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Section 3: Points & Crossings

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AMENDMENT VERSION #	DATE REVIEWED	CLAUSE	DESCRIPTION OF AMENDMENT
1.0	03 Sep 24		New inspection tasks have been added and competency for detailed inspection changed

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3 Section 3: Points & Crossings

3.1 General

This section of the ARTC Track and Civil Code of Practice includes controls for the design, rating maintenance and inspection of Points and Crossings to minimise the risks of derailment and collision.

Standard plain track components used in points and crossing installations should be designed, constructed, and maintained in accordance with the relevant sections of this Code of Practice.

This section includes some guidance and controls that aid efficient, reliability, performance, and safe work practice outcomes. Asset management plans and project specific technical requirements, may also be relevant.

3.1.1 Reference Documents

The following documents support this Standard:

- AS 1085.21:2020 Railway track material Part 21 Turnouts, switches, and crossings
- AS 7724:2020 Unauthorised movement protection - Operational Requirements.
- AS 7642:2022 Turnouts and Other Special Track Work
- ETA-03-03 Technical Specification for Manufacture of Components for Points Crossing Structures
- ARTC Route Access Standard
- ARTC Track and Civil Code of Practice

3.1.2 Definitions

The following terms and acronyms are used within this document:

TERM OR ACRONYM	DESCRIPTION
Assembly	An arrangement of points and or crossings such as a turnout, diamond, slip, catch point or diamond.
Assessment	Rate the condition, taking measurements when relevant, determining appropriate response.
CER	Civil Engineering Representative as per PEO-PR-008 Engineering, Design and Project Management Identification of Competence Procedure
CoP	Code of Practice
Critical Area	Areas where wheels must be guided to negotiate a discontinuity, such as a switch or a crossing. For a switch the critical area extends from the weld in front of the toe to the weld behind the heel. In a crossing the critical area extends from weld in front of the crossing to the weld behind it, including check rails
Footprint	The geometry of a points and crossing assembly required for incorporation into track geometry designs.
MGT	Million gross tonnes
RCF	Rolling contact fatigue
Repair	Activity to address defect or condition so response is no longer required.
Response	Control to manage risk or condition including recording in defect management system and prioritisation.

3.2 Design

This section outlines the requirements for design of points and crossing assemblies and their interface with railway infrastructure including rollingstock. For the design and manufacture of specific points and crossing components also refer to ETA-03-03 Technical Specification for Manufacture of Components for Points Crossing Structures. Other sections of the code will also be applicable for components that are not points and crossing specific (for instance rail, track geometry, sleepers and fastenings).

3.2.1 General Requirements

Sections 3.2.1 - 3.2.4 are of relevance to points and crossing designers and are only applicable to new designs of points and crossing equipment.

A turnout is typical example of a points and crossings assembly, other examples include catch points, slips or diamond. Complex assemblies occur where simple assemblies are grouped together, such as a crossover or a dual gauge turnout.

The following requirements apply to the design of new points and crossing assemblies:

1. Standard gauge designs shall be nominally 1435 mm.
2. Shall be designed for wheelset with a back-to-back dimension of 1357 mm to1360 mm.
3. May have either vertical or canted rail. [1]
4. If rail is canted, it shall be canted 1:20.
5. Where required 1:20 cant in plain track shall be transitioned to zero cant over a minimum of 3 sleepers clear of the points and crossing bearers. [2]
6. Design of assemblies should include cant transitions.
7. Infill panels, turnouts and other assemblies should use standard footprints per 3.2.5. [3]
8. Rail shall comply with the requirements of ARTC CoP Section 1 Rail. NB: rail minimum length [4]
9. AS60kg rail should be used. [5]
10. New designs should utilise concrete bearers.
11. Under sleeper pads should be considered for heavy haul.
12. Bearer and fastening design of assemblies shall comply with ARTC CoP Section 2 Sleepers and Fastenings. [6]
13. Bearer design shall meet or exceed the required axle load rating of the turnout. [8]
14. Bearers should be of consistent depth through an assembly. [7]
15. Cant transition bearers should be consistent depth with either the points and crossing assembly or the adjoining plain track.
16. Track geometry design of assemblies shall comply with ETS-05-00 Track Geometry. [9] [10] [11] [12]
17. Track geometry shall meet or exceed the speed rating of the assembly.
18. Assemblies should be designed to have zero superelevation.
19. Points and crossing shall safely accommodate all permissible wheels. [13]
20. Assemblies should be compatible with ARTC inspection and assessment regime outlined in this document.

Notes:

1. *Typically points and crossings are designed with vertical rail. Canted components introduce a barrier to interchangeability and commonality of spares though may offer other benefits in certain circumstances.*
2. *In some circumstances, such as at higher speeds, double length cant transitions may be warranted to reduce train dynamics.*
3. *Standard footprints provide for competitive supply, as well as interchangeability.*
4. *Short lengths can sometimes be avoided by using long tails on insulated joints, points, crossings, check rail and units.*
5. *Broad/Standard mixed gauge designs should use AS50kg, as AS53kg and AS60kg rail feet would require machining due to the close proximity of the standard and broad rails.*
6. *In complex arrangements longer bearers are often required. Where a design is adapted from a simple turnout the existing bearer depth may be insufficient. Bearer design is integral to the axle load rating of an assembly.*
7. *Consistent depth from top of rail to underside for bearer is preferred to simplify tamping and construction.*
8. *Typically, the axle load and speed requirement is 30TAL @80 km/h and 25TAL @ 115 km/h. See 3.3.1.*
9. *NB: limits of applied superelevation, superelevation deficiency/excess, and the rate of change of these parameters.*
10. *Limits on bends are applicable to straight and secant switch geometry.*
11. *Some assemblies, such as crossovers, may include virtual transitions at spacings less than bogie centres. The geometry shall be rated considering the combined effects.*
12. *See 3.2.6.1 requirements for incorporation into track geometry.*
13. *Details of wheel profiles, wheelset dimensions and permissible wear can be found in the ARTC Route Access Standard (General Information Section 1, at time of publication). Further details are included in design of points and design of crossings.*

3.2.2 Design of Points

The following requirements apply to new switch designs:

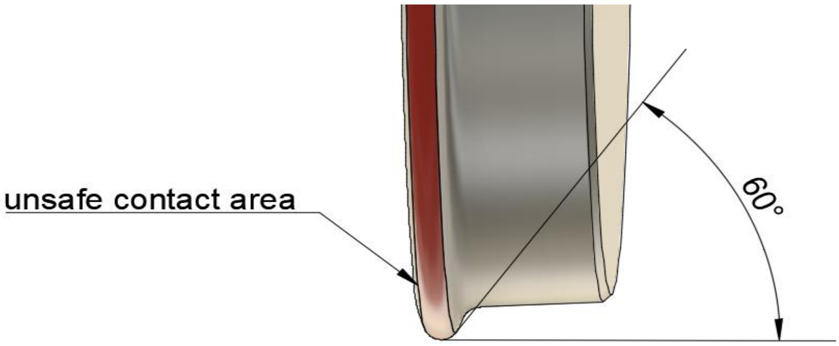
1. The contact angle between the wheel flange and the switch blade along its entire length shall be at an angle steeper than 60 degrees. [1]
2. Assessment of wheel strike should be undertaken. [2]
3. The design shall consider the risk of wheel strike for the allowable wear range. [3]
4. The assessment should be performed in the following rollingstock condition:
   a. facing movement approaching the switch
   b. with the flange against the stock rail corresponding to the closed switch
   c. at a wheelset angle of attack corresponding to the maximum possible adverse angle of attack of the wheelset on nominally gauged track
   d. for both new and worn wheel profiles

5. The assessment should be repeated for each of the following switch conditions:
    a. design condition
    b. switch partly open 3mm and with 2mm vertical wear on stock rail
    c. switch partly open 3mm and with 2mm side wear on stock rail
    d. the switch set for each possible movement (normally for straight and divergent routes)
6. Conventional switch blade designs should not be used. [4]
7. Switches may be checked.
8. Where a check rail is provided it shall prevent wheel contact to the closed switch tip it protects.
9. The design should minimise the dip angle for new and worn wheels profiles. [5]
10. The dip angle should be less than 20 milliradians. [5]
11. The transfer point from the stock to the switch should occur at a minimum head width of 30mm. [6]
12. Straight or secant switches should be avoided. [7]
13. Bend angles, if necessary, at straight or secant switches shall comply with the requirements for Section 5 (including maximum bend angle and maximum super deficiency at a bend).
14. Switches unless approved by ARTC shall not use pivot heels. [8]
15. Wheels shall be prevented from contacting the intentionally open switch tip.
16. The minimum design switch opening dimension shall be 105mm.
17. Switch blade throat opening:
    a. shall not be less than 50mm; and
    b. where possible should be at least 65mm [9]
18. An assessment of the blade flexure for all flexible or fixed heel switches accounting for a range of friction values, wheelset tracking, new and worn wheel condition and variation of track gauge should be undertaken to determine potential for back of flange contact.
19. Back of flange wheel contact to moveable switch blades shall be prevented from occurring unless approved by ARTC. [9,10]
20. Where back of flange contact is possible the blade shall be able to flex to a position where contact could not occur.
21. Blades should not spring back such that subsequent wheels can make back of flange contact.
22. Components including fastenings shall be designed for the loading fatigue and impact associated with the flexure.
23. Back of flange wheel contact of switch blade at points machines or supplementary drives shall not occur. [9,10]
24. A minimum clearance of 20mm shall be provided between moving components not intended to contact. [11]
25. The minimum clearance shall be achieved at the extremities of potential blade creep. [12]

26. Fixed points are not to be used. [13]

Notes:

1. *Wheel climb is regarded as unlikely if the contact angle between the wheel flange and the rail is steeper than 60 degrees from the track plane. A low gauge face angle along the length of the switch blade may cause a wheel climb derailment.*



2. *Switch tip strike assessment and wheel transfer assessment may not be required, where switch blade and stock machining at the wheel interface are unchanged from an accepted existing design, at the discretion of ARTC.*
3. *Wheel strike at the switch tip may cause derailment. Wheel strike occurs if the wheelset is required to make a sudden change in direction that causes excessive lateral or vertical force that risks derailment or component damage. Typically, if the flange tip radius to an angle of 60 degrees is prevented from making contact, wheel strike has been managed. Reference worn wheels are shown in Appendix A and are available from ARTC upon request.*
4. *Conventional Switches are more exposed to strike risks.*
5. *Impact loading may cause failure of turnout and track support components. When a wheel transfers from the stock to the blade, the wheel experiences a dip.*
6. *Switch blades are required to support the axle load. Inadequate strength of the blade may result in failure.*
7. *Horizontal bend angles in combination with speed may cause lateral forces high enough to cause wheel climb at otherwise acceptable wheel rail contact angles and excessive impact loading.*
8. *Pivot heels are subject to impact loading and introduce risk and maintenance issues not found on fixed or flexible heeled switches. Fixed heel switches are more difficult to manually operate, pivot heels may be considered by ARTC in these circumstances.*
9. *Back of flange contact to the switch blade can cause excessive loading and failure of turnout components. Back of flange contact can be avoided using supplementary drives.*
10. *Where switches are arranged to be trailable it is permissible for the first wheelset in the case of spring levers, or multiple wheelsets in the case of self-restoring switches to make back of flange contact.*
11. *This requirement is intended to improve reliability by preventing components from fouling when switches are moved.*

12. Extremities of blade creep may be determined by considering unrestrained thermal expansion of blade or anti creep device clearance.

13. Switches with fixed points have at least one unmoveable switch blade, guidance is provided by other means such as of the other blade and or a check. They are uncommon but have been prevalent in broad/standard dual gauge turnouts due to the limited space.

