TRACK AND CIVIL INFRASTRUCTURE

CODE OF PRACTICE

VOLUME THREE - TRAM SYSTEM [CP3]

POINTS AND CROSSINGS

TABLE OF CONTENTS

1.0 PURPOSE AND SCOPE

1.1 PURPOSE

The purpose of this part is to set standards to ensure that tramline points and crossings are safe and fit for purpose.

1.2 SCOPE

This part complies with the principles set out in the "Code of Practice for the Defined Interstate Rail Network," volume 4, part 2, section 3.

1.3 DEFINITIONS

1.3.1 Railway points and crossings

Railway points and crossings are designed and manufactured for use with trams and are modified through the flangeways and switches to accept tram profile wheels.

1.3.2 Tramline points and crossings

Tramline points and crossings are designed and manufactured for use only with trams and are compatible with grooved rail.

1.3.3 Points and crossing check rails

Check rails used in points and crossings are used opposite "V" crossings to prevent wheels deviating from their normal course and may be made of rail or other steel sections.

Note that in this Code of Practice, points and crossing check rails are hereafter referred to as "check rails" with the usage distinguishing them from check rails used as continuous check rails.

1.4 REFERENCES

1.4.1 TransAdelaide documents

a) **CP3**

CP-TS-976: Part 6, Track geometry
CP-TS-980: Part 10, Track support systems
CP-TS-981: Part 11, Rails and rail joints
CPRD/PRC/046 Records Management

b) **Infrastructure Services Management System Procedure Manual**

QP-IS-501: Document and Data Control

2.0 DESIGN OF POINTS AND CROSSINGS

2.1 STANDARD TRACK COMPONENTS

This part refers to components specifically designed for use in tramline points and crossings (e.g. switches, crossings etc.). Other components used in points and crossings and the relevant parts are as follows:

a) Closure and lead rails, plain running rails, rail joining methods (including Kirby Joints), fishplates, insulated joints or welded joints and rail fastenings generally – see CP-TS-981 (Rails and rail joints);

b) Sleepers, crossing timbers and bearers, track fastenings including all base plates/sleeper plates and their fastenings and ballast – see CP-TS-980 (Track support systems).

c) Track geometry – see CP-TS-976 (Track geometry).

2.2 DESIGN CRITERIA FOR TRAMLINE POINTS AND CROSSING ASSEMBLIES

The following criteria shall be common to the design of all tramline points and crossings used on 1435mm gauge tramlines of TransAdelaide:

a) Components shall be designed for the back to back dimension of wheelsets to be 1389 ± 1mm and shall allow for new and worn wheels, i.e. a maximum wheel flange height of [redacted].

b) The dimension from the running rail gauge face of the ‘V’ or ‘K’ crossing to the working face of the check rail shall be 1405 ± 1mm.

c) The flangeway through crossings shall be as follows:

1) width = 30 ± 1mm wide;

2) depth = 20 ± 1mm at ends ramped up no steeper than 1 in 80 to 11 ± 1mm between the knuckle and the point of the “V”.

d) The width and depth of the flangeway through check rails shall be 30 ± 1mm.

e) Check rails shall be flared, either with a bend in the rail or by planing, with a lead-in angle of 1 in 18 and a flare opening of 90mm (i.e. flare is 810mm long).

f) Check rails shall be at the same top of rail level as the running rail (± 5mm).

g) The design switch opening shall be [redacted]mm.

h) The switch flangeway at the throat of the switch (when open) shall be a minimum of 35mm.

i) The crossing nose shall be 14mm wide; the distance from the theoretical point of the crossing to the actual point shall be 14 times the crossing number in mm. The crossing nose shall be 3mm below the plane of the tops of the rails.

j) The maximum speed through all turnout curves shall be at ‘notch 1’ speed.

3.0 MONITORING AND MAINTENANCE

3.1 INSPECTION

This section and sections 4.0 to 6.0 prescribe the minimum requirements for the inspection and response to the condition of all points and crossing configurations. Inspections shall include the specific conditions shown in table 3.1.

