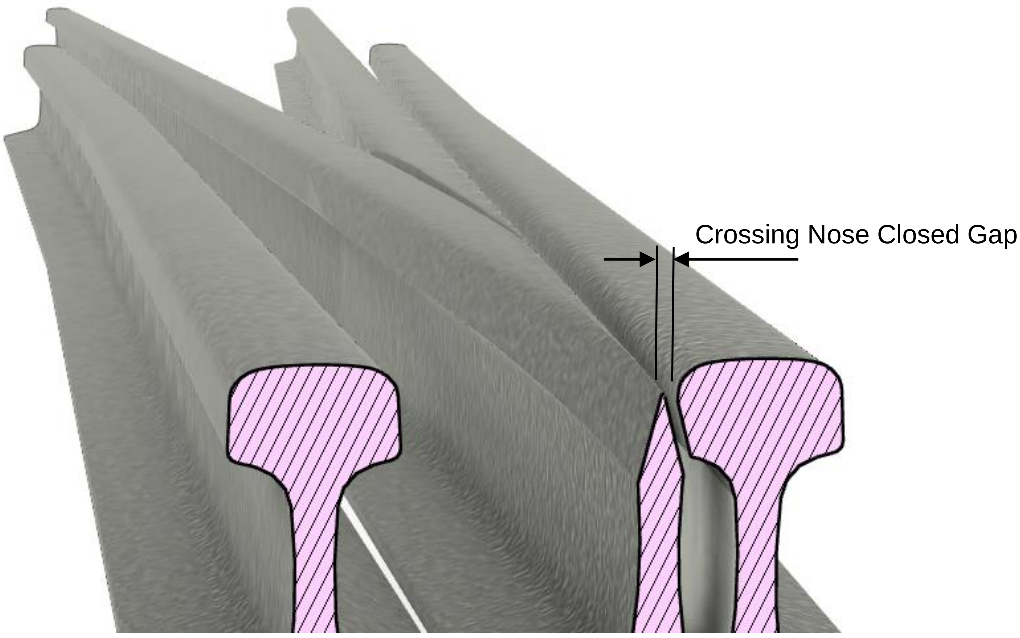
7.1 Crossing Nose Closed Gap

The crossing nose closed gap should be measured between the crossing nose tip and the wing rail. The measurement is made when the nose is closed against either wing. As a swing nose crossing has two wings, the nose should be swung, and the measurement repeated.

This measurement should be taken using a steel rule, refer to the following Figure.

The limit helps control the hazards of wheel strike to the crossing nose and transfer of excessive forces to the drive locking and detection equipment.

Figure 7-1 Crossing nose closed gap



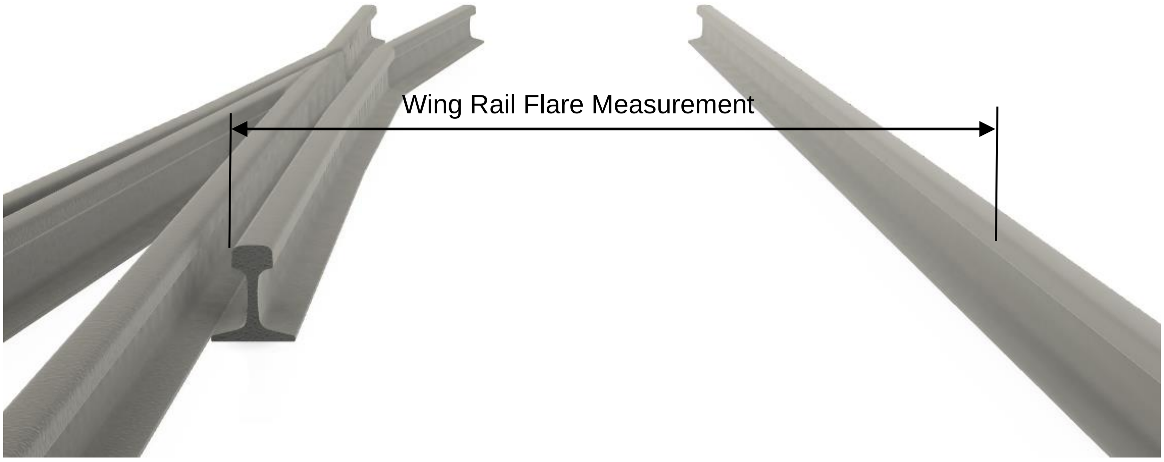
Where the wing is side worn below the height of the nose the top edge of blade becomes further exposed to the wheel that may cause a derailment hazard. Additionally, the blade can become vulnerable to being bent or broken which may also create a derailment hazard.

Where large gaps are present swing noses should be inspected for damage, such as bends from run through.

7.2 Wing Rail Flare

Wing rail flare is measured at the end of the wing and is the distance from the running rail to the wing 16mm below the track plane (refer Figure 7-2). Each crossing has two wing rails.

Figure 7-2 Wing rail flare measurement



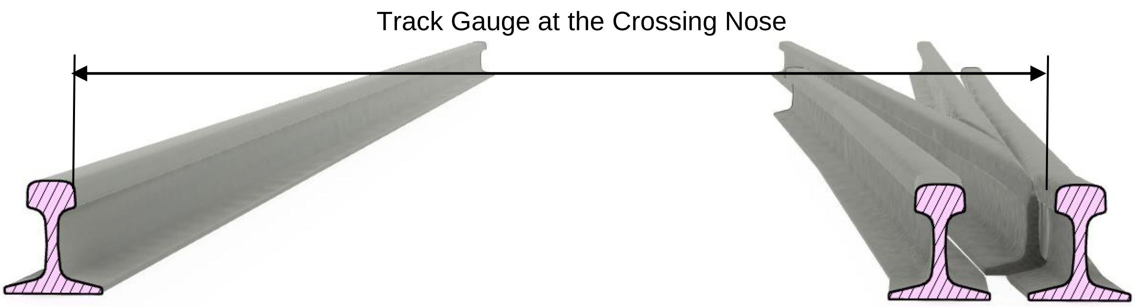
Wing rail flare dimension controls the risk of back of flanges striking the wing for trailing movements. Visual observation should identify the distance of back of flange contact to the end of the wing. Contact indicates the proximity of back of wheel flanges to the end of the wing.

7.3 Track Gauge at the Crossing Nose

Gauge should be measured using a track measuring gauge.

The gauge should be taken between the two running rails in front of the crossing nose and immediately ahead of the bend in the wing.

Figure 7-3 Track gauge at crossing nose



Each swing nose crossing requires two gauge measurements.

Track gauge at the crossing nose helps control the risk of wheel climb in the instance of tight gauge.

Gauge variation from design is likely to impact drive lock and detection equipment performance. This should be considered in prioritising repair irrespective of speed restriction.

On timber bearers wide gauge or an increase in gauge over time may indicate a deterioration of bearers.

7.4 Crossing nose and wing condition (metal flow, cracks and breakouts on crossing and wing)

The nose and wing shall be visually inspected for defects such as RCF or squats, spalling metal flow and batter.

Check for wear and metal flow on the wing and nose, particularly any "lipping" that may prevent the nose closing completely. See Figure 14-1 Metal Flow Measurement. A steel rule or callipers may be of assistance.

Metal flow >1mm that may obstruct operation should be removed immediately.