3.2.3 Design of Crossings and Check Rails

The following requirements apply to new fixed crossing designs:

1. Check rails shall be used to prevent the front of wheel flanges from striking crossings noses. [1]
2. Contact between the front of wheel flange and the crossing shall be at an angle steeper than 60 degrees to the track plane.
3. Nominal check rail effectiveness shall be in the range 1390–1392 mm.
4. Crossing flangeways shall be a minimum of 42 mm wide.
5. Flangeways shall be designed to accommodate a maximum wheel flange height of 45 mm.
6. The design should minimise the dip angle for new and worn wheels profiles and potential extents of wheelset tracking.
7. The dip angle should be less than 20 milliradians.[2]
8. The transfer point from the wing rail to the point should occur at a minimum head width of 30 mm.
9. The check rail and wing rail end openings should be flared and have at least 80 mm clearance to the gauge face of the running rail at the flared end.
10. Contact between back of wheel flange and flare shall be at an angle steeper than 60 degrees to the track plane. [3]
11. Check rail height shall be between 0 mm and 38 mm above the running rail. [3]
12. Check rails should be effective for a minimum of 450 mm either side of the working point or points they are protecting.
13. In the instance of diamonds back of wheel contact to the point of K crossings cannot entirely be prevented.
14. At K crossings contact between back of wheel flange and point rails shall be at an angle steeper than 60 degrees to the track plane. [5]
15. For fabricated crossings the point rail should be used for the dominant route.

Notes

1. Flanges striking crossing noses can cause derailment.

2. Impact loading may cause failure of turnout and track support components. When a wheel transfers from the nose to the wing, the wheel experiences a dip. Reference worn wheels are shown in Appendix A and are available from ARTC upon request.

3. This is a control to reduce risk of wheels from striking and or climbing check rails.

4. Road wheels of hi rail equipment may can run over raised checks and possibly unload guidance wheels creating a derailment risk. Raised checks shall be used judiciously.

5. This includes point rails on K crossings as well as the working point.

3.2.4 Requirements for specific assembly types

3.2.4.1 Swing nose crossings (including switched K crossings)

New swing nose crossings shall comply with the requirements for the design of points per 3.2.2. Point rails should be aligned to the dominant route.

Note: This requirement is only applicable to swing nose V crossing designs that require differential longitudinal movement of the rails connected to the nose. Typically, this achieved by use of a splice joint.

3.2.4.2 Spring wing crossings

The following requirements are applicable to spring wing crossings:

1. Spring wing crossings will be accepted by type approval only.
2. Shall be provided with check rail assemblies on each leg.
3. Shall self-restore to normal following movements.
4. Shall have one movable wing only.
5. The rated speed for the divergent route (i.e. that which requires the wheel to move the wing rail) shall be limited to control wheel impact and wheel climb.
6. Shall be suitable for negotiation by hi rail equipment.
7. Spring wings should include an oil buffer or similar device to reduce wear and fatigue.

Note: Spring wing crossings have advantages of reducing wheel impact for the normal movement.

Road-rail vehicles have smaller wheels and reduced vertical load on guidance wheels and may be unsuitable to traverse spring wing crossings

Spring wing crossings have advantages of reducing wheel impact for the normal movement.

3.2.4.3 Catch Points

The following requirements are applicable to catch points:

1. Catchpoints assemblies intended to protect mainline track shall include a throw off rail and ramp block to direct a train to a landing area or a guard rail to keep a train on the sleepers.
2. Catchpoints may use single switch (“half set”).
3. Catchpoint designs should ensure that both wheels on an axle derail fully before engagement with the throw off rail.
4. Catchpoints designs shall be rated for maximum speed at which they can be relied upon to work as intended (including following of throw off rail by first derailed vehicle).

Where the catchpoint point relies upon a throw off rail, that is intended to cause a sudden change in direction, the maximum rated speed shall be limited by V_{max} as follows:

$$V_{max} = \frac{0.36}{\sin\alpha}\sqrt{h}$$

Where:

α is the angle of the throw off rail

h is the height of the rail in mm

V_{max} is given in km/h

3.2.4.4 Dual Gauge

Dual Gauge designs shall be accepted by type approval only.

3.2.4.5 Diamonds

The maximum unchecked area of K crossings in diamonds shall be no greater than the unchecked area of a 1:8.25 straight "K" crossing with a 25 mm raised checkrail being traversed by a fully worn wheel of 840 mm diameter.

New designs should be checked for flange clearance and protection of point rails.

Diamonds shall be straight on both routes unless approved by ARTC.

3.2.4.6 Compounds slips doubles

Compounds slips and double designs shall be accepted by type approval only.

Single and Double Slips are special track layouts that combine turnouts and diamond crossings. They allow train movements across, onto and out of a track. Double turnouts are overlapping turnouts. These are complex layouts to design, construct, and maintain.

3.2.4.7 Derailers

Any derailer or similar device proposed shall be type approved by ARTC.

3.2.5 Design Registration

This section addresses design acceptance of points and crossing equipment.

ARTC maintains a register of accepted designs.

General layouts/arrangements shall be classified as either footprint or detailed.

Footprints have detail of set out geometry and typically include weld locations, bearer locations and lengths. Footprints are used to incorporate turnouts in the design of track geometry, as the basis for detailed design and provide for a level of interchangeability.

Detailed designs support management of turnouts. Typically, they have sufficient detail to order spares, bill of materials, references to part drawings, sub assembly and manufacturing drawings.

Detailed designs shall include detail of points machines, supplementary detection equipment, rodding, stretchers etc.

The design register includes attribute such as:

- Footprint or Detailed
- Legacy or Accepted
- Rated Speed
- Rated Axle Load
- Preferred status/usage

- Limitations on use
- other important characteristics as required.

Addition of new designs to the register may be by business unit acceptance or by type approval depending upon the degree of novelty and sufficiency of standards. Determination of pathway shall be at the discretion of ARTC Technical Standards. Typically, a simple single gauge turnout that conforms to standards will be by acceptance. Dual gauge turnouts will require type approval. Type approval follows EGP-21-01 New Equipment & System Approvals.

Where acceptance is the appropriate pathway the ARTC Management of Change Procedure COR-PR-015 shall be used. The Manager Engineering of the business unit / asset management authority intended to use the design will be responsible for providing acceptance.

Updates to the design register such as additions or removals shall be communicated to Procurement.

3.2.6 Incorporation of Points and Crossings into the rail network.

This section is applicable to designs of new layouts including points and crossings or integrating different footprint points and crossing equipment into existing layouts.

Selection of appropriate equipment for incorporation into new track arrangements has requirements in Section 3.2.7.

3.2.6.1 Track Geometry

The design of track alignment and general arrangements have requirements in the ARTC Track and Civil CoP Sections 5 Track Geometry.

Additional requirements for the inclusion of Points and Crossings in new alignments are as follows:

1. Turnouts should be used in preference to more complex assemblies such as slips or other special arrangements.
2. Curved turnouts such as contraflexure and similar flexure shall not be used unless approved by ARTC.
3. Mainline turnouts shall be straight on the dominant route unless approved by ARTC.
4. Mainline turnouts should be adjoined by 20m straight plain track on both sides for the primary route on mainline. [1]
5. Cant transitions should be omitted and zero cant sleepers used between adjacent turnouts separated by less than 20m.
6. Cant transitions may be omitted and zero cant sleepers used between adjacent turnouts separated by up to 40m.
7. Alignments should utilise preferred designs as found in the register.
8. Alignments should avoid the need for custom infill panels. [2]
9. Points and Crossings should only be situated on track with a design superelevation of zero. [3]
10. Where an assembly designed for zero superelevation is incorporated into track with superelevation, the assembly shall be re rated.
11. Vertical curves should not occur within points and crossing assemblies.
12. Vertical curves in points and crossing assemblies shall be of a minimum 3000m radius.

13. Layouts of multiple assemblies shall be coplanar unless approved by ARTC. [4]
14. Layouts with changes of horizontal geometry occurring within bogie centres shall have the geometries speed rated to consider combined effects. [5]
15. Track adjoining Points and Crossings shall be coplanar for a minimum of 20m unless approved by ARTC.
16. Diamonds shall not be curved.

Notes

1. Straight track simplifies construction and maintenance and can reduce dynamic vehicle effects. In mainline junction work this may be unreasonable, though attempt should be made to limit the extent through which adjacent curves impact vehicle guidance as they traverse turnouts.

2. Infill bearers are those between the standard footprint and last long bearer of an assembly.

3. Where a turnout is on a grade the divergent track will have a very small incidental superelevation as the assembly is co planar. This is acceptable.

4. Non coplanar arrangements can induce twist or superelevation that were not considered in the design and rating of individual turnouts. Additional complications are use of shared bearers and difficulty in performing maintenance and identification of geometry defects.

5. Toe to Toe arrangements of opposite handed turnouts present reverse curves. Other arrangements may also impact the speed rating. In particular, rate of change of deficiency is impacted. Track geometry design limits shall be complied with.

3.2.6.2 Other Corridor Considerations

1. Points and Crossings should only be placed where track side access for maintenance vehicles is provided.
2. Points machines should be situated on the side with the best access for maintenance.
3. Points machines may require additional protection to avoid being struck by maintenance vehicles.
4. Where extended bearers are required for points machines, ballast and formation shall also be extended for support and track drainage design adjusted accordingly.
5. Placement of points and crossings shall consider clearances and signalling system requirements.[1]
6. Assessment of clearances for the straight and divergent track. [2]
7. Turnouts should not be placed alongside platforms.[3]
8. Points and Crossing assemblies should not be used on bridges, in tunnels or other high-risk locations. [4]
9. Turnouts should not be installed above culverts.
10. Insulated joint should be avoided on dominant route if possible.

Notes:

1. *The location of safety clearance points associated with points and crossing installations and their protection, e.g. catchpoints, signals, track circuits and insulated joints, etc. may affect the rolling stock standing room within crossing loops and sidings.*
2. *Curve effects project beyond the extent of the curve due to end throw.*
3. *Turnouts alongside platforms require an increase in platform offset creating a boarding hazard.*
4. *Points and crossing on bridges and tunnels create issue for maintenance access. Points and crossings should also be avoided at these locations due to the increased consequence of derailment.*

3.2.6.3 Special Requirements Catch Points

The requirement for protection of track from unauthorised movements comes from signalling and safe working standards. Catchpoints when used for their intended purpose are hazardous and require careful consideration to incorporate them into the network.