Table 3.1: Points and crossings inspection

Type of inspection	Specific actions or conditions to look for
Scheduled inspections	
Walking inspections	a) Identify visually, and report, obvious points and crossings defects and conditions (i.e. indicators of a defect) including: 1) broken crossings, switch blades or rails; 2) missing components; 3) damage to any component affecting its integrity; 4) flangeway or other obstructions; 5) track geometry defects; 6) wheel marks indicating incorrect wheel/rail relationship; 7) rail creep or rail pulling affecting points and crossings; or 8) any other obvious defects as defined in sub-section 3.2. b) Intervals between walking inspections shall not exceed 31 days.
Detailed inspections	To be carried out in a manner appropriate to the points and crossing type, condition, and rate of deterioration, and other local and seasonal factors, at intervals dictated by necessity but not exceeding one year. A detailed inspection of specific components should also be carried out when suspected defects are identified from conditions determined during walking inspections. Measurements should be taken and recorded for assessment and action where any defect is suspected. A checklist is to be used and each item, as defined in sub-section 3.2, checked off and passed with any defects or defective conditions recorded.
Unscheduled inspections	To be undertaken following the report of suspected sub-standard condition, damage or a derailment and may include a detailed inspection.
Assessment and maintenance actions	The condition assessment, response criteria and assessment responses shall be in accordance with sections 4.0 to 6.0. The following define condition assessment and response criteria for other components relevant to points and crossings: a) Track geometry: CP-TS-976 (Track geometry). The track geometry criteria defined in CP-TS-976 (Track geometry) for plain track shall only be used in the non-critical areas of points and crossing structures; b) Ballast: CP-TS-980 (Track support systems); c) Sleeper or fastenings in non-critical areas: CP-TS-980 (Track support systems); d) Rails and welded & non-welded rail joints: CP-TS-981 (Rails and rail joints).

3.2 IDENTIFYING SUSPECTED DEFECTS

Inspections should identify suspected defects in points and crossings and their components including the following check list:

3.2.1 Turnout and diamond assemblies in respect of:
- a) missing or broken components;
- b) track geometry; and
- c) track centre to track centre at fouling points or catch points.

3.2.2 Rail condition in respect of:
- a) rail and weld defects from visual inspection;
- b) rail wear.

3.2.3 Switches in respect of:
- a) gauge at toe of switch blade and other locations in the critical area;
- b) switch flangeway at throat of switch;
- c) switch opening at toe of switch when open;
- d) switch opening at toe of switch when closed;
- e) alignment of switch blades;
- f) heel opening;
- g) fit of distance studs to stock rail in accordance with design;
- h) condition of chair bolts and distance studs;
- i) switch blade toe break;
- j) switch blade and stock rail wear;
- k) switch blade damaged or crippled;
- l) metal flow on all running rails;
- m) sleeper plates and switch chairs including support of switch blade;
- n) heel block condition;
- o) rail joint condition including bolts.

3.2.4 Crossings in respect of:
- a) gauge in critical area;
- b) check rail effectiveness;
- c) vertical wear on the crossing nose and wing rails;
- d) flangeway clearances;
- e) flangeway depth;
- f) rail alignment;
- g) running rail wear;
- h) metal flow;
- i) crossing nose condition;
- j) crossing cracks;
- k) broken or cracked crossing blocks;
- l) check rail blocks; and
- m) check rail and crossing bolts.

3.2.5 Check rails.
- a) check rail effectiveness;
- b) flangeway clearances;
- c) flangeway depth;
- d) check rail blocks; and
- e) check rail bolts.

3.2.6 Fastenings in respect of:
- a) damaged fastenings e.g. from incorrect installation, derailment or vandalism; and
- b) missing, ineffective (e.g. corrosion, wear, loose), incorrect type of fastenings (clips, insulated spacers, metal spacers, pads and special components.