Crossing nose surface condition is to be visual inspected for RCF and or spalling. See Table 14-1 Surface Condition Classification for RCF, spalling and shelling.

If the crossing uses cast wing rails the castings shall be visually inspected for cracks.

Cracks in castings are classed as follows:

"Cracked: non critical" means cracks longitudinally or vertically that may eventually cause a crossing to need repair.

"Cracked: critical" means cracks longitudinally or vertically that may lead to a piece of crossing eventually lifting or breaking out and affecting the running surface integrity.

"Cracked: fully" (not affecting the running surface)" means a crack that runs the full section of the crossing such that the crossing is in two pieces, all fastenings are secure and does not impact on the running surface.

"Cracked: fully (affecting the running surface)" means a crack that runs the full section of the crossing such that the crossing is in two pieces and fastening are not secure or the break affects running surface integrity.

7.5 Nose Alignment

A bent crossing nose refers to a nose that has suffered damage from a run through or derailment. Such noses may be suitable for temporary repair and re-installation to a geometry suitable for train movements at a reduced speed. The swing nose may have been, bent, twisted or have suffered wheel damage. It should be repaired to a condition suitable for the reduced speed of operation both in terms of geometry and structural integrity. The reduced speed of operation should not exceed 40km/h.

7.6 Swing Nose Protrusion

For general inspections the swing nose blade should be examined for damage or contact near the tip that indicates a striking risk. For detailed inspection the protrusion of the swing nose shall be measured as shown in the following figure.

Figure 7-4 Checking protrusion of swing nose crossing

This control helps manage the hazard of wheels striking and or climbing nose tips on facing movements as well as prevention of nose damage.

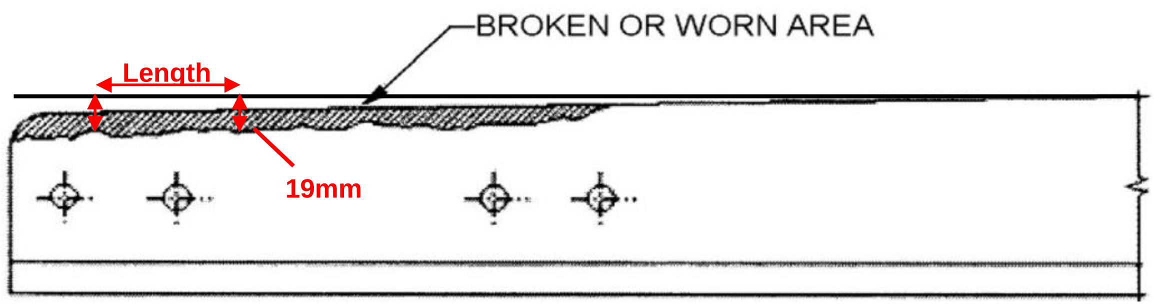
7.7 Swing nose point rail damage

Swing nose point rail damage is classified as anywhere along the swing nose point rail where it is intended to fit up to a wing rail, and deeper than 19mm from the wing rail running surface.

“Length of damage” applies to the sum of consecutive areas of damage.

Damage deeper than 19mm from the wing rail running surface should be measured with a steel rule and tape measure, refer to the following Figure.

Figure 7-5



Swing nose point rail damage measurement and response is a control to manage the risk of wheel climb and derailment.

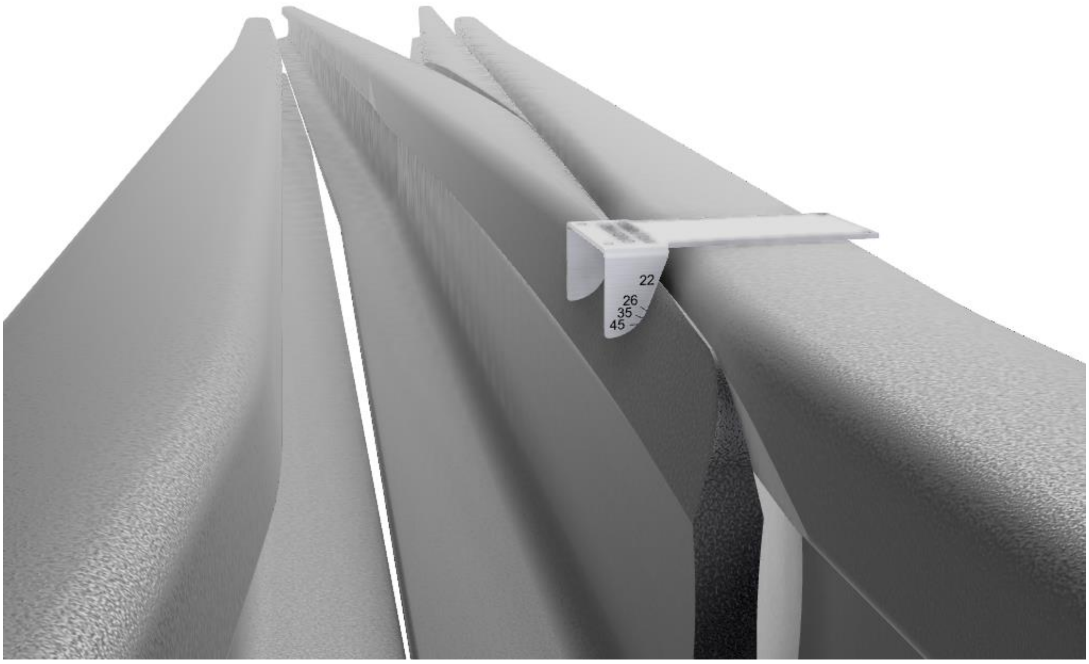
7.8 Point or wing rail gauge face wear angle

Point or wing rail gauge face wear angle is the angle of wear imposed on the wing or point rail due to wheel contact. The angle is measured at the point of wheel flange and rail contact.

The measurement should be taken along the first 2m of the switch blade and any other areas that are suspected of having a poor gauge face angle. The worst measurement shall be recorded. The measurement shall be taken using the ARTC gauge face angle gauge.

Whilst keeping the top of the gauge parallel to the track plane, slide it towards the gauge face until contact is made. The gauge face angle is determined by the contact point.

Figure 7-6 Measuring gauge face angle at crossing nose



A sheet of paper is useful in determining the contact point.

Gauge face angle measurement and responses help manage the risk of wheel climb derailment.

7.9 Heel blocks including bolts

Visual inspection shall check crossing blocks for damage, cracks and identify if any are missing or loose.

Crossing bolts (including nuts washers hucks etc) shall be checked to see if they are loose, missing, or ineffective.

Ineffective bolts include missing or broken bolts.

Loose bolts should be tightened. Missing or ineffective bolts should be replaced.

Loose fasteners may be evident by uncompressed spring washers or rust bleeding or movement when tapped.

7.10 Anti creep devices including bolts

Visual inspection shall check blocks for damage, cracks and identify if any are missing or loose.

Bolts (including nuts washers hucks etc) shall be checked to see if they are loose, missing, or ineffective.

Ineffective bolts include missing or broken bolts.

Loose bolts should be tightened. Missing or ineffective bolts should be replaced.

Loose fasteners may be evident by uncompressed spring washers or rust bleeding or movement when tapped.