1. Accepted points and crossings designs from the register shall be used. [1]
2. Each site will need to be reviewed in detail and the final arrangement confirmed by risk analysis. [2]
3. Derailers shall not be used in new arrangements to protect mainline track.
4. Derailers should not be used elsewhere.
5. Catch points, derailers or other similar devices, shall have a clear and even throw-off area to minimise subsequent damage (see 3.2.7 Ballast Drag). [3]
6. Derailed vehicles should not be directed towards a building or onto any structure, particularly overbridges, masts or transmission line poles, earthworks or over any embankment or directly into any cutting or retaining wall in the adjacent area. [4,5]
7. Where space permits catch points should be positioned on track not directed at the line being protected. [6]
8. Catchpoints shall be positioned such a derailed vehicle following a guide or throw off rail maintains minimum clearance from the line being protected.
9. The above requirement (10) may be regarded as being satisfied if all the following conditions are met:
    a. A 100mm minimum air gap between kinematic envelopes shall exist as shown in Figure 3-2. [7]
    b. Kinematic envelopes 1 and 2 are based upon the approved rollingstock outlines for the given tracks and are full kinematics calculated in accordance with ETS-07-00 Clearances.
    c. Kinematic envelope 1 is positioned such so that the vehicle overhang past the bogie centre extends beyond the throw off rail as shown. The bogie centre shall be positioned on the centreline.
    d. The throw-off rail is parallel to or directed away from the line being protected.
10. Alternatively (to the above requirement 11), requirement 10 may be regarded as being satisfied if all the following conditions are met:

e. a 200 mm air gap between the swept path kinematic envelopes shall exist as shown in Figure 3-3.

f. Kinematic envelopes 1 and 2 are based upon the approved rollingstock outlines for the given tracks and are full kinematics calculated in accordance with ETS-07-00 Clearances.

g. Kinematic envelopes 1 and 2 are based upon swept paths to account for curvature effects.

h. For kinematic envelope 1, beyond the catchpoint, the vehicle is guided by the back of switch blade and then throw off rail. [8]

Notes:

1. *Complete turnouts may be used in place of a catch point.*
2. *Catchpoints may vary from a half set to entire turnout with track and a buffer. The later providing not only a higher level of protection but also reduced consequences when used as intended. See figures 3.4 to 3.7.*
3. *Whilst throw-off rails can be an appropriate control there is risk they may not be followed by rollingstock which increases with speed, more notably above 15 km/h.*
4. *Bridge columns may need deflection walls in accordance with other standards.*
5. *This will include land outside the rail boundary where there is, or is the potential for, building development.*
6. *The arrangement depicted in Figure 3-1 is generally preferred in that with this arrangement the throw off rail is located outside the return curve on track parallel to the mainline where normal track centres have been achieved. Derailed movements cannot be guaranteed to follow the throw of rail. In this configuration the derailed vehicle is not directed toward the running line in the event of jumping the throw off rail. For existing track it is accepted that the preferred solutions may not always be achievable within the constraints provided. Where the preferred arrangement cannot be achieved either of the following solutions may be employed.*
7. *The air gap minimum is only 100 mm. However, a derailed vehicle will not be aligned to the centreline as shown but guided by the back of the switch blade. An approximate 200 mm theoretical air gap will be maintained. This method using 100 mm minimum may be used as a simplification.*
8. *A centreline path offset 700 mm from the contact faces is adopted. The 700 mm offset is derived as half of the maximum back-to-back wheelset dimension plus the wheelset clearance used in ETS-07-00 Clearances. Allowing the full kinematic to be used.*

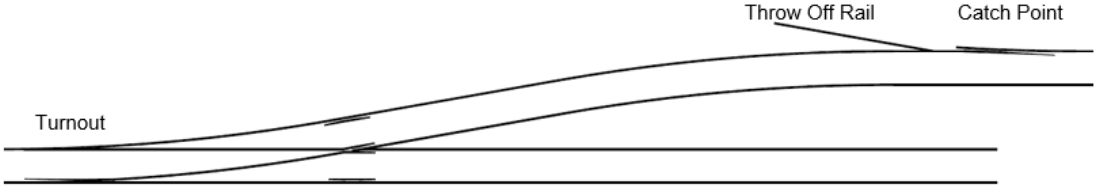


Figure 3-1

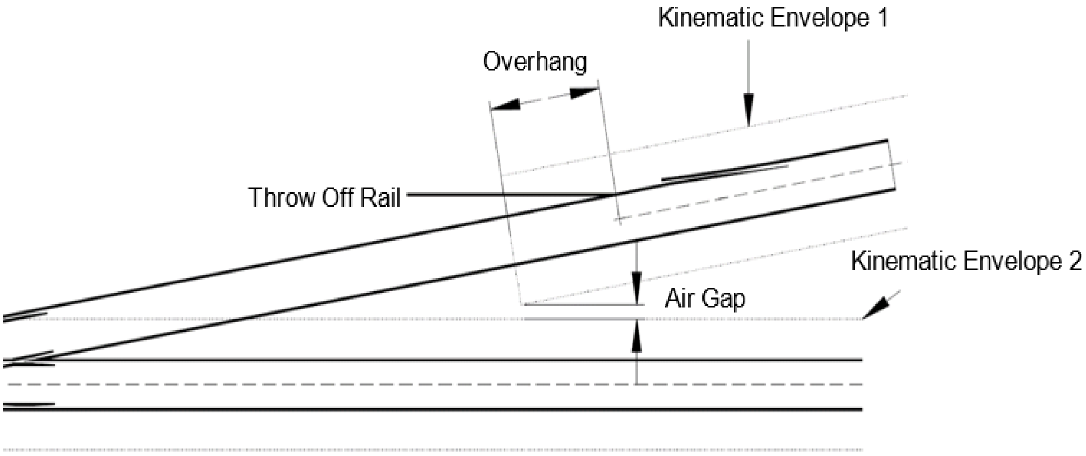


Figure 3-2

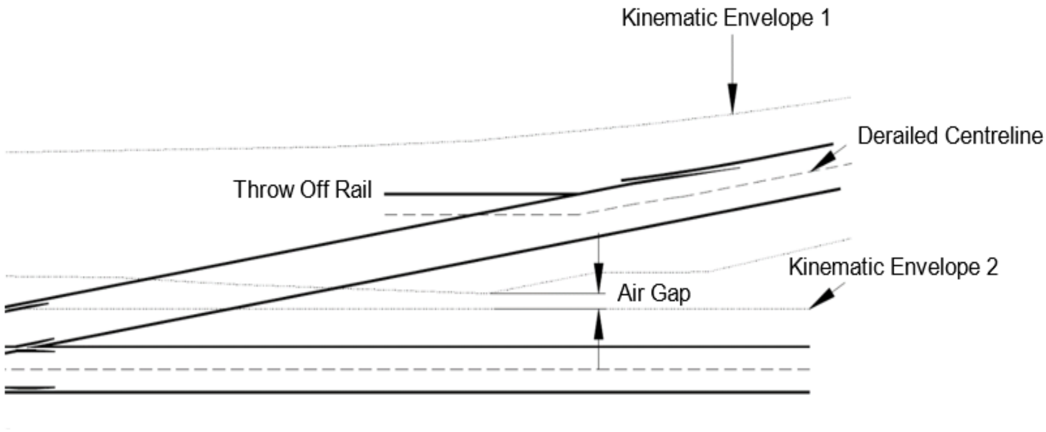


Figure 3-3

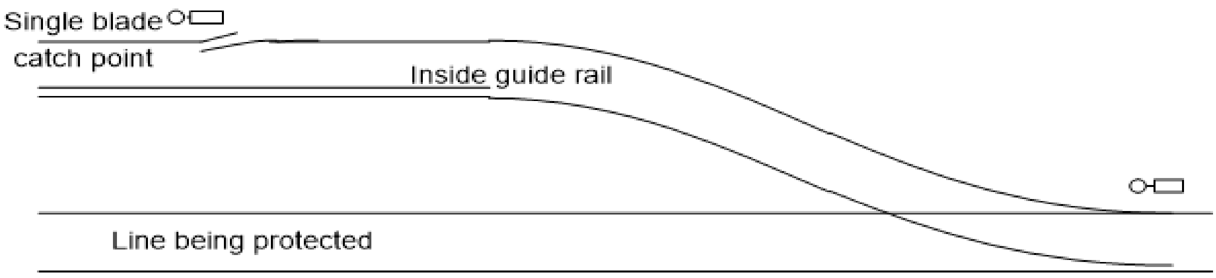


Figure 3-4

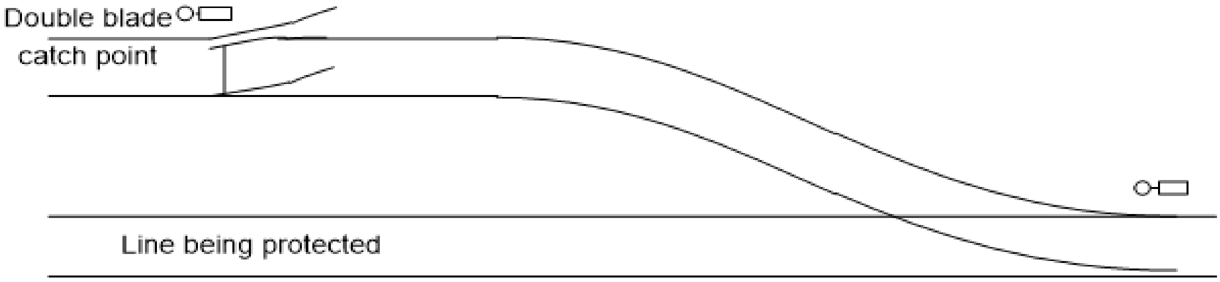


Figure 3-5

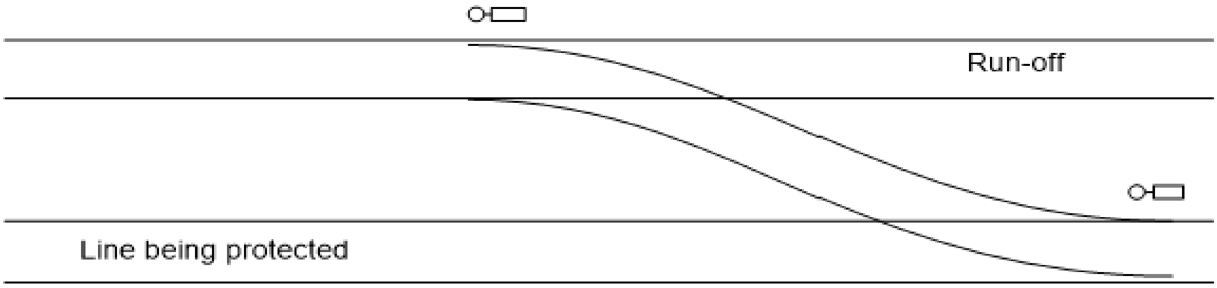


Figure 3-6

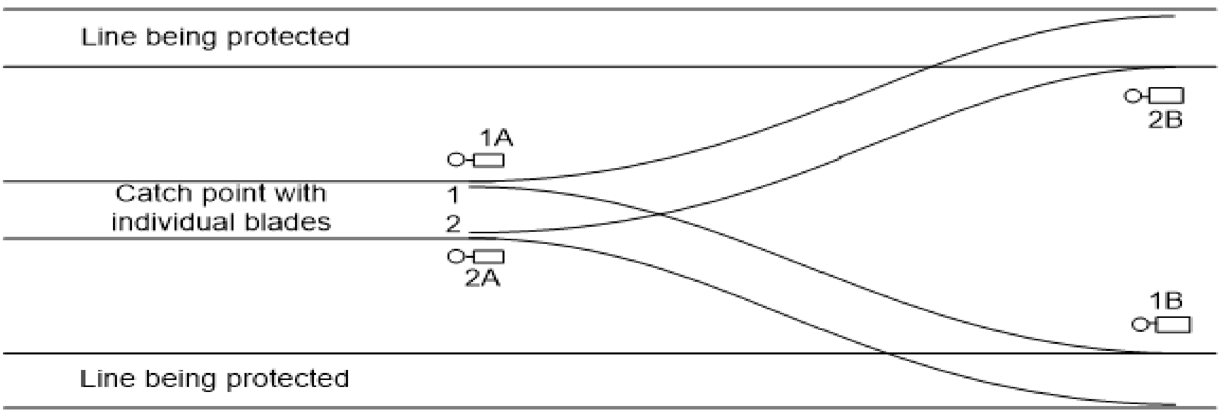


Figure 3-7

3.2.7 Ballast Drag

1. Catch points should be accompanied with a ballast drag.
2. The size of the ballast drag shall be based upon likely potential rolling stock, runaway speed and ballast drag calculations specific to the site.
3. The length of the ballast drag shall be determined using ESI-06-05 – 'Runaway Speed and Ballast Drag Length Calculators'.
4. The ballast drag should extent a minimum of 2 vehicle lengths beyond the catch point.
5. Ballast should be poured and raked into position and must never be compacted during installation. The ballast shall remain loose and free to deform under the wheels of derailed vehicle.

6. If a guide rail is used within the four foot in conjunction with a derailer then the ballast drag should be laid parallel to the rail in direction of travel a minimum of two metres out from the running rail.
7. Ballast must be placed a minimum of two metres on either side of an outside guide rail.

3.2.8 Selection of Equipment

The following sub-sections are for guidance only. Alternate rail sizes and materials may be used where supported by life cycle economic appraisal.

The operating environment across the ARTC Network varies considerably. ARTC uses a wide variety of equipment.