3.2.7 Bearer condition.

3.2.8 Ballast in respect of profile and condition.

3.2.9 Components that may cause track circuit failure.

3.3 CONDITION ASSESSMENT AND RESPONSE CRITERIA

Sections 4.0 to 6.0 list the condition assessment and response criteria for the various configurations of points and crossings. The following actions apply to all configurations and are to be read in conjunction with the tables in each of sections 4.0 to 6.0:

a) Where a number of temporary speed restrictions are applied, rectification work should be programmed on a priority basis.

b) Where reference is made to “routine inspection,” the condition of the asset is subject to gradual deterioration over a period of time and no action apart from routine inspection is necessary until the deterioration reaches the limit specified.

c) Where reference is made to “increase monitoring”, the condition of the asset is subject to a specific defect of a non-critical type and no action apart from increased frequency of inspection is necessary until the occurrence of further deterioration as specified. The increased monitoring frequency is to be determined by knowledge of local factors that may affect the track’s rate of deterioration and a knowledge of its performance history. The action prescribed however shall not preclude routine maintenance being carried out. For example where one bolt is broken in a group and “increased monitoring” is prescribed, the bolt could be replaced under routine maintenance. The increased monitoring should be continued until rectification work is carried out.

d) Where reference is made to “immediate repair,” the defect should either be removed before the next tram movement or if repairs cannot be made prior to the passage of the next tram, the maximum speed nominated should be imposed as a temporary speed restriction along with an appropriate increase in the monitoring [see note (c)]. All tram movements shall continue to observe the temporary speed restriction until the track has been repaired to at least the minimum condition requiring a lesser restriction or no restriction.

e) Where reference is made to “pilot all trams until repaired,” the track defect shall be assessed by a qualified person.

   i. If the assessment concludes that it is safe, further tram movements may be permitted under the control of a pilot at the speed nominated by him (but not at a speed exceeding ‘notch 1’) and arrangements shall be made to carry out repairs to restore track to normal speed. All tram movements shall continue to be under the control of the pilot until the track has been repaired to at least the minimum condition requiring a lesser restriction or no restriction.

   ii. If the assessment concludes that it is not safe, immediate repairs must be carried out before any further movements shall be permitted to pass over the defective track. Rectification work where required is to be programmed on a priority basis.

f) Where in any track configuration, the condition identified is a hazard for one direction only, any speed restrictions imposed need only cover those movements. For some defects in switches, after being assessed by a qualified person, an alternative action to those specified may be either to prohibit facing tram movements, or clamp and spike switches, where possible, for movements over one route only.

g) “Ineffective sleepers” and “ineffective bearers” are defined in CP-TS-980 (Track support systems).

h) The **critical area for switches** is defined as the area between the toe of the switch and the distance blocks, or heel blocks where distance blocks are not provided.

i) The **critical area for ‘V’ crossings** is defined as the area extending over the length of the checkrails protecting the crossing.

4.0 RAILWAY TYPE TURNOUTS

4.1 CONDITION ASSESSMENT AND RESPONSE CRITERIA FOR SWITCH AREA

The condition assessment and response criteria for the switch area of railway type turnouts are described in tables 4.1 and 4.2.

Table 4.1: Switch area assessment responses for critical dimensions

Component parameter	Design dimension (in mm)	Range for routine inspection (in mm)	Range for increased monitoring (in mm)	Range (in mm) for immediate repair or impose speed restriction shown – [see clause 3.3 (b)]:		
				'notch 2' speed	'notch 1' speed	pilot all trams until repaired
1. Switch flangeway – see figure 4.1						
Minimum switch blade throat opening – back of switch rail to stock rail	35	35 to 25	-	-	< 25	
Minimum switch opening		>28	-	-	28 to26	< 26
2. Track gauge at toe of switch – see figure 4.1 and also note [1]						
Gauge at toe of switch between stock rails	1445	1445 to 1439	-	-	-	< 1439

Notes to table 4.1

[1] For wide gauge in the switch critical area, the assessment for plain track in CP-TS-976 (Track geometry) shall apply. Note that wide gauge is any gauge wider than 1435mm even at the toe of, i.e. the design dimension of 1445mm is to be considered as 10mm wide.