Anti creep devices are provided to allow movement of the blades without causing misalignment of the track. At extremes however they will limit movement to allow the swing noses to function correctly. A broken, missing or ineffective anti creep device may allow rail to move further than intended. In turn this may cause problems for drive lock and detection equipment.

Broken or damaged anti creep device may indicate an issue with rail creep. Refer to rail creep section.

7.11 Crossing spacer blocks and bolts

Visual inspection shall check crossing blocks for damage, cracks and identify if any are missing or loose.

Crossing bolts (including nuts washers hucks etc) shall be checked to see if they are loose, missing, or ineffective.

Ineffective bolts include missing or broken bolts.

Loose bolts should be tightened. Missing or ineffective bolts should be replaced.

Loose fasteners may be evident by uncompressed spring washers or rust bleeding or movement when tapped.

Loose fasteners are often the result of wheel impact. Maintaining crossing in good condition may reduce occurrence of loose or failed fasteners.

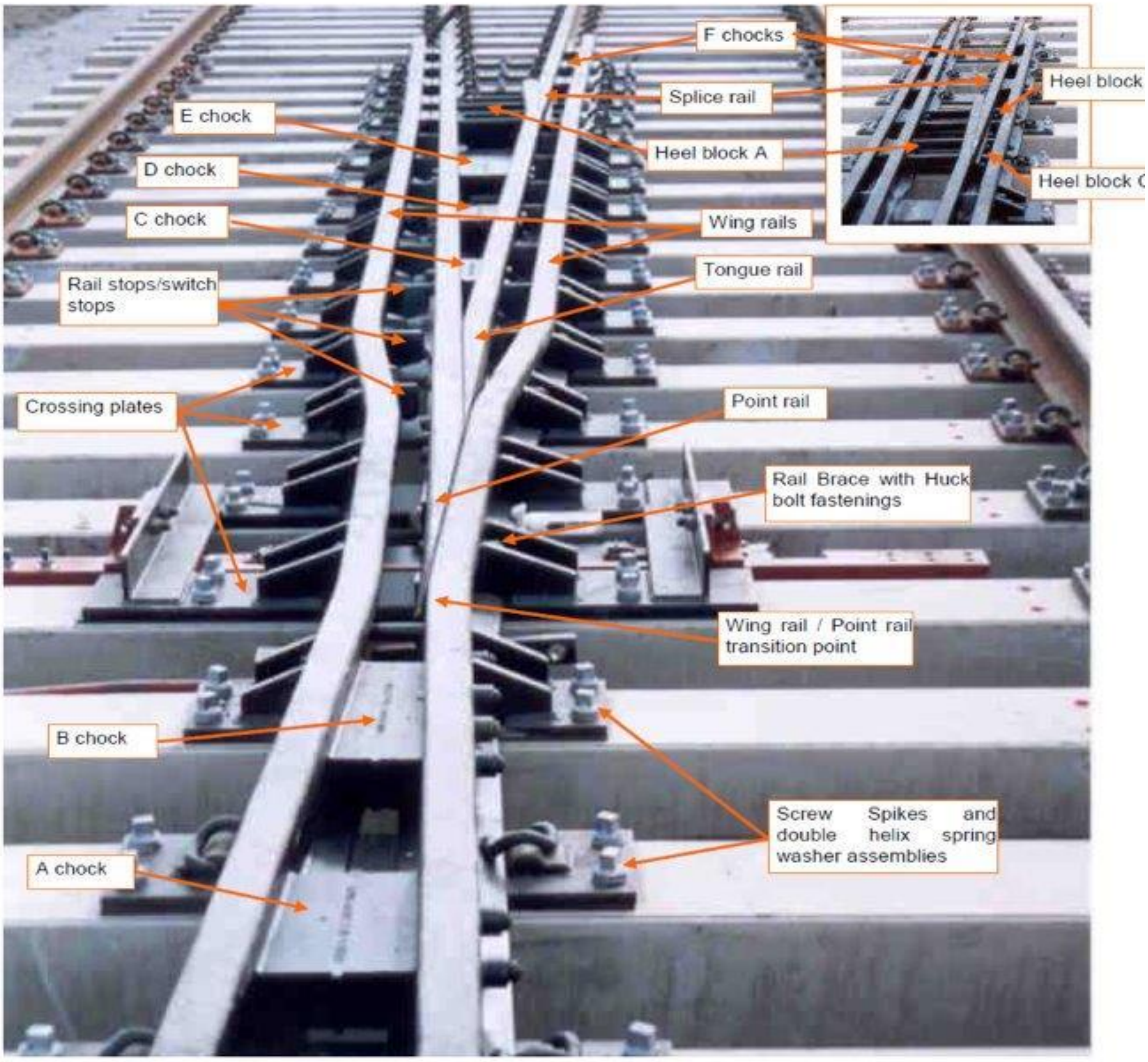
7.12 Splice Joint

Swing nose crossing have a sliding joint to allow the nose to move. This joint is referred to the splice joint, following the convention from fabricated crossings. Designs have evolved and, in some instances, the sliding splice has been relocated away from the nose by introducing a tongue rail. Both arrangements are depicted below.

The purpose of this task is to inspect the sliding joint that is designed to allow movement.

Figure 7-7 Swing Nose Crossing without Tongue Rail

Figure 7-8 Swing Nose Crossing with Tounge Rail



The splice rail must be held against point or tongue rail whilst also permitting sliding motion.

In a point and splice arrangement this is typically achieved with preloaded fasteners supplemented with a safety clamp. **These components are critical and shall be inspected with attention paid ensuring proper preload of spring washers (including conical). Missing or ineffective fasteners in such joints shall be subject to a maximum 10 kph TSR or appropriate route booked out of service.** Note: the splice joint is normally on the non-dominant route.

In a tongue and splice arrangement switch stops and chairs/ braces may be used. Refer 7.13 Rail brace/chair slide plates and rollers.

Excessive creep movements can expose the point of the splice rail to wheel flanges.

To examine the points rail's exposure to the wheel flanges of facing movements it is necessary to have crossing swung to the corresponding route (normally the divergent route). A straight edge shall be held against the gauge face of the adjacent rail to ascertain if the relative position of the point. Projection of the splice rail is measured in a similar manner to that of the swing nose (see 7.6 Swing Nose Protrusion).

Any projection of a splice's point beyond the running surface of the rail to which it is affixed shall be measured.

Splice joint surface condition is to be visual inspected for RCF and or spalling. See Table 14-1 Surface Condition Classification for RCF, spalling and shelling.

Any suspect defect of the splice rail should be assessed in the same way as for the swing nose point rail.

7.13 Rail brace/chair slide plates and rollers

Visual inspection shall check swing nose braces/ chairs/ slide plates and rollers for damage, cracks and identify if any are missing or loose.

Chair or brace bolts (including nuts washers hucks etc) shall be checked to see if they are loose, missing, or ineffective.

Ineffective bolts include missing or broken bolts.

Loose bolts should be tightened. Missing or ineffective bolts should be replaced.

Rail Braces also referred to as chairs require additional attention to other base plates. As they function as bracket, they are susceptible to cracking, also they have fasteners attaching them to the rail.

Some designs of swing nose crossing use a frame around the crossing (see Figure 7-7). Cracks found in the assembly should be assessed as if were individual chairs.

Arrangements making use of a tongue rail (see 7.12 Splice Joint) may have slide plates and chairs at the splice joint.