The following requirements apply to the selection of new equipment:[1]

1. Selected points and crossing assembly ratings shall meet or exceed the maximum allowable speed and axle load. [2]
2. Selected equipment shall be from the Points and Crossings register. [3]
3. Legacy designs shall not be selected.
4. Preferred equipment from the Points and Crossings register should be selected.
5. Drive, locking and detection equipment shall be consistent with turnout design. [4]

Notes:

1. This requirement is not applicable to like for like component replacement.

2. Maximum axle loads and speed applicable to a track can be found in the ARTC Route Access Standard. Project or asset management requirements may exceed these.

3. Where equipment is sought from outside the register, the design shall be accepted or type approved see 3.2.5.

4. There is a wide variety of points and crossings equipment and drive lock and detection systems. Many combinations have not been considered or designed and may be incompatible. New arrangements are possible however will require detailed design and inclusion in the register before they may be used.

Important factors in selecting equipment include:

- Speed
- Axle Loads
- Annual tonnage
- Reliability requirements
- Maintenance access, both site conditions and access regime

Table 3-1 Crossing Type

CROSSING TYPE	RAIL SIZE		FOR USE IN TURNOUT TYPE
	NEW	REPLACEMENT	
Fabricated	50, 60	50, 53, 60	Non-Tangential
Rail Bound Manganese	60	53, 60	Non-Tangential & Tangential
Compound	60	53, 60	Non-Tangential & Tangential
Fully cast (Monobloc)	60	60	Non-Tangential & Tangential
Swing Nose	60	60	Tangential
Spring Wing	60	60	Tangential

Generally, crossings fabricated from rail are least durable. Such crossings are undesirable in mainline. Crossings machined utilising improved materials (such as wear resistance alloys or improved grades) have potential of high wear resistance and are in a different class to crossings fabricated from plain standard carbon rail.

Rail Bound Manganese, Compound and Monobloc crossing have improved durability over fabricated crossings and are suitable for mainline use. Standard tangential turnouts should be provided with fixed nose crossings unless specified otherwise.

Standard tangential turnout designs are approved for both straight and curved crossings. Where there are no site constraints or adverse impacts on other rail infrastructure the straight crossing type should be used.

Swing nose crossings provide continuous support and significantly reduce wheel impact, noise, vibration and steering effects. They can outlast fixed crossings. At shallow crossing angles they avoid long thin crossing noses that may struggle to support wheel contact stress. Swing noses offer benefits for high axle loads, passenger comfort at higher speeds, and in noise and vibration sensitive areas. They should only be used where the advantage offsets the ongoing and capital costs of an additional points machine and associated signalling componentry.

Swing nose crossings are available for the standard tangential turnouts see the design register.

Spring wing crossings offer similar benefits to swing nose crossings, however, only provide continuous support for the normal movement. The speed on the divergent route is limited due to being actuated mechanically by the wheel flanges.

Selection of moving point K crossings has similar considerations to those of swing nose v crossings. Fixed K crossings are more problematic than V crossings due to the exposure of the back of flange to a point avoided in a moving point K crossing.

Some diagrams for reference are given is Apendix B.

3.2.8.1 Turnout Renewals in Heavy Haul and Interstate Lines

Turnout Renewals in Heavy Haul and Interstate lines should be in AS60 kg head hardened rail, provided the preventive grinding cycle can be maintained. Head hardened rail is at risk of developing squat defects. The following conditions are risk factors:

- Potential lack of regular grinding in accordance with turnout profiling standards
- High proportion of light passenger traffic and lower MGT levels of freight traffic
- Regions prone to higher moisture levels
- Where wheel slip is a problem

Use of standard carbon rail may be appropriate mitigation. Advice should be sought from the business unit if the risk factors are present.

Where the adjoining track has concrete sleepers, concrete bearers should be used in all turnouts. In other locations timber bearers may be used.

Cast in shoulders are preferred for heavy haul turnouts.

Use of switch and swing nose rollers are preferred for reliability.

Rail-bound Manganese Crossings or Solid Cast Manganese Crossings (Monoblocs) should be used where non-tangential turnouts on Heavy Haul lines require renewal. Crossings in Interstate lines should be Rail-bound Manganese or Monoblocs or fabricated from Head Hardened AS60 kg material.

On Interstate lines AS53 kg components may be replaced by suitable AS53 kg material where stock is available. Where AS53 kg points require renewal, they may be replaced in AS60 kg material if AS53 kg material is not available. In these circumstances junction rails or welds shall be fitted between the switches and the crossing and associated closure rails.

Where the new turnout is of a different weight to the adjoint rail on mainline, junction rails should be considered to mitigate the higher breakage risk of junction welds.

3.2.8.2 Turnout Renewals in Intrastate lines

Suitable second-hand AS53 kg turnouts or 47 kg turnouts may be used in preference to new material where cost effective. If new material is to be used it should be at least as heavy as the adjoining plain track or heavier to suit any future line upgrade strategy. Fabricated crossings are suitable in Intrastate lines.

3.2.8.3 Turnout renewals in Light Weight lines

Second-hand turnouts of the same weight and standard as the Mainline are to be used when available and cost effective on these lines. If new material is to be used it should be at least as heavy as the adjoining plain track or heavier to suit any future line upgrade strategy. Fabricated crossings are suitable in Light Weight lines.

3.2.8.4 Sidings

Turnouts in sidings connected to Heavy Haul and Interstate lines should be renewed in recovered AS53 kg rails or better. Turnouts connected to lines with lower axle loads should be at least as heavy as the adjacent main line.

3.3 Construction and Maintenance

3.3.1 Construction Requirements

Track geometry tolerances in a turnout or other points and crossing assembly post construction shall meet the corresponding construction limits specified in ETS-05-00 (Track Geometry).

The turnout specific tolerances in Table 3-2 shall be achieved for any new installation.

Table 3-2 Turnout Construction Tolerances

ELEMENT	LIMIT (mm)
Geometry Limit Gauge at the switch tips, through turnouts, slips, and crossings and in catch points	+ 2 / - 4
Flangeways at V and K crossings	± 1
Check rail effectiveness	± 2
Switches bearing on plates in the closed position	+1 / - 0
Switch points and crossing intersections*	± 10
Switches installed square to design	± 6
Gap between switch blade and stock rail in turnouts	≤0.5

* *The relative positions of theoretical toe of points and crossing theoretical intersection points of an assembly shall be constructed within these tolerances relative the dimensions shown on the general arrangement or set out geometry for the assembly's design. Practical toe of points and crossing points relative positions may alternatively be used to demonstrate compliance and simplify measurement.*

Acceptance of track alignment and quality outside of the tolerances in this section shall be at the discretion of the Manager Engineering.

Following construction profile grinding etc may be required to install target rail profile.

Some suppliers offer components machined to as ground rail profiles, this are typically preferable as they may remove the need for post installation grinding and present a more cost-effective solution.

3.3.2 Maintenance

Switch blades and stock rails shall only be replaced as a set as blades and worn stocks create a wheel climb / strike hazard.

Where equipment is typically accompanied with a supplier manual or supplier recommendations, these documents should be complied with.

Many newer check rails units have provision for adjustment. Restoring check rail effectiveness to nominal dimension can reduce wheel impact on the crossing nose.

Where a maintenance has been undertaken to improve a feature or where a feature has been disturbed during maintenance, the relevant tolerances from ETS-05-00 and Table 3-2 above should be achieved.

3.3.2.1 Grinding

Turnouts with head hardened rail risk squat and RCF defects. In operating environments where such defects are known to develop head hardened turnouts should have planned preventative profile grinding see ETM-01-02.

Similar to plain track, turnouts benefit from rail grinding by the restoration of rail profile and metal removal. Such profile grinding is typically performed by heavy plant.

Flow on crossings and wings should be removed when it exceeds 1 mm. Worn crossings and wing rails can be repaired by building up with weld metal and ground. Refer to ETM-03-03.

Flow on switches may also be removed by grinding refer ETW-03-02. On conventional switches where the stock rail is worn and the switch blade has become proud, either by switch tip height or width the blade may be ground

3.3.3 Repairs of defects

Whilst turnouts may be repaired utilising the following techniques, they may also be used for preventive maintenance by implementing before a defect limit is reached. In many instances such interventions will contribute to an extended service to not only the component but the entire assembly life. Further they may increase safety and reliability but come at a cost. It is therefore an asset management decision to determine when to undertake such preventive maintenance.

Table 3-3 Overview Repairs

Defect	Repair
Component Damage	Repair or replace component
Track geometry, Pumping in Critical Areas	Tamp and or renew track support structure
Track Geometry Defect	Tamp
Bearers and Fasteners	Damaged bearers are replaced by side insertion. Damaged or missing fasteners should be replaced.
Ballast condition and profile	Insufficient ballast is corrected by replenishment and regulation. Degraded ballast may be replaced in failed locations only or in entirety at turnout renewal.
Ballast, Excess	Manually remove excess ballast from around drive lock and detection equipment. In severe instance regulation of ballast may be required.
Rail, Creep	Adjust rail. Investigate rail stress in adjacent track. Develop plan for release of turnout and correcting creep errors and stress adjustment of adjoining track.
Rail, Condition	Grind or replace.
Head height	Replace
Skewed Bearers	Adjust to design spacing within maintenance tolerance.

Table 3-4 Points Repairs

DEFECT	REPAIR
Insufficient switch opening or variation from design	Refer to signal maintainers for adjustment
Wide gauge at the switch tip	Investigate cause of wide gauge, this may be worn clips or shoulders which can be replaced. On timber bearers may require replacement. If wide gauge is due to worn rail, rerailing may be necessary.
Excessive distance from back of switch blade to opposite switch gauge face at tip measurement	This defect could be due to either wide gauge or insufficient switch opening or a combination of both. See corresponding remedies.
Excessive back of switch blade to opposite switch blade at supplementary drive or stretcher, measurement.	Check for gauge defect, bent rail and inadequate drive of switch blades, and rectify as appropriate.
Throat Opening (Back of switch rail to stock rail at the junction of heads)	Check for gauge defect, bent rail and inadequate drive of switch blades, and rectify as appropriate.
Blade and stock condition, metal flow	Metal flow should be removed by either hand grinding or using a switch grinder depending upon extent.

Blade and stock condition, surface condition defect	Deep defects may only practically be repair by replacement of switch and stock. Switch grinding or turnout grinding may be appropriate to manage asset life or for ensuring ultrasonic testability.
Poor Switch Alignment	Blade should be inspected for possible obstructions, inadequate lubrication of base plates condition of stretchers and any supplementary drives for remedy. If blade is found to have been bent typically a new switch and stock are required to correct, though in less used non mainline rail straightening has been successful.
Excessive switch blade closed gap	The blade should be checked for run through damage obstructions, metal flow. In the absence of obstructions or other defects the switch should be referred to signal maintenance for adjustment.
Switch width at the tip	Excess switch tip width can be caused by the switch not sitting against the stock. Excess width can also be caused by breakage of the top of blade. If there is sufficient material, it may be possible to repair by grinding the switch blade. In some cases, the switch and stock will require replacement.
Switch height at the tip	High switch blades typically occur due to a loss of stock rail height. If there is sufficient material, it may be possible to repair by grinding the switch blade.
Switch Tip Wheel Clearance	A proud switch blade could be caused by poot fitment to the stock rail. Check for obstructions track geometry and blade alignment. Loss of stock rail from side wear, top wear or rail profiling can also result in exposure of the switch tip. If there is sufficient material, it may be possible to repair by grinding the switch blade.
Switch blade damage	Conventional switch blades may be ground so that the tip is no more than 200mm behind the original position.
Stock or switch rail gauge face wear angle	Switch griding may be able to restore the gauge face in some instances. If wear is excessive, replacement of stock and switch is likely required.
Fixed and pivot heel blocks and fasteners	Broken blocks and bolts should be replaced. Failures can be the result of wheel impacts or poor track geometry. These factors should be investigated.
Anti creep device including bolts	Broken bolts or anti creep devices should be replaced. Failures can be a consequence of excessive rail creep possibly caused by loss of design stress free temperature in adjoining track. This should be investigated
Rail brace/chair, slide plates and rollers.	Loose or ineffective bolts should be tightened or replaced. Cracked braces or chairs or plates should be replaced.
Switch Stops	Loose switch stops should be tightened and missing, or damages stops should be replaced.
Spreader bar	Losse of missing spreader bar bolts should be tightened or replaced. Worn insulators should be replaced. Damaged spreader bars should be replaced.