Figure 4.1: Switch assembly

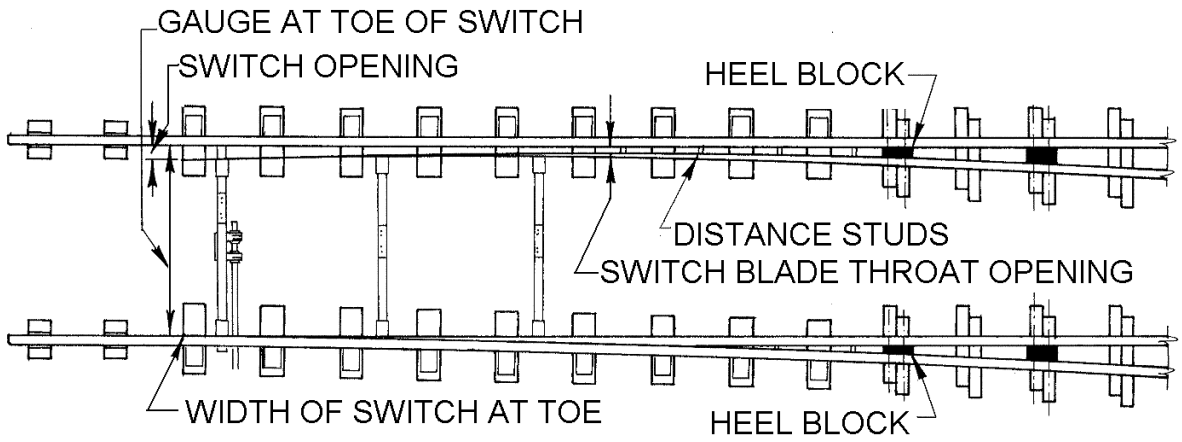


Table 4.2: Switch area assessment responses for key component condition

COMPONENT AND CONDITION	ACTION
1. Heel block - see note [2] and figure 4.1	
cracked/broken but still effective	immediate repair or impose 'notch 1' speed limit
missing or broken and ineffective	pilot all trams until repaired
2. Switch chairs	
(any) cracked or loose: or 1 broken or ineffective	increase monitoring
2 consecutive broken/ineffective	immediate repair or impose 'notch 2' speed limit
more than 2 consecutive broken or ineffective	pilot all trams until repaired
3. Distance studs or chair bolts – see figure 4.1	
(any) cracked or loose; or 1 missing or ineffective	increase monitoring
2 consecutive missing/ineffective	immediate repair or impose 'notch 2' speed limit
more than 2 consecutive missing or ineffective	pilot all trams until repaired
4. Ineffective bearers or fasteners – in critical area, also see clause 3.3 (g)	
1 only	increase monitoring
2 consecutive	immediate repair or impose 'notch 2' speed limit
more than 2 consecutive	pilot all trams until repaired
5. Bolts – see note [3]	
6. Spreader bar including brackets, bolts, etc.	
missing or broken	pilot all trams until repaired – see also note [4]
7. Switch blade damage - see note [5]	
length of damage < 100mm	routine inspection
length of damage 100 to 199mm	increase monitoring
length of damage ≥ 200mm	pilot all trams until repaired
8. Stock rail or switch blade face wear - angle from vertical at point of wheel flange/rail contact at switch toe - see figure 4.2	
< 18 degrees	routine inspection
18 degrees to < 26 degrees	increase monitoring
≥ 26 degrees	pilot all trams until repaired - see note [6]
9. Switch blade angle from horizontal at any point between 19mm and 30mm below running surface of stock rail - see figure 4.3	
≥ 40 degrees	routine inspection
< 40 degrees	pilot all trams until repaired
10. Stock rail gauge face wear at gauge point - where switch blade contacts stock rail	
<2mm	routine inspection
2mm to < 3mm	increase monitoring
≥ 3mm	pilot all trams until repaired - see note [7]
11. Switch toe height from stock rail running level to top of switch blade, see figure 4.4	
≥ 13mm	routine inspection
> 12mm to < 13mm	increase monitoring
≤12mm	pilot all trams until repaired
12. Switch width at toe - as presented to the wheel - see figure 4.4 and note [8]	
0 to 5mm	increase monitoring
6 to 8mm	immediate repair or impose 'notch 2' speed limit
>8mm	pilot all trams until repaired
13. Switch blade crippled - see note [9]	