7.14 Swing Nose Stops

The condition of the bearing stops is to be observed and any cracked or broken/ineffective noted, particularly clusters of 2 or more consecutive.

Visual inspection should identify whether stops are present, free of obvious damage, and secure.

Swing nose crossings use switch stops to support the moving point and tongue/splice rail. All shall be inspected. The swing nose will need to be thrown so that stops on each side may be inspected.

Switch stops are provided to support the rail laterally. Ineffective or missing switch stops may allow the gauge to spread or the rail to roll, both of which pose derailment hazards.

Switch stop clearance should be visually inspected.

Excess clearance between a switch stop and the rail with which it is intended to fit (i.e. point splice or tongue) indicates potential for switch stop damage or rail misalignment. Where there is a gap between the blade and the switch stop, the later should be regarded as ineffective.

Arrangements making use of a tongue rail (see 7.12 Splice Joint) may have switch stops and at the splice joint.

7.15 Swing nose support

Visually inspect the gap between the moving swing nose and its support plates when closed.

Any gaps greater than 1mm at drive points or 2mm elsewhere should be measured and recorded worst value.

Swing noses should be supported on all slide plates.

Score marks may indicate a slide plate/ bearer is high, whereas untouched lubrication may be due to the plate/bearer being low.

Special attention should be given to scenarios that may cause the nose to rise when the blade is under load. The movement not only creates a derailment hazard but causes fasteners to come loose.

Swing nose rails may be prevented from moving vertically by engagement with sloping faces on the wing rail or by their drive bars having minimal clearance to the stock rail foot. Lack of even support can cause drive issues that may cause drive lock and detection problems.

More than 1-1.5mm vertical clearance between the nose and slide plates at the first two bearers supporting the nose can lead to lock and/or detection failures since the swing nose will move sideways as well as down under load and may not always drive to a consistent position against the stock rail. Uneven bearing on plates through the length of the swing nose, leads to high frictional loads, scoring on those few plates on which the swing nose rails are bearing, and failure of the swing nose to fit up correctly to the wing. As there will be lateral movement when the swing nose is under load, detection failures can result.

8 Switch Operation

On manually controlled points (Thornley levers, ball levers, throw-over levers), the tension of the switch operating lever should be checked by inserting a 400mm bar between the stock rail and switch at a point just beyond separation of the switch and stock rail. The bar should be levered against the switch in an attempt to prise it open. The control lever should produce enough tension to make it difficult to open the switch. If the switch opens easily there will be insufficient tension available to keep the switch closed under traffic. If this is the case, the condition must be noted on the inspection form and the appropriate action taken immediately. Both switch blades must be tested in this manner.

Figure 8-1 Checking tension at manually controlled points

9 Catchpoints

The aspects of the switch and stock rail which are to be measured and recorded during detailed inspection are the same as those detailed in Section 4. Overview Inspection tasks are the same as those detailed in Section 3 through the length of the catchpoint assembly. Also the condition and security of the throw-off rail, derail/jump block and the landing area are to be checked and reported.

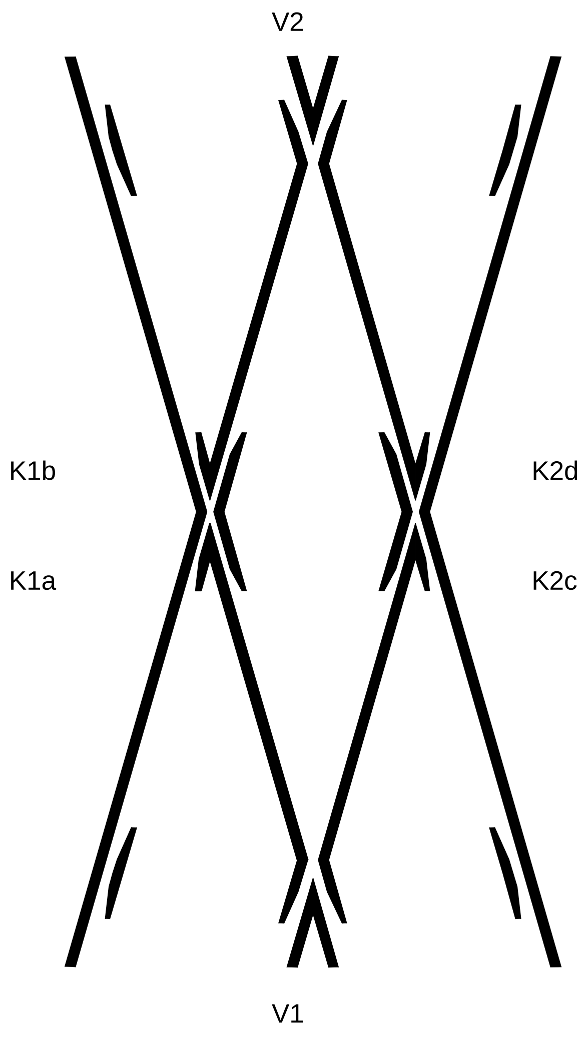
10 Diamonds

Diamonds are an assembly of four fixed crossings and are to be measured and recorded during detailed inspection as those in Section 4. Overview Inspection tasks are the same as those detailed in Section 3 through the diamond.

Naming of components in diamonds is based on viewing the assembly from the end with the lowest kilometrage facing in the direction of ascending kilometrage. The nearer V crossing is named V1 and the furthest V2. The K crossing to the Left is K1 with K1a representing the closest nose and K1b being the further nose. The crossing to the Right is K2 with K2c representing the closest nose and K2d being the further nose.

The two track paths are designated Main Line and Secondary Line with the Main being that on the Right when facing from V1 to V2 and the Secondary on the left. This distinction is critical for distinguishing which path the Gauge and Check Rail Effectiveness measurements relate to at the V crossings as well as the closure rails throughout the assembly, these being Main/Secondary Left or Right when facing V1 to V2.

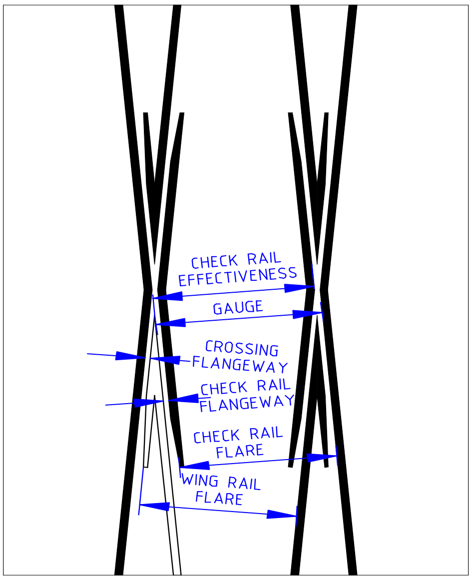
Figure 10-1 Diamond



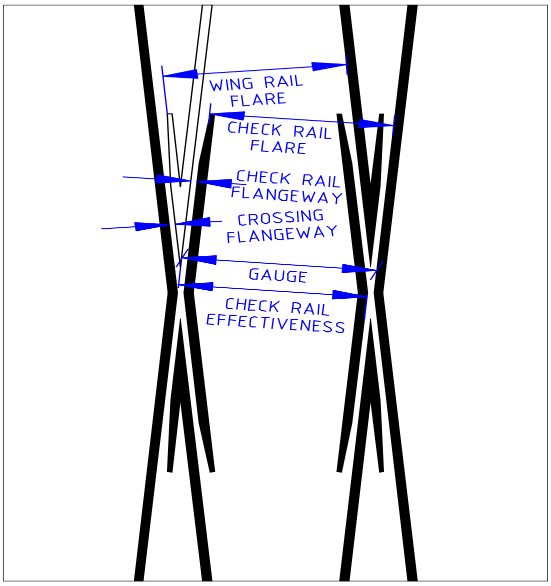
For diamonds, where there is poor alignment, it may be necessary to measure all side and diagonal dimensions for comparison to design. 'K' Crossings have running and checking surfaces. Special attention is needed to check the alignment of the V assembly checking face and checking wing rail face with a stringline or straightedge where alignment is poor.