Table 3-5 Fixed Crossing Repairs

DEFECT	REPAIR
Wide gauge at the crossing nose	Investigate cause of wide gauge, this may be worn clips or shoulders. Timber bearers may require replacement. If wide gauge is due to worn rail, rerailing may be necessary.
Insufficient Check Rail Effectiveness	Loss of check rail effectiveness could be the result of tight gauge in which case fastenings and bearers should be examined. Skewed or incorrectly positioned bearers may be responsible. Alternatively, loss of effectiveness could be the result of check rail wear. Adjustable check rails should be repositioned and worn fixed check rails replaced.
Crossing nose break	Broken crossings may be repaired by building up the nose with weld. Subsequent repairs tend be less durable than the first. After the third repair replacement should be considered.
Crossing nose condition, metal flow	Metal flow should be removed by griding.
Crossing nose condition, batter/ hollow	Hollow or battered crossings can be repaired by welding.
Crossing nose condition, surface condition	Dependant upon extent of damage grinding may be appropriate to remove damage material. In more severe instances crossing replacement may be required.
Crossing Cracks	Depending upon depth crossing cracks may be repaired by welding. Cracks through the section of the casting or extending from the foot will likely require crossing replacement.
Crossing flangeway	Obstructed flangeways should be cleared.
Crossing spacer blocks and bolts	Losse or missing bolts should be tightened or replaced. Damage or missing spacer blocks should be replaced.
Wing rail vertical wear	Wing rails may be restored by welding. Typically the nose will also require welding at the same time to maintain correct nose height. Excess wear may require crossing replacement.
Wing Rail Condition, metal flow	Metal flow should be removed by griding.
Wing Rail Condition, surface condition	Dependent upon extent of damage grinding may be appropriate to remove damage material. In more severe instances crossing replacement may be required.
Wing Rail flare	Wing rail flare is impacted by wide track gauge. Check gauge and restore to design if necessary.
Check rail flangeway	Obstructed flangeways should be cleared.
Check rail flare	Check rail flare is impacted by wide track gauge. Check gauge and restore to design if necessary. Adjustable check rails with excessive wear corrected by repositioning may also cause a flare problem. In such instances the check should be replaced.
Check rail spacer blocks and bolts	Losse or missing bolts should be tightened or replaced. Damage or missing spacer blocks should be replaced.

3.4 Inspection and Assessment

Requirements to perform ultrasonic testing for points and crossings are specified in ARTC ETE-01-03 non-destructive testing of rail.

At locations where deterioration may occur at higher rates due to such factors as curvature, usage, axle load or speed, more frequent inspections may be warranted. The business unit / asset owner / asset management authority should determine if more frequent inspections are required.

Unscheduled inspections shall be conducted where an event or circumstance has occurred and has impacted, or has the potential to impact, the integrity of the track and civil infrastructure at the location of turnouts or other special trackwork.

3.4.1 Scheduled Patrol Inspections

Patrol Inspections are intended to find obvious defects that affect the safe running of trains or the material safety of the turnout.

TRACK PATROL	
Applicability	As per ETP-00-03. All mainlines, crossing loops and refuges.
Frequency	7 days where not specified by ETP-00-03 Technical Maintenance Plan
Method	As part of a patrol inspection at a maximum of 5km/h over turnouts
Reference Procedure	ETE-00-02 Track Patrol, Front of Train, and General and Detailed Inspections
Competency Required	Track Examiner & Certifier

This type of inspection shall be conducted to identify defects or conditions that could have the potential to affect the integrity of the track structure, or that indicate a risk of failure to guide rolling stock correctly over the infrastructure.

Scheduled patrol inspections should identify the following types of defects:

Table 3-6 Track Patrol Identifiable Items

Overall	Component damage that may inhibit operation (including switch operating equipment)
	Track geometry defects (including excessive or abnormal wear or damage to switch blades or other geometry crucial components).
	Loose, missing, or broken components
	Excessive material flow on the crossing nose and wing rails or the switch blade and stock rail.
	Wheel marks which indicate incorrect wheel/rail interaction.
Rail	Broken crossings, switch blades, or rails.
	Flangeway and other obstructions.
	Rail crippling.
	Rail creep which may for example lead to displacement of components and rail alignment problems.
	Rail pulling including at the point and splice rails of fabricated crossings.
Points	Switch blade not fully closed against the stock rail.
Crossings	Other obvious defects that may affect continuity of support and direction to rolling stock.
	Swing nose crossing not fully closing against wing rail.

A general inspection of specific components shall be carried out when suspected defects are identified during patrol inspections.

3.4.2 Scheduled General and Detailed Inspections

A general inspection's purpose is to identify points and crossing conditions requiring action and determine the need for further specialist inspection.

GENERAL INSPECTION OF POINTS AND CROSSINGS	
Applicability	As per ETP-00-03. General Inspection of Points and Crossings
Frequency	91 days where not specified by ETP-00-03 Technical Maintenance Plan
Method	On track observations and measurements
Reference Procedure	ETE-00-02 Track Patrol, Front of Train, and General and Detailed Inspections ETE-03-01 Inspection of Points and Crossings 3.4.4.
Competency Required	Track Examiner & Certifier

A detailed inspection purpose is similar to a general inspection but is more thorough and collects and records more data.

DETAILED INSPECTION OF POINTS AND CROSSINGS	
Applicability	As per ETP-00-03. General Inspection of Points and Crossings
Frequency	364 days where not specified by ETP-00-03 Technical Maintenance Plan
Method	On track observations and measurements
Reference Procedure	ETE-00-02 Track Patrol, Front of Train, and General and Detailed Inspections ETE-03-01 Inspection of Points and Crossings 3.4.4.
Competency Required	Advanced - Track Examiner & Certifier*

Note: This inspection may be completed by rack Examiner & Certifier until 12 months after the introduction of the Advanced – Track Examiner & Certifier role

Scheduled General and Detailed Inspections shall undertake the tasks outline in the tables below.

Only items relevant to the assembly being inspected and the type of inspection being conducted are required (for instance a diamond does not require a switch inspection and only some crossings using braces).

Assemblies contain multiples of similar components. All components shall be inspected (for instance a turnout has two switches and two check rails).

Some inspection tasks are similar. All required inspection tasks shall be completed. Identifying damaged, loose or missing components is included in overview but overlaps with more specific tasks under points or crossings. Overview inspection tasks are intended to be wide reaching and account for instances not captured under more specific tasks.

In this section:

"V" denotes a visual assessment only is required. This may include having to physically interact with the trackwork, for instance checking bolt tightness but does not include taking of measurements.

"M" denotes a measurement is required to be undertaken.

"R" denotes that the result shall be recorded.

"VR" Indicates that a visual examination shall be made, the condition rated (such as excellent, good, bad) and the result recorded.

Where required, records shall be entered using ARTC Enterprise Asset Management System forms or temporarily on ARTC standard paper report forms for future entry into the Asset. Management System. The form corresponding to the assembly type shall be used i.e. turnouts and catchpoints; diamonds and slips; and swing nose crossings etc.

Suspected defects from visual inspection shall be further investigated.

All M and VR tasks shall be assessed using 3.4.3 Assessment.

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.

Table 3-7 Overview Inspection Tasks

Feature	Task	
	General	Detailed
Inspect for damaged, loose, missing, or broken components	V	V
Check Track geometry, measure any suspected faults	V	VR
Check bearer and fastener effectiveness and general condition	V	VR
Check ballast condition, fouling and profile	V	VR
Check condition of welds and joints	V	V
Check for broken steelwork (crossing, points, rails)	V	V
Check for indicators of rail creep, position of anti-creep blocks, switch squareness	V	V
Check condition of rail	V	V
Check rail wear	V	MR
Look for indicators of incorrect wheel/rail interaction	V	V

Table 3-8 Points Specific Inspection Tasks

Feature	Task	
	General	Detailed
Switch opening	MR	MR
Track gauge at the switch tip	MR	MR
Back of switch blade to opposite gauge face at tip	MR	MR
Back of switch blade to opposite switch rail at supplementary drive or stretcher	V	MR
Measure Throat opening	MR	MR
Check switch blade and stock rail for metal flow, cracking and damage breakout	V	V
Check for indicators of switch alignment issues	V	VR
Switch blade closed gap	MR	MR
Tip Width (conventional only)	V	MR
Tip Height (conventional only)	V	MR
Switch Tip Wheel Clearance (undercut only)	V	MR
Check for switch blade damage, measure if present	V	MR

Feature	Task	
	General	Detailed
Gauge face angle	V	MR
Check for damaged, missing or loose heel block and bolts	V	V
Check for damaged, missing or loose anti-creep devices and bolts	V	V
Check for damage to rail brace/chair, slide plates and rollers	V	VR
Check for damaged, lose or ineffective switch stops	V	VR
Check for loose, broken or missing spreader bars	V	V
Check for gaps between switch and chairs/baseplates	V	V/MR

Housed points have additional tasks. They shall be completed in addition to those of unhoused points excepting switch opening for unhoused points shall be omitted.

Table 3-9 Housed Points Inspection Tasks

Feature	Task	
	General	Detailed
Checkrail flangeway and housing flangeway clearance	V	MR
Top of housing above checkrail	V	MR
Vertical clearance between Switch tip and Housing	V	MR
Open throw dimension	MR	MR
Width of housing	V	MR
Flare at end of housing and check rail	V	MR

Table 3-10 Fixed Crossing Inspection Tasks

Feature	Task	
	General	Detailed
Gauge at nose	MR	MR
Checkrail effectiveness	MR	MR
Crossing nose width	V	MR
Check for cracks and breakouts on crossing	V	VR
Crossing flangeway	V	VR
Check for cracked, broken or missing crossing spacer blocks and bolts	V	V
Wing rail wear	V	MR
Check for metal flow, cracks and breakouts on wing rail	V	V
Wing Rail flare	V	M
Check Rail flangeway	MR	V
Check Rail flare	V	M
Check for cracked, broken or missing check rail spacer blocks and bolts	V	V

Swing nose crossings do not require inspection against the fixed nose crossing criteria only the following:

Table 3-11 Swing Nose Crossing Inspection Tasks

Feature	Task	
	General	Detailed
Point Rail closed gap	MR	MR
Wing Rail Flare	V	V
Track gauge at the crossing nose	MR	MR
Check for metal flow, cracks and breakouts on crossing and wing	V	V
Check for indicators of incorrect nose Alignment	V	VR
Swing Nose Protrusion	V	MR
Swing nose point rail damage	V	MR
Gauge face angle	V	MR
Check for cracks and breakouts Heel blocks and bolts	V	V
Check for loose, cracked, broken or missing anti-creep devices	V	V
Check for protrusion, cracks and breakouts splice joint	V	MR
Check for damaged, lose or ineffective Rail brace/chair, slide plates and rollers	V	VR
Check for cracked, ineffective, broken or missing swing nose stops	V	VR
Check for gaps between swing nose and chairs/baseplates	V	VR

Table 3-12 Switch Operation Inspection Tasks

Feature	Task	
	General	Detailed
Drive, lock or detection bars binding on underside of rail	V	V
Hand operated lever (non-interlocked yards and sidings) lubrication, operation and condition of equipment and visibility of indicators.	V	V
Slide plate lubrication and condition of rollers	V	V

3.4.3 Assessment

This section contains responses that are specific to points and crossing equipment only. It is in additional to responses required by other parts of the ARTC Code of Practice.