RAILWAY TYPE TURNOUTS

Notes to table 4.2

[2] Applies to fixed heel blocks only. Pivot heel cracks and breaks should be assessed by a qualified worker.

[3] Where individual defects have been identified, a qualified worker should assess the effectiveness of the bolts. Ineffective bolts include bent, cracked, 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 not to be fully tightened so as to allow for design switch movement.

[4] An alternative action that may be taken is to install a switch clamp and/or spike the switches in accordance with the action specified in clause 3.3(f).

[5] “Length of damage” implies damage anywhere in the switch blade deeper than 19mm from the running surface. It also applies to consecutive areas of damage less than the length specified apart, but forming a total length greater than the length specified. The response applies to chamfered switches only (i.e. not undercut switches). When a worn switch blade at the end of its service life is being replaced, a complete half set of switches should be installed.

[6] Where the gauge face angle limit is exceeded, the action should be to replace the complete half set of switches.

[7] It is recommended that the stock rail be replaced. Following repair, it is necessary to check the fit between the switch blade and stock rail. The replacement of switches should be carried out with care where the stock rail is approaching this amount of wear to ensure that a blunt nose is not presented to the wheel.

[8] Switch width at toe includes the effects of side wear on stock rails and closed gap between switch blade and stock rail. The gap between the switch blade and stock rail should not exceed 3mm at any time.

[9] A crippled 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 reduced speed. The switch blade may have been bent, twisted or have suffered wheel damage however 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.

[10] This code does not consider the additional issues to address trailable switches.

Figure 4.2: Stock rail and switch blade wear angle detail:

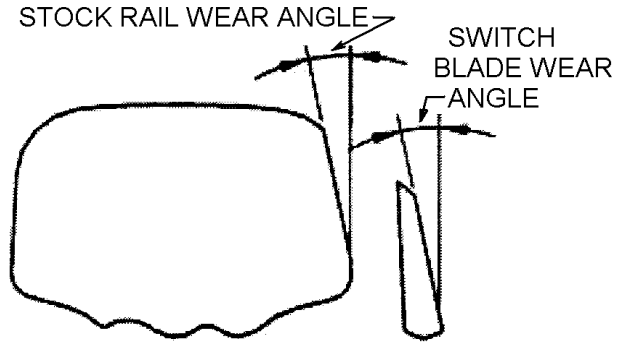


Figure 4.3: Broken or worn switch blade toe detail:

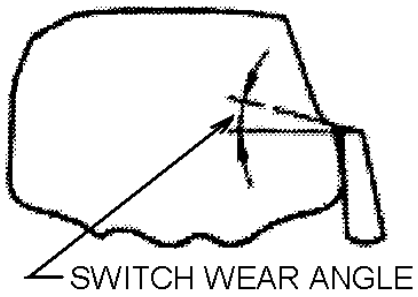


Figure 4.4: Stock rail side wear and switch blade width/height detail:

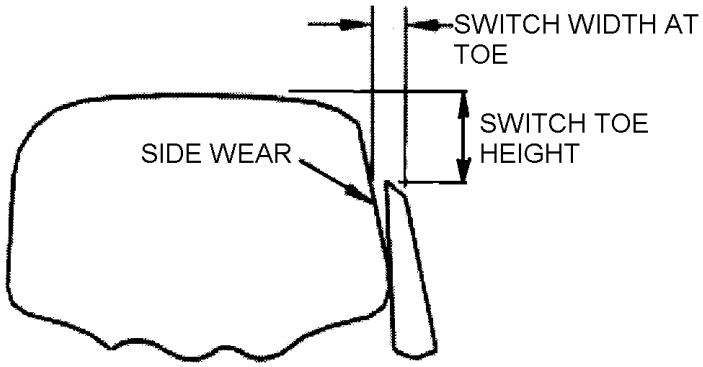
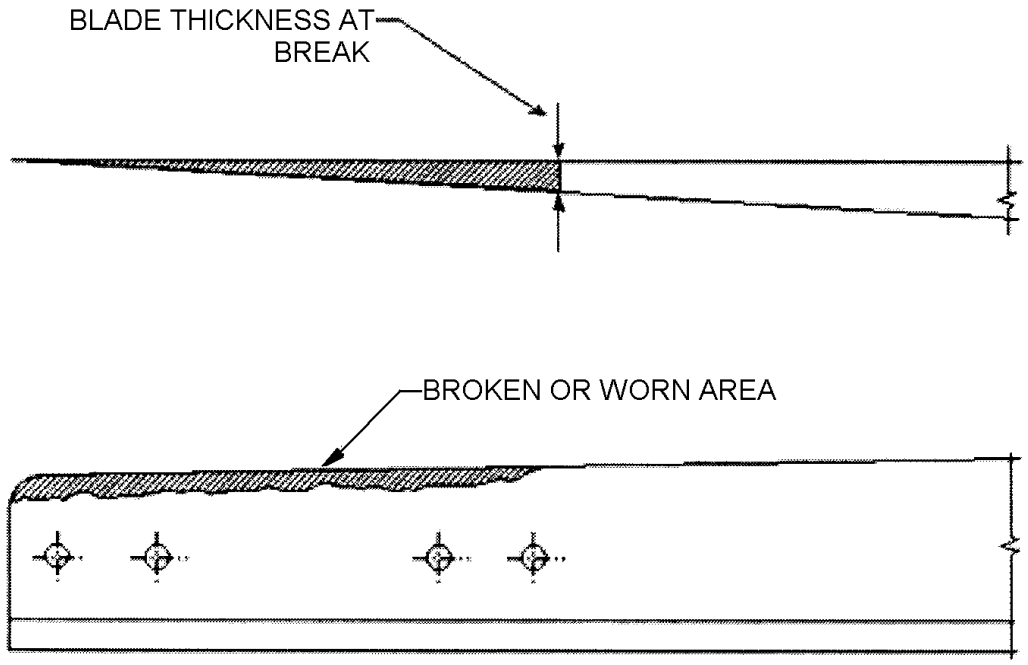


Figure 4.5: Broken or worn switch blade toe detail:



4.2 CONDITION ASSESSMENT AND RESPONSE CRITERIA FOR 'V' CROSSING AREA

The condition assessment and response criteria for the "V" crossing area of broad gauge turnouts are described in tables 4.3 and 4.4.

Table 4.3: 'V' crossing area assessment responses for critical dimensions

Component parameter	Design dimension (in mm)	Range for routine inspection (in mm)	Range for increased monitoring (in mm)	Range (in mm) for immediate repair or impose speed restriction shown – [see clause 3.3 (b)]:		
				'notch 2' speed	'notch 1' speed	pilot all trams until repaired
1. Check rail and track gauge – see figure 4.7						
Working face of check rail to crossing nose – see note [1]	1405	1401 to 1410	-	-	1395 to 1400 *or* 1411 to 1415	>1415 or < 1543
Track gauge – running rail to crossing nose – see note [2]	1435	1435 to 1431	1430 to 1427	1426 to 1425 -	-	< 1425
2. Worn wing rails and worn or broken nose – see figures 4.8 and 4.9						
Vertical wear of wing rail	running rail level	0 to 4	-	5 to 10 -	-	>10
Vertical wear of crossing nose	3 below running rail level	3 to 8 below running rail level	9 to 13 below running rail level	-	-	> 13 below running rail level
Broken crossing nose – thickness of 'V' at break (within transfer area)	14	-	14 to 20	21 to 25	-	> 25