When carrying out the inspection of field assembled insulated rail joints in the fully checked area of a diamond crossover it is necessary to ensure that the chock between the rails has not worn through the end post. Where there is external evidence of wear, such as squeezed end post, worn or bent bolts, loose plates or loose bolts the joint should be pulled apart to check the condition of the end post.

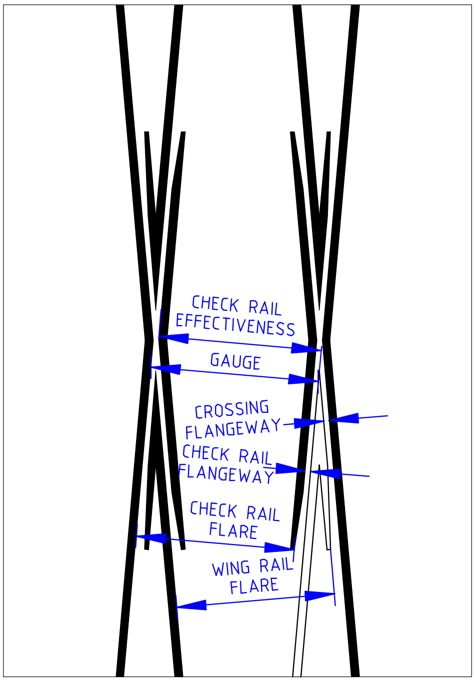
Figure 10-2



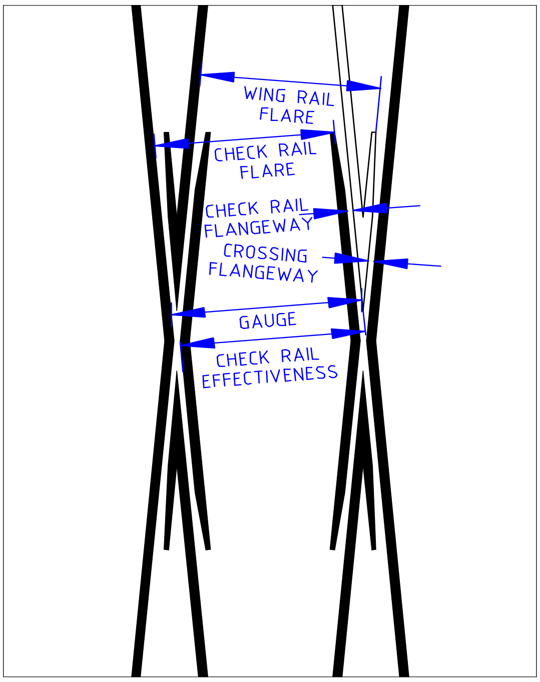
K1a



K1b



K2c



K2d

11 Dual Gauge P&C

The aspects to be measured/observed and recorded during detailed inspections of dual gauge turnouts, dual gauge separations, and dual gauge diamonds are the same as those detailed above in sections for points, crossings, and check rails, as appropriate, allowing for the added complexity of the switch, crossing, and checking arrangements.

Dual gauge turnouts may have no, one or two V crossings. Here, we consider the most complicated with two crossings. Simpler dual gauge turnout crossings may be assessed by omitting unnecessary sections.

Referring to the following figures, where a turnout uses two V crossings as shown in a), they are separated into b) and c) and inspected separately. Shown in solid is the first V crossing and its corresponding rails are shown in b). The second V crossing, and its corresponding rails are shown in c).

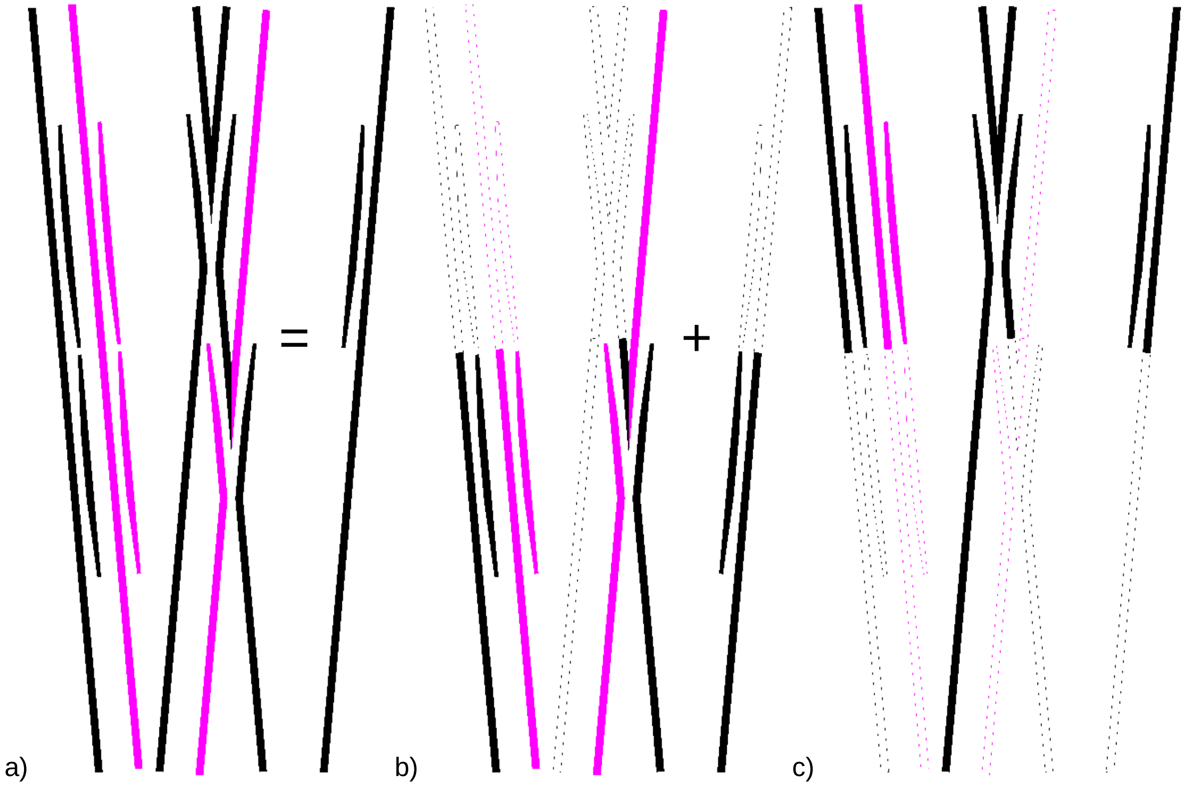


Figure 11-1 Standard and Narrow (Magenta)