Where a defect is identified that does not have a specific response (such as a general missing component), the response should be determined by a competent Inspector. The inspector may seek further advice from the local engineering authority if required.

CER AUTHORITY
If the cause of the defect is known and it is known that it will not deteriorate into an unsafe condition a less stringent result to that shown may be permitted by the CER.

At all times, vertical, lateral, longitudinal and rotational restraint and support of the rails shall be maintained to ensure acceptable geometry is presented to the rolling stock wheels as specified in ETS-05-00 Track Geometry.

Table 3-13 references other parts of this document that define condition assessment and response criteria for components relevant to points and crossing assemblies.

Unless specified below the track geometry criteria defined in ETS-05-00 Track Geometry should be used.

Table 3-13 Other Relevant Sections in this Code of Practice

COMPONENT	CODE OF PRACTICE
Rail and Rail Joints (Welded and Non-Welded)	Section 1 Rail
Sleepers/Fastenings (non-critical areas)	Section 2 Sleepers and Fastenings
Ballast	Section 4 Ballast
Track Geometry	ETS-05-00 Track Geometry

ARTCs network exists in many different operating conditions as well as having different objectives dependent upon criticality or other factors. Business units should determine the necessity for additional or escalated responses applicable to meet their asset management objectives.

Where a defect only impacts one route through a turnout it may be controlled by preventing train movements through a route of the turnout, in effect closing one track but continuing to permit movement on the other, an alternative action that may be taken is to install a point's clip in accordance with safe working rules.

Where a defect relates to a switch tip strike hazard an additional control may be to prevent facing movements.

Where a response includes a TSR that is the same or higher than the posted track speed a TSR is not required to be implemented. In these instances, the condition shall still be recorded, monitoring increased and repair prioritised.

3.4.3.1 Overview

Table 3-14 Overview Assessment

ELEMENT	CONDITION	RESPONSE	
Component Damage	Any component loose, missing or broken.	A6	Increase monitoring, prioritise repair
Track geometry, Pumping in Critical Areas	5 – 20 mm	A6	Increase monitoring, prioritise repair
	20 mm or more	A6	Increase monitoring, prioritise repair
Track Geometry, Overall Condition	Visible deterioration	A6	Increase monitoring, prioritise repair
	Single Measured defect	-	ETS-05-00 5.4 table 5-15
	Multiple measured defects	-	ETS-05-00 5.4 table 5-15
Bearers and Fasteners, Ineffective in Critical Areas	1	A6	Increase monitoring, prioritise repair
	2 consecutive	A3	40 km/h TSR until repaired
	> 2 consecutive	A1	10 km/h TSR until repaired
Bearers and Fasteners, Overall Condition	< 20% loose clips, screws or spikes, timbers degraded	A6	Increase monitoring, prioritise repair
	Pads and insulators skewed some fasteners missing 1 in 4 timbers deteriorating	A6	Increase monitoring, prioritise repair
	> 50% loose clips, screws or spikes, 1 in 3 timbers degraded missing fasteners	A6	Increase monitoring, prioritise repair

ELEMENT	CONDITION	RESPONSE	
Ballast, condition and profile	Fines on surface. Ballast shoulder reduced.	A6	Increase monitoring, prioritise repair
	Trapped moisture, mud and track pumping. Ballast low, ends of multiple bearers visible.	A6	Increase monitoring, prioritise repair
Ballast, Excess	Ballast < 25 mm from moving parts. Ballast loose on sleepers.	A6	Increase monitoring, prioritise repair
	Ballast touching moving parts or ballast obstructing inspection of fasteners. Ballast fallen into trough.	A6	Increase monitoring, prioritise repair
Rail, Creep	Any of below Misalignment at heel Signs of rail movement Blade up out of square. Greater than 15 mm clearance of moving drive locking and detection equipment from fixed parts. Anti creep device not correctly positioned for current rail temp	A6	Increase monitoring, prioritise repair
Rail, Condition	Irregular contact band.	A6	Increase monitoring, prioritise repair
	Minor RCF, wheel burns or top / side wear. Evidence of bent rail.	A6	Increase monitoring, prioritise repair
	Severe RCF likely to interfere with Ultrasonic testing. Advanced wear. Corrugations. Other rail defects requiring a response.	A6	Increase monitoring, prioritise repair
Rail, Remaining Head Height	35mm to 26 mm	A7	Routine scheduled inspection
	24 to 26 mm and without defect per Section 1 Rail	A6	Increase monitoring, prioritise repair
	Head height defect	-	Section 1 Rail

3.4.3.2 Points

ELEMENT	CONDITION	RESPONSE	
Switch Opening, actual	85 mm to < 95 mm	A6	Increase monitoring, prioritise repair
	80 mm to < 85 mm	A2	20 km/h TSR until repaired
	< 80 mm	A1	10 km/h TSR until repaired
Track gauge (at the switch tip)	≥ 1456 mm	-	Assess as per ETS-05-00 Table 5-15
	1445 mm to < 1456 mm	A6	Increase monitoring. Prioritise repair
	1430 mm to < 1445 mm	A7	Routine scheduled inspection
	1427 mm to < 1430 mm	A4	60/65 km/h TSR until repaired
	1425 mm to < 1427 mm	A2	20 km/h TSR until repaired
	< 1425 mm	A1	10 km/h TSR until repaired
Back of switch blade to opposite switch gauge face at tip	1360 mm to < 1365 mm	A6	Increase monitoring. Prioritise repair
	1365 mm to < 1370 mm	A2	20 km/h TSR until repaired
	≥ 1370 mm	A1	10 km/h TSR until repaired
Back of switch blade to opposite switch blade at supplementary drive or stretcher, measurement	1370 mm to < 1380 mm	A6	Increase monitoring. Prioritise repair
	1380 mm to < 1390 mm	A3	40 km/h TSR until repaired
	1390 mm to < 1400 mm	A2	20 km/h TSR until repaired
	> 1400 mm	A1	10 km/h TSR until repaired
Throat Opening (Back of switch blade to stock rail at the junction of heads)	40 mm and greater	A7	Routine inspection
	35 mm to < 40 mm	A3	40 km/h TSR until repaired
	< 35 mm	A1	10 km/h TSR until repaired
Switch blade and stock rail condition, metal flow	1 mm or more flow	A6	Increase monitoring. Prioritise repair
Switch blade and stock rail condition, surface condition	Visible damage, breakout of cracks, moderate to severe RCF and head checking	A6	Increase monitoring. Prioritise repair
Switch Alignment	Bends evident, possible previous repair. Gap to switch stops and/or gap switch blade to stock rail through (excepting toe) 5 -10 mm.	A3	40 km/h TSR until repaired
	Bent, gaps greater 10 mm	A1	10 km/h TSR until repaired
Switch blade closed gap	1 mm to 3 mm	A6	Increase monitoring. Prioritise repair
	>3 mm	A1	10 km/h TSR until repaired
Switch width at the tip, conventional only	3 mm to < 4 mm	A6	Increase monitoring. Prioritise repair
	> 4 mm to < 5 mm	A3	40 km/h TSR until repaired
	5 mm or more	A1	10 km/h TSR until repaired
Switch height at the tip, measured using ARTC switch tip gauge, conventional only	> 10 mm to < 12 mm	A6	Increase monitoring. Prioritise repair
	> 8 mm to < 10 mm	A3	40 km/h TSR until repaired
	8 mm or less	A1	10 km/h TSR until repaired
Switch height at the tip, measured with ruler, conventional only	> 12 mm to < 13 mm	A6	Increase monitoring. Prioritise repair
	12 mm or less	A1	10 km/h TSR until repaired

ELEMENT	CONDITION	RESPONSE	
Switch Tip Wheel Clearance, undercut only	2 mm to > 1 mm	A6	Increase monitoring. Prioritise repair
	1 mm to > 0 mm	A3	40 km/h TSR until repaired
	0 mm or less	A1	10 km/h TSR until repaired
Switch blade damage	100 mm to < 200 mm	A6	Increase monitoring. Prioritise repair
	> 200 mm	A1	10 km/h TSR until repaired
Stock rail or switch blade gauge wear face angle	≤ 22	A7	Routine inspection
	>22 to < 26	A6	Increase monitoring. Prioritise repair
	26 or greater	A1	10 km/h TSR until repaired
Fixed and pivot heel blocks	Cracked	A4/ A3	80/90 km/h TSR until repaired Heavy Haul 40 km/h TSR until repaired
	Broken but still effective	A3	40 km/h TSR until repaired
	Missing/Broken and ineffective	A1	10 km/h TSR until repaired
Fixed and pivot heel blocks, bolts	Missing/ineffective ≤ 2	A4/ A3	60/65 km/h TSR until repaired Heavy Haul 40 km/h TSR until repaired
	Missing/ineffective 3	A3	40 km/h TSR until repaired
	Missing/ineffective >3	A1	10 km/h TSR until repaired
Anti creep device including bolts	Loose cracked but effective.	A6	Increase monitoring. Prioritise repair
	Missing/Broken and ineffective	A6	Increase monitoring. Prioritise repair
Rail brace/chair, slide plates and rollers.	Cracked/loose 1 only	A6	Increase monitoring. Prioritise repair
	Broken/Ineffective 1 only	A4/ A3	60/65 km/h TSR until repaired Heavy Haul 40 km/h TSR until repaired
	2 consecutive cracked / loose / broken / ineffective	A3	40 km/h TSR until repaired
	> 2 consecutive cracked / loose / broken / ineffective	A1	10 km/h TSR until repaired
Switch Stops	Cracked/loose 1 only	A6	Increase monitoring. Prioritise repair
	Missing/Ineffective 1 only	A4/ A3	60/65 km/h TSR until repaired Heavy Haul 40 km/h TSR until repaired
	2 consecutive cracked / loose / broken / ineffective	A3	40 km/h TSR until repaired
	> 2 consecutive cracked / loose / broken / ineffective	A1	10 km/h TSR until repaired
Spreader bar	Loose fastenings or worn insulators	A6	Increase monitoring. Prioritise repair
	Missing/broken	A1	10 km/h TSR until repaired
Switch Blade Support	Gaps >2mm through blade or >1mm at drive points	A6	Increase monitoring. Prioritise repair

Table 3-15 Points Assessment

3.4.3.3 Housed Points

ELEMENT	CONDTION	RESPONSE	
Checkrail flangeway and housing flangeway clearance	> 50 mm	A4	60/65 km/h TSR until repaired
	48 mm to 50 mm	A6	Increase monitoring. Prioritise repair
	42 mm to 47 mm	A7	Routine scheduled inspection
	40 mm to 41 mm	A6	Increase monitoring. Prioritise repair
	< 40 mm	A4	60/65 km/h TSR until repaired
Top of housing above checkrail	32 mm to 35 mm	A6	Increase monitoring. Prioritise repair
	36 mm to 37 mm	A3	40 km/h TSR until repaired
	> 37 mm	A1	10 km/h TSR until repaired
Vertical clearance between Switch tip and Housing	< 3 mm	A6	Increase monitoring, raise known condition and plan rectification.
Switch toe to stock rail open throw dimension	85 mm to < 95 mm	A6	Increase monitoring. Prioritise repair
	80 mm to < 85 mm	A2	20 km/h TSR until repaired
	< 80 mm	A1	10 km/h TSR until repaired
Width of housing	< 140 mm	A6	Increase monitoring. Prioritise repair
Flare at end of housing and check rail	1360 mm to < 1365 mm	A6	Increase monitoring. Prioritise repair
	1365 mm to < 1370 mm	A3	40 km/h TSR until repaired
	≥ 1370mm	A1	10 km/h TSR until repaired

Table 3-16 Housed Points Assessment

3.4.3.4 Fixed Crossings

ELEMENT	CONDITION	RESPONSE
Track gauge (at the crossing nose)	≥ 1443 mm	A1 10 km/h TSR until repaired
	> 1440 mm to < 1443 mm	A4 60/65 km/h TSR until repaired
	> 1438 mm to 1440 mm	A6 Increase monitoring. Prioritise repair
	> 1430 mm to 1438 mm	A7 Routine scheduled inspection
	> 1427 mm to 1430 mm	A6 Increase monitoring. Prioritise repair
	> 1425 mm to 1427 mm	A4 60/65 km/h TSR until repaired
	1425 mm and less	A1 10 km/h TSR until repaired
Check Rail Effectiveness	≥ 1400 mm	A1 10 km/h TSR until repaired
	1398 mm to < 1400 mm	A3 40 km/h TSR until repaired
	1396 mm to < 1398 mm	A4 60/65 km/h TSR until repaired
	1389 mm to < 1396 mm	A7 Routine scheduled inspection
	1386 mm to < 1389 mm	A6 Increase monitoring. Prioritise repair
	1384 mm to < 1386 mm	A4 60/65 km/h TSR until repaired
	1382 mm to < 1384 mm	A3 40 km/h TSR until repaired
	< 1382 mm	A1 10 km/h TSR until repaired
Crossing nose break width	15 mm to 20 mm width	A6 Increase monitoring. Prioritise repair
	20 mm to 25 mm width	A3 40 km/h TSR until repaired
	> 25 mm wide	A1 10 km/h TSR until repaired
Crossing nose condition, metal flow	1 mm or more flow	A6 Increase monitoring. Prioritise repair
Crossing nose condition, batter/ hollow	2 mm or more hollow / severe	A6 Increase monitoring. Prioritise repair
Crossing nose condition, surface condition	Pieces 3mm or more across have fallen from surface	A6 Increase monitoring. Prioritise repair
Crossing Cracks	No cracks	A7 Routine scheduled inspection
	Noncritical	A6 Increase monitoring. Prioritise repair
	Critical	A6 Increase monitoring. Prioritise repair
	Fully (not affecting the running surface)	A4 60/65 km/h TSR until repaired
	Fully (affecting the running surface)	A1 10 km/h TSR until repaired
Crossing flangeway	Visible evidence of flange tips running in dirt.	A6 Increase monitoring. Prioritise repair
	Flangeway obstructed (with ballast etc) or evidence of flange tip running on steel work	A1 10 km/h TSR until repaired
Crossing spacer blocks	Cracked	A4 60/65 km/h TSR until repaired A3 Heavy Haul 40 km/h TSR until repaired
	Broken but still effective	A3 40 km/h TSR until repaired
	Missing/Broken and ineffective	A1 10 km/h TSR until repaired

ELEMENT	CONDITION	RESPONSE	
Crossing spacer blocks, bolts	Single or multiple bolts loose yet effective	A6	Increase monitoring. Prioritise repair
	Missing/ineffective ≤2	A4 A3	60/65 km/h TSR until repaired Heavy Haul 40 km/h TSR until repaired
	Missing/ineffective 3	A3	40 km/h TSR until repaired
	Missing/ineffective >3	A1	10 km/h TSR until repaired
Wing rail vertical wear	5 mm to 10 mm	A6	Increase monitoring. Prioritise repair
	>10 mm	A3	40 km/h TSR until repaired
Wing Rail Condition, metal flow	2mm or more flow	A6	Increase monitoring. Prioritise repair
Wing Rail Condition, surface condition	Pieces 3mm or more across have fallen from surface	A6	Increase monitoring. Prioritise repair
Wing Rail flare	1360 mm to < 1365 mm	A6	Increase monitoring. Prioritise repair
	1365 mm to < 1370 mm	A3	40 km/h TSR until repaired
	≥ 1370mm	A1	10 km/h TSR until repaired
Check rail flangeway	>49 mm	A4	60/65 km/h TSR until repaired
	48 mm to 49 mm	A6	Increase monitoring. Prioritise repair
	40 mm to < 48 mm	A7	Routine scheduled inspection
	38 mm to < 40 mm	A6	Increase monitoring. Prioritise repair
	< 38 mm	A4	60/65 km/h TSR until repaired
Check rail flare	1360 mm to < 1365 mm	A6	Increase monitoring. Prioritise repair
	1365 mm to < 1370 mm	A3	40 km/h TSR until repaired
	≥ 1370mm	A1	10 km/h TSR until repaired
Check rail spacer blocks	Cracked	A4 A3	60/65 km/h TSR until repaired Heavy Haul 40 km/h TSR until repaired
	Broken but still effective	A3	40 km/h TSR until repaired
	Missing/Broken and ineffective	A1	10 km/h TSR until repaired
Check rail spacer blocks, bolts	Missing/ineffective ≤2	A4 A3	60/65 km/h TSR until repaired Heavy Haul 40 km/h TSR until repaired
	Missing/ineffective 3	A3	40 km/h TSR until repaired
	Missing/ineffective >3 or missing end bolt in check rail.	A1	10 km/h TSR until repaired

Table 3-17 Fixed Crossing Assessment

3.4.3.5 Swing Nose Crossings

ELEMENT	CONDITION	RESPONSE ACTION	
Crossing nose closed gap	1 mm to 3 mm	A6	Increase monitoring. Prioritise repair
	> 3 mm	A1	10 km/h TSR until repaired
Wing rail flare	1360 mm to < 1365 mm	A6	Increase monitoring. Prioritise repair
	1365 mm to < 1370 mm	A3	40 km/h TSR until repaired
	≥ 1370mm	A1	10 km/h TSR until repaired
Track gauge (at the crossing nose)	≥ 1456 mm	-	Assess as per ETS-05-00 Table 5-15
	1445 mm to < 1456 mm	A6	Increase monitoring. Prioritise repair
	1430 mm to < 1445 mm	A7	Routine scheduled inspection
	1427 mm to < 1430 mm	A4	60/65 km/h TSR until repaired
	1425 mm to < 1427 mm	A2	20 km/h TSR until repaired
	< 1425 mm	A1	10 km/h TSR until repaired
Crossing nose and wing condition, metal flow	1 mm or more flow	A6	Increase monitoring. Prioritise repair
Crossing nose and wing condition, surface condition	Pieces 3 mm or more across have fallen from surface	A6	Increase monitoring. Prioritise repair
Nose Alignment	Bends evident, possible previous repair. Gap to switch stops and/or gap switch blade to stock rail through (excepting toe) 5 -10 mm.	A3	40 km/h TSR until repaired
	Bent, gaps greater 10 mm	A1	10 km/h TSR until repaired
Swing nose protrusion	Nose projects beyond running surface less than 1mm, no evidence of flange contact.	A6	Increase monitoring. Prioritise repair
	Nose projects beyond running surface less than 1mm with evidence of flange contact.	A3	40 km/h TSR until repaired
	Nose projects beyond running surface by more than 1mm.	A1	10 km/h TSR until repaired
Swing nose point rail damage	100 mm to < 200 mm	A6	Increase monitoring. Prioritise repair
	> 200 mm	A1	10 km/h TSR until repaired
Swing nose point rail or wing rail gauge wear face angle	22 to < 26	A6	Increase monitoring. Prioritise repair
	26 or greater	A1	10 km/h TSR until repaired
Heel blocks	Cracked	A5 A3	80/90 km/h TSR until repaired Heavy Haul 40 km/h TSR until repaired
	Broken but still effective	A3	40 km/h TSR until repaired
	Missing/Broken and ineffective	A1	10 km/h TSR until repaired
Heel blocks, bolts	Missing/ineffective ≤ 2	A4 A3	60/65 km/h TSR until repaired Heavy Haul 40 km/h TSR until repaired
	Missing/ineffective 3	A3	40 km/h TSR until repaired

ELEMENT	CONDITION	RESPONSE ACTION	
	Missing/ineffective > 3	A1	10 km/h TSR until repaired
Anti creep device including bolts	Loose cracked but effective.	A6	Increase monitoring. Prioritise repair
	Missing/Broken and ineffective	A6	Increase monitoring. Prioritise repair
Crossing spacer blocks	Cracked	A4 A3	60/65 km/h TSR until repaired Heavy Haul 40 km/h TSR until repaired
	Broken but still effective	A3	40 km/h TSR until repaired
	Missing/Broken and ineffective	A1	10 km/h TSR until repaired
Crossing spacer blocks, bolts	Single or multiple bolts loose yet effective	A6	Increase monitoring. Prioritise repair
	Missing/ineffective ≤2	A4 A3	60/65 km/h TSR until repaired Heavy Haul 40 km/h TSR until repaired
	Missing/ineffective 3	A3	40 km/h TSR until repaired
	Missing/ineffective >3	A1	10 km/h TSR until repaired
Splice joint, protrusion of point of splice	Point of splice rail projects beyond running surface less than 1mm, no evidence of flange contact.	A6	Increase monitoring. Prioritise repair
	Point of splice rail projects beyond running surface less than 1mm with evidence of flange contact.	A3	40 km/h TSR until repaired
	Point of splice projects beyond running surface by more than 1mm.	A1	10 km/h TSR until repaired
Splice joint, surface condition	Pieces 3 mm or more across have fallen from surface	A6	Increase monitoring. Prioritise repair
Rail brace/chair, slide plates and rollers.	Cracked/loose 1 only	A6	Increase monitoring. Prioritise repair
	Broken/Ineffective 1 only	A4 A3	60/65 km/h TSR until repaired Heavy Haul 40 km/h TSR until repaired
	2 consecutive cracked / loose / broken / ineffective	A3	40 km/h TSR until repaired
	>2 consecutive cracked / loose / broken / ineffective	A1	10 km/h TSR until repaired
Swing nose stops	Cracked/loose 1 only	A6	Increase monitoring. Prioritise repair
	Missing/Ineffective 1 only	A4 A3	60/65 km/h TSR until repaired Heavy Haul 40 km/h TSR until repaired
	2 consecutive cracked / loose / broken / ineffective	A3	40 km/h TSR until repaired
	>2 consecutive cracked / loose / broken / ineffective	A1	10 km/h TSR until repaired
Point Rail Support	No gap or gaps less than 1mm	A7	Routine scheduled inspection
	Gaps up to 2mm through blade but less than 1mm at drive points	A6	Increase monitoring. Prioritise repair
	Gap of up 4mm or 2mm at drive points	A6	Increase monitoring. Prioritise repair
	Gaps greater than 4mm or greater than 2mm at point	A6	Increase monitoring. Prioritise repair
Point Rail Slide	New no wear up to 2mm	A7	Routine scheduled inspection

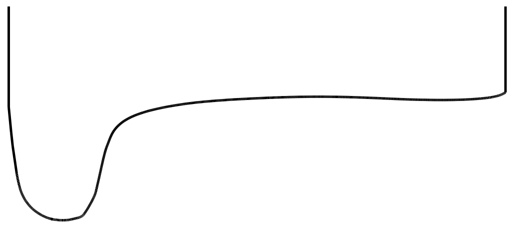
ELEMENT	CONDITION	RESPONSE ACTION
Plate Wear	Wear more than 2mm deep	A6 Increase monitoring. Prioritise repair