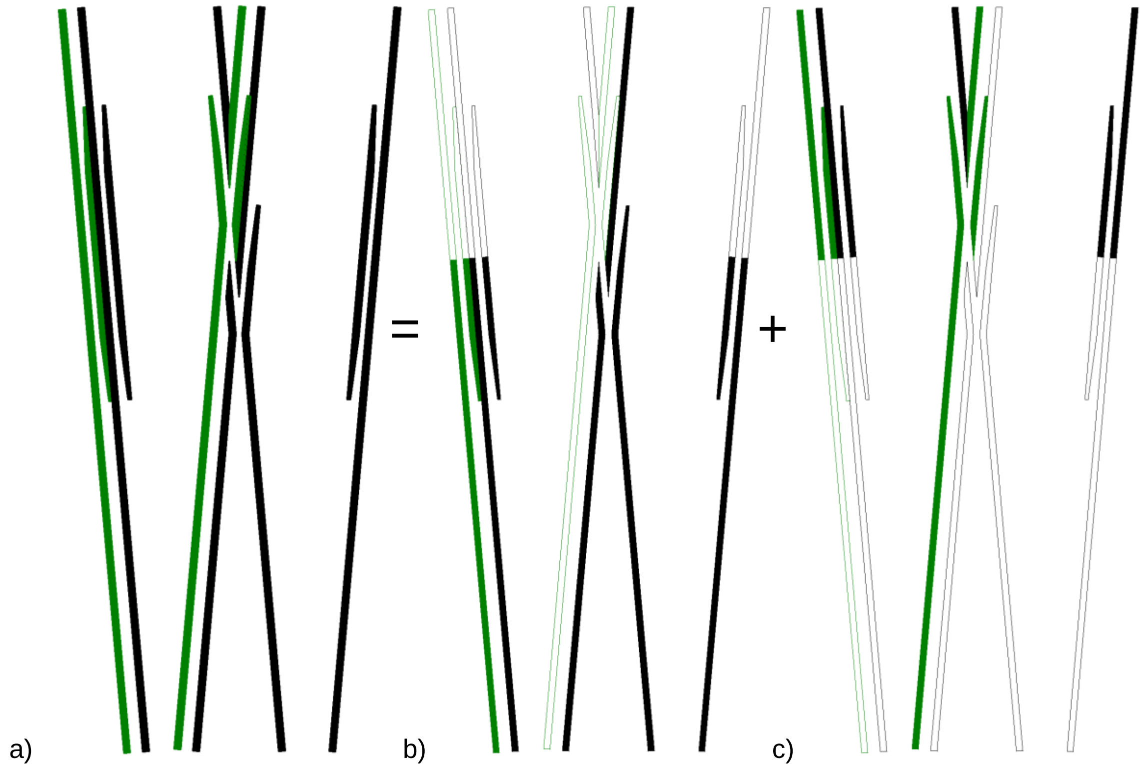


Figure 11-2 Standard and Broad (Green)

As for conventional v crossings a v crossing in dual gauge turnout has left and right-side measurements, however as it may have the added complexity of co-operating with two gauges.

Measurements that are taken across the track such as gauge or check rail effectiveness need to be taken for each gauge. For these measurements we use the terminology left standard and left secondary. The adjunct gauge, be it narrow or broad, is generically referred to as the second gauge.

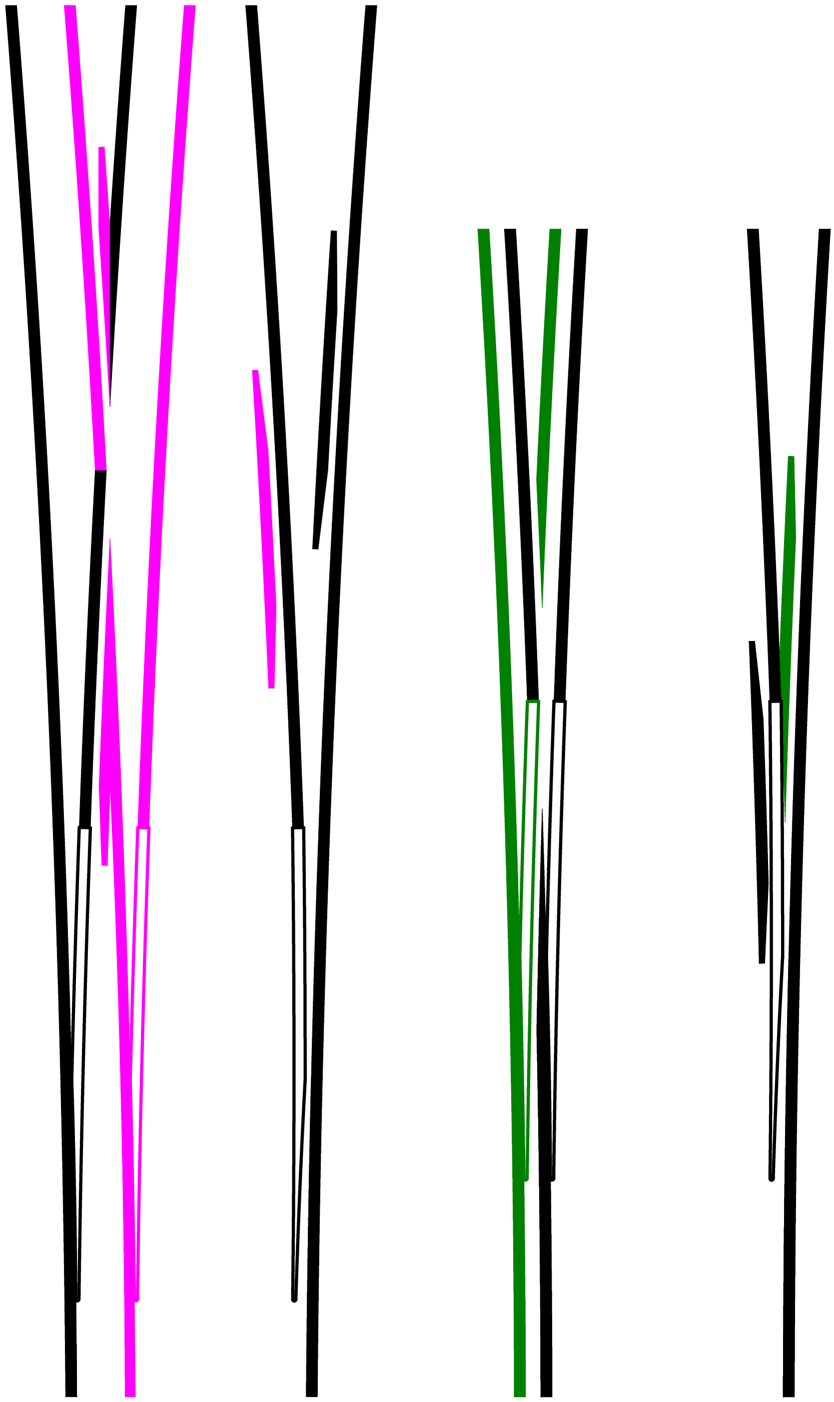
The form provides for standard and secondary measurements on both left and right, four combinations, however only a maximum of three would ever be required.