Table 3-18 Swing Nose Crossing Assessment

Appendix A - Reference Wheel Profiles

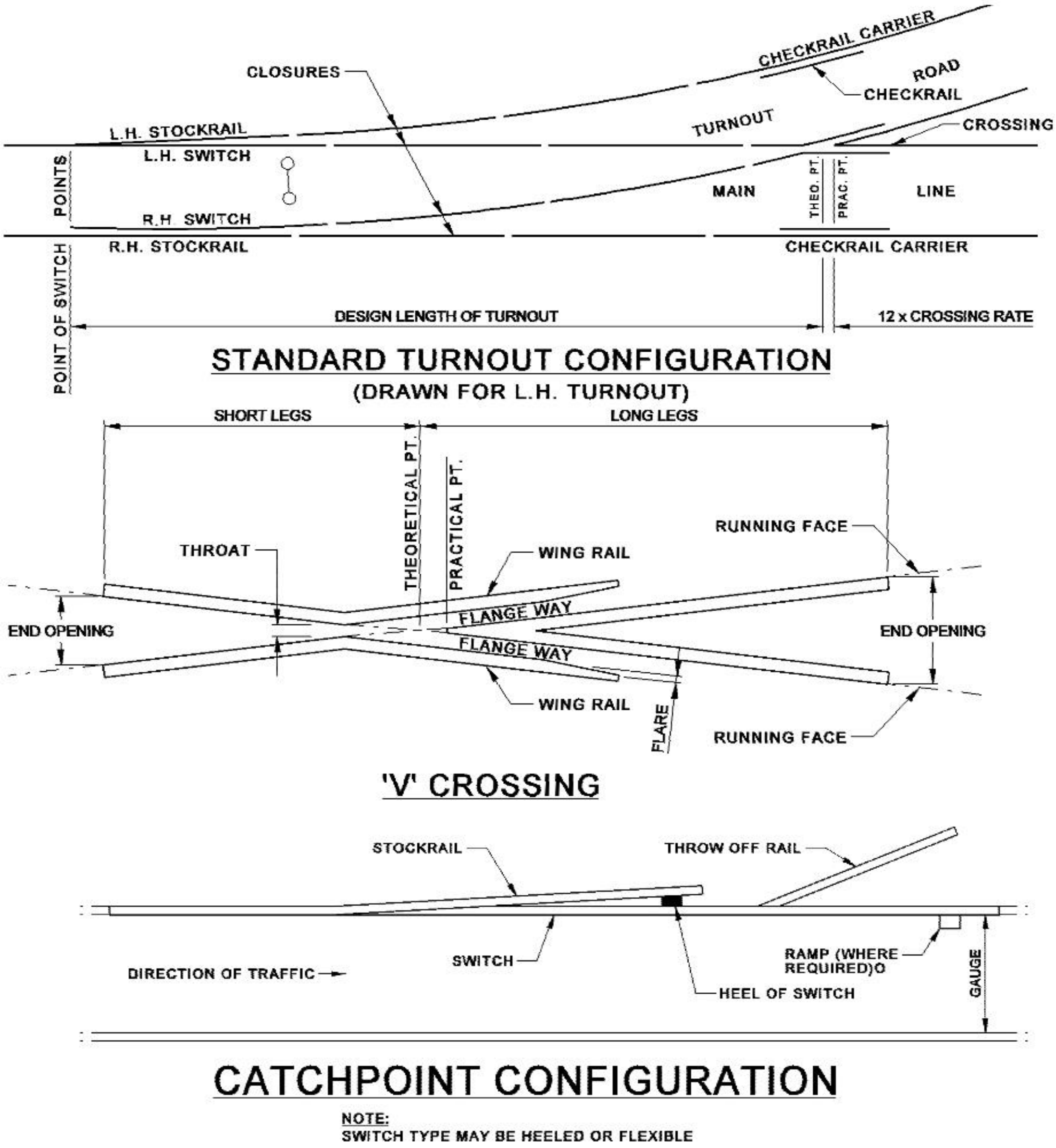
Figure 3-8 Profile for strike assessment

Figure 3-9 Profile for wheel transfer / impact assessment



Appendix B - Typical Configurations

Figure 3-10 Heeled and Flexible Switches



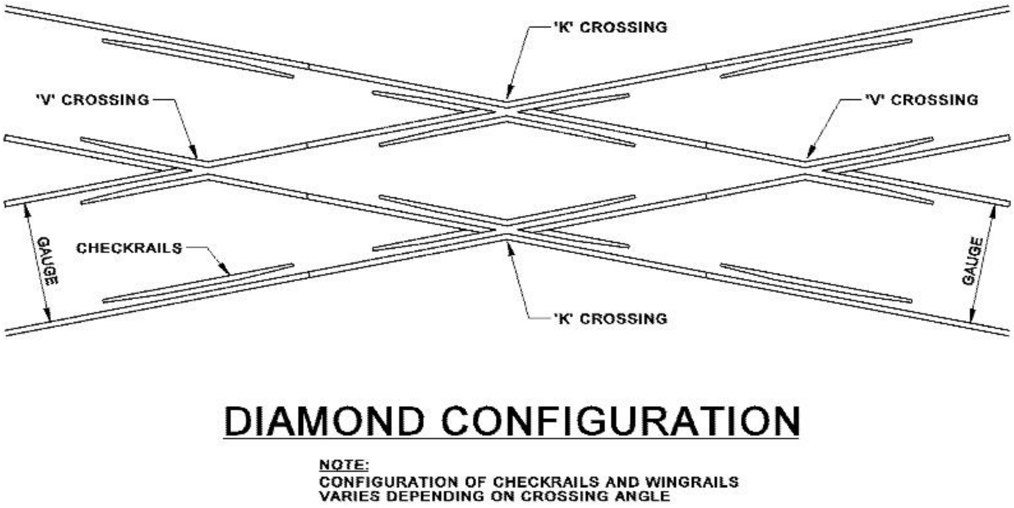
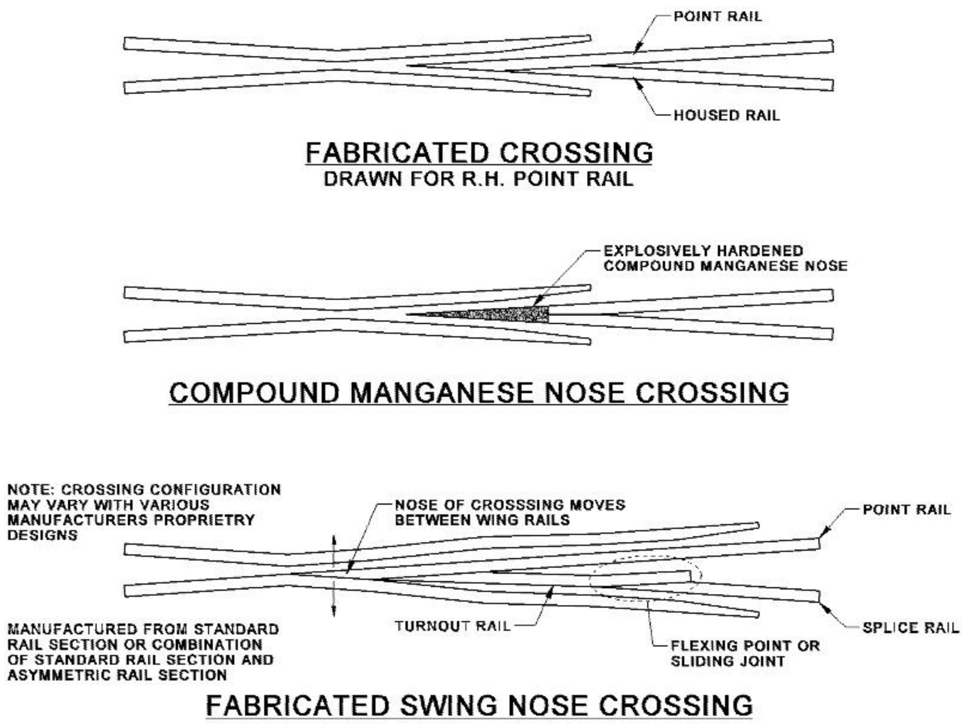
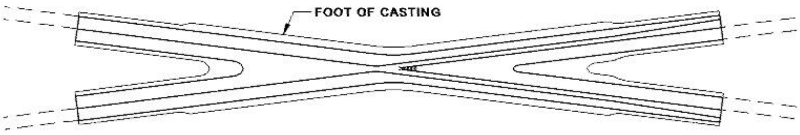
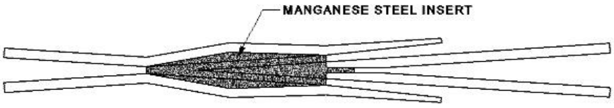


Figure 3-11 V Crossing types





SOLID CAST MANGANESE CROSSING



RAIL BOUND MANGANESE CROSSING

SPRING WING CROSSING

Figure 3-12 Heeled and Flexible Switches

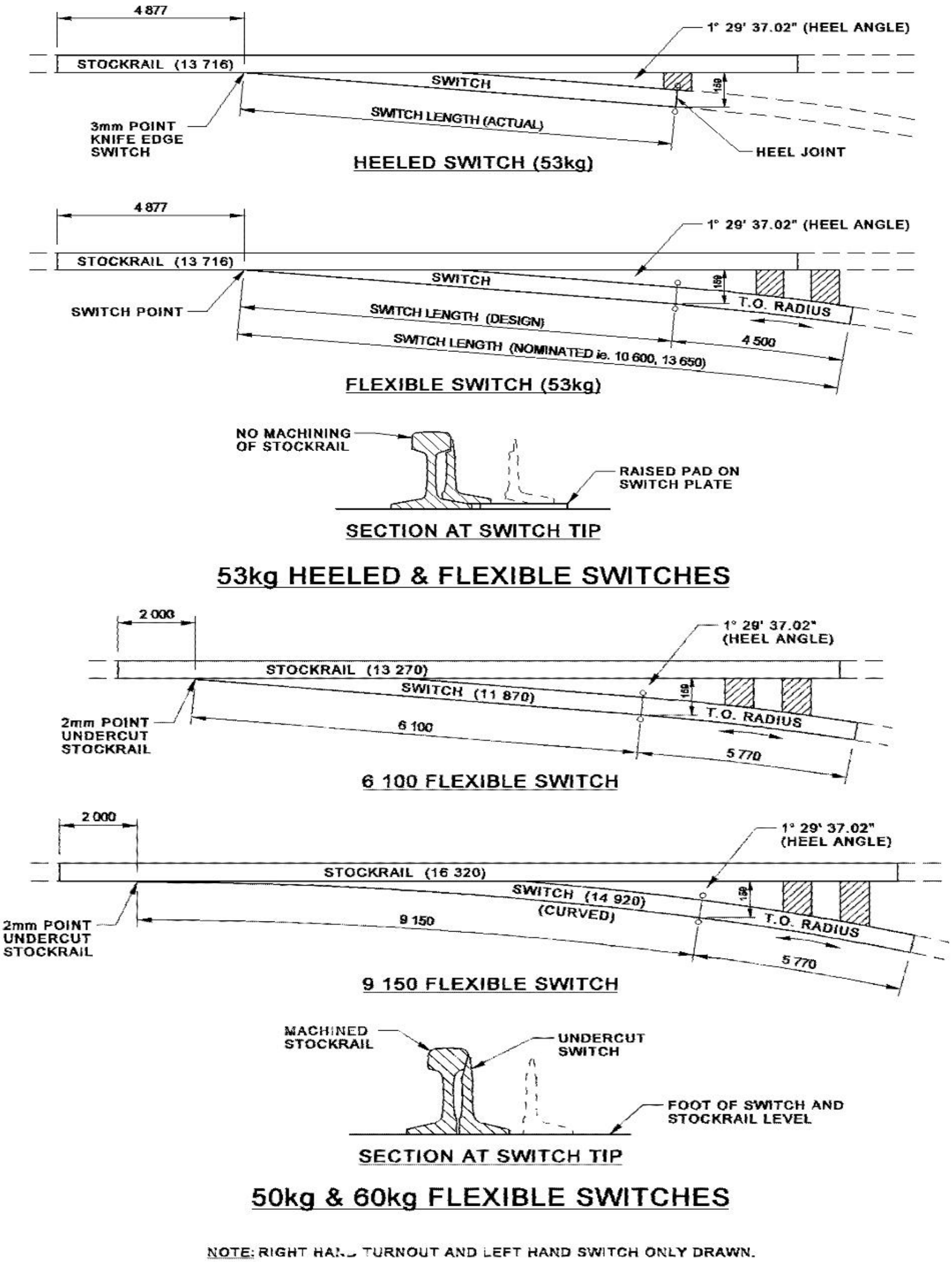


Figure 3.4 Tangential and Heavy Duty Switches

Figure 3-13 Heeled and Flexible Switches