11.1 Dual Gauge K Crossings

Dual gauge turnouts may include a K crossing. The complexity varies depending upon the manoeuvres possible. The inspection forms remain generic and measurements on the forms may need to be omitted.

As dual gauge turnouts only have one K crossing, K1. K1a is nearer the toe of points and K1b is further. Some measurements, such as flare, check rail effectiveness require measurements for two track gauges.

Figure 11-3 Fixed K crossings in dual gauge switches



12 Recording and Assessment

For consistency in inspections and measurements it is recommended to pop mark or white paint locations where measurements are to be taken. These locations should be allocated station numbers.

The results of the detailed inspection of points and crossings may be recorded either electronically utilising the electronic forms on the Asset Management System or manually on the appropriate ARTC standard forms available on the ARTC Extranet site as follows:

- Form ETP0301F-01 for Turnouts
- Form ETP0301F-01a plus for Turnouts with housed points
- Form ETP0301F-02 for Diamonds
- Form ETP0301F-03 for Swing Nose
- Form ETP0301F-04 Manual Recording of Gauge, Play and Superelevation in Points and Crossings
- Form ETP0301F-05 for Dual Gauge Turnouts and Dual Gauge Separations
- Form ETP0301F-06 for Catch Points
- Form ETP0301F-07 for Turnouts with Spring Wing Crossings
- Form AMT-FM-004 Defects Found Report Form for all defects found.

Ideally the assessment of the detailed inspection observations and measurements would be carried out by the person undertaking the inspection, if that person is appropriately qualified and experienced, at the time of the inspection. If the inspecting person is not competent to conduct the assessment, then a suitably competent person is to conduct the assessment based on the report form, discussion with the inspecting person, and personal inspection if appropriate.

13 Generic Diagrams

Figure 13-1 Track Plane

The Track Plane is a surface defined by the running surfaces of a pair of rails.

Gauge:

- is measured between the rail head,
- 16mm below the track plane and
- perpendicular to the rail.

Raised check rails will be above the track plane and crossing noses and switch tips will be below it.

14 Surface Condition Classification

Table 14-1 Surface Condition Classification

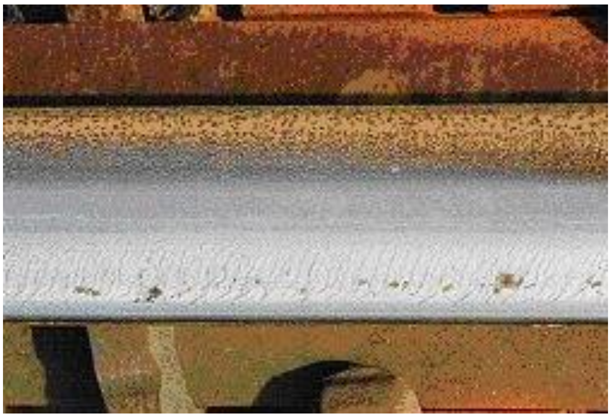
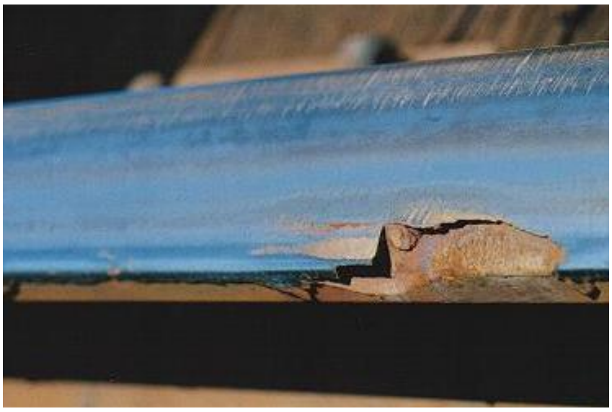
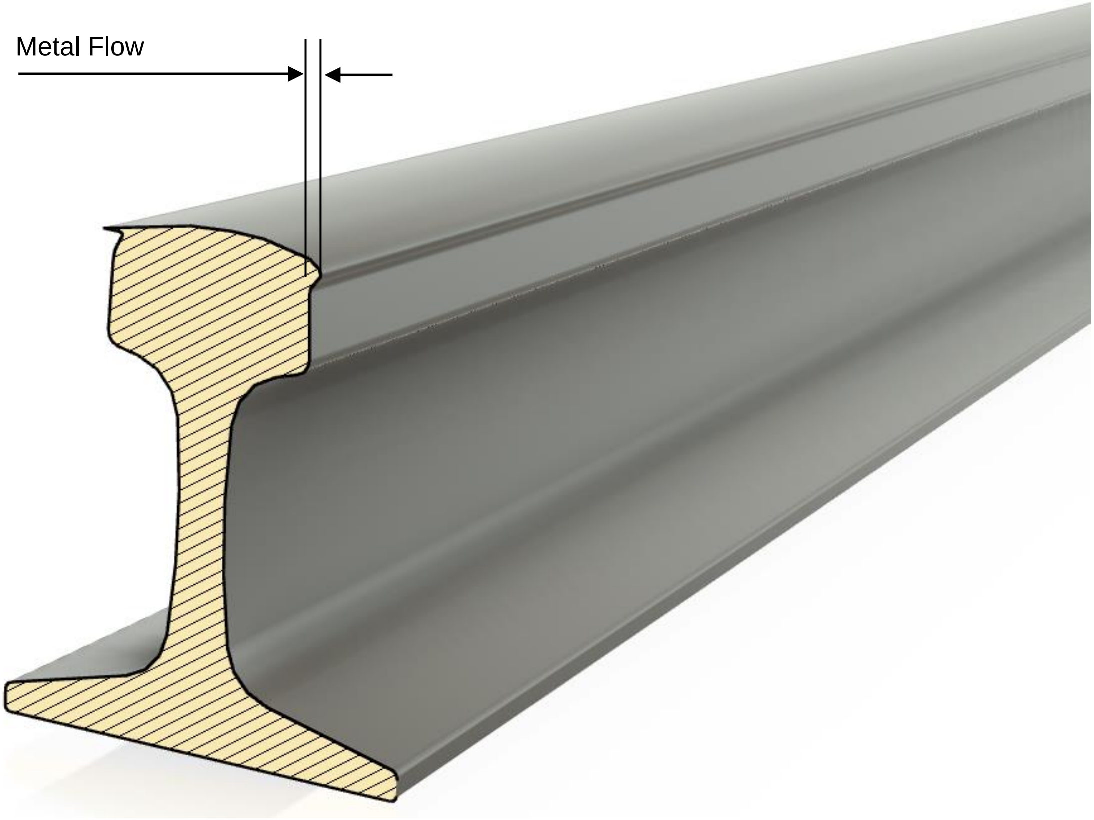
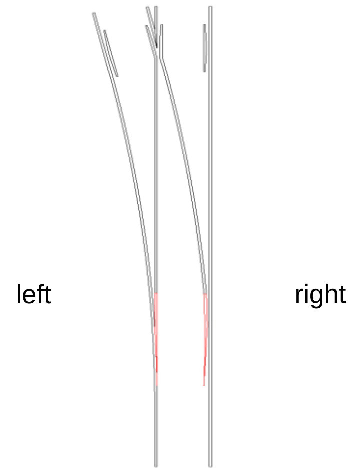
	RCF and Spalling	Shelling
Initiation		
Intermediate		
Severe		

Figure 14-1 Metal Flow Measurement



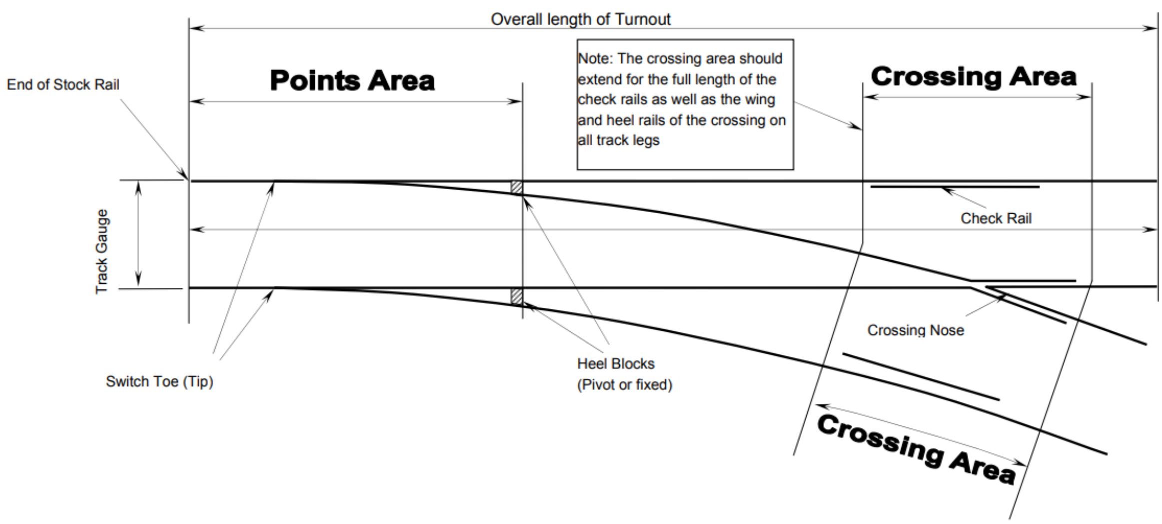
15 Turnout Terminology

Figure 15-1 Turnout left and right



Turnout naming conventions are from the perspective of standing at the points end. The left and right hand sides are as they appear and are shown in the above figure. Turnouts typically have one straight track and one curved. As the left hand route is curved in the above figure it is called a left handed turnout.

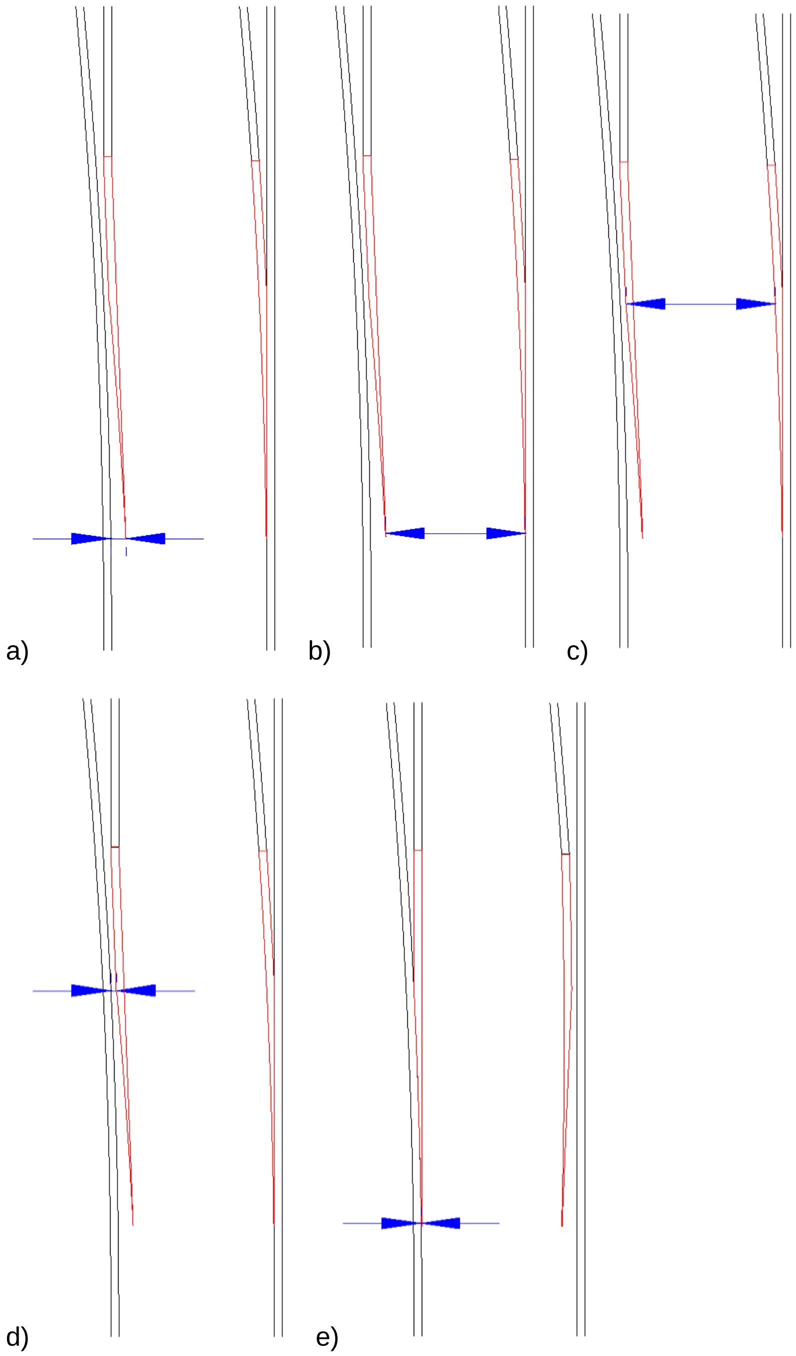
Figure 15-2 Turnout general terminology



15.1 Points

Measurements terminology of the points is based upon the switch being inspected. It is not related to the handing of the turnout. Shown below is left measurements for a) Switch Opening, b) back of switch to opposite switch gauge face at tip, c) back of switch to opposite switch gauge face at stretcher, d) throat opening and e) blade closed gap. Plain turnouts require both left and right measurements.

Figure 15-3



Mixed gauge turnouts an ARTCs network may have up to three switches in a turnout. The standard gauge and common rail switches shall retain the naming convention using left and right. The common rail switch (be it left or right) requires the back of switch to opposite switch rail at tip and stretcher measurements to be taken for the secondary gauge as well as standard gauge.

The secondary switch (be it broad or narrow and left or right) also requires measurements. Switch opening, track gauge, back of switch to opposite switch rail at tip and back of switch to opposite switch rail at supplementary drive or stretcher shall be measured from the foreign switch to the common rail.

Forms are based upon the most complex designs that have three switches. Other variants may be arrived at by omitting the unnecessary components.

15.2 V Crossings

Measurement terminology is based upon the side of the crossing nose being inspected. It is not related to the handing of the turnout. Shown below is left measurements for a) track gauge, b) check rail effectiveness, c) crossing flangeway, d) wing rail flare e) check rail flangeway and f) check rail flare. Plain turnouts require both left and right measurements.

Figure 15-4