Notes to table 4.3:

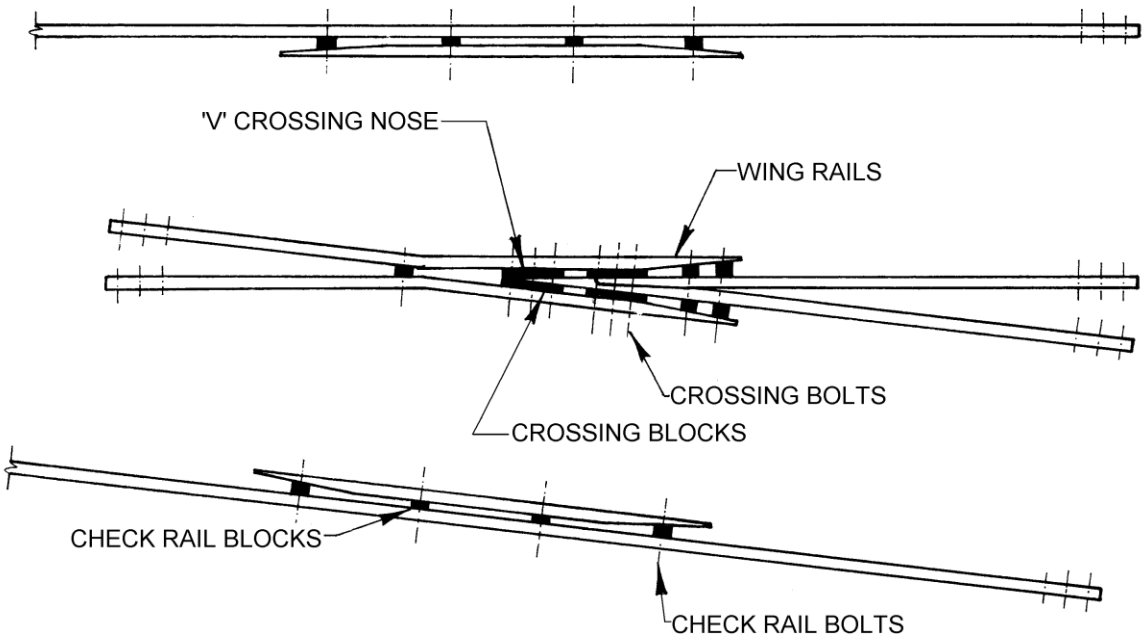
[1] The main effectiveness of the check rail is its ability to protect the crossing nose. Wheel contact with the crossing nose is therefore a vital observation to be made during inspections. Any sign of excessive damage to the crossing nose is reason for replacement or adjustment of the check rail regardless of the check rail wear.

[2] For wide gauge in the crossing critical area, see assessment for plain track in CP-TS-976 (Track geometry).

Table 4.4: 'V' crossing area assessment responses for key component condition

COMPONENT AND CONDITION	ACTION
1. Ineffective bearers or fasteners - in critical area, see also clause 3.3 (g)	
1 only	increase monitoring
2 consecutive	Immediate repair or impose 'notch 2' speed limit
>2 consecutive	pilot all trams until repaired
2. Cracks in cast 'V' crossings, either solid or rail bound - see note [3]	
cracked: non-critical or critical	increase monitoring
cracked fully: not affecting the running surface	Immediate repair or impose 'notch 2' speed limit
cracked fully: affecting the running surface	pilot all trams until repaired
3. Cracks in fabricated 'V' crossings - see note [4]	
cracked: non-critical or critical	increase monitoring
broken: not affecting the running surface	Immediate repair or impose 'notch 2' speed limit
broken: affecting the running surface	pilot all trams until repaired
4. Heel rail and other rail defects - refer to CP-TS-981 (Rails and rail joints)	
5. Crossing bolts – see figure 4.6 and note [5]	
6. Crossing and check rail blocks –see figure 4.6 and note [6]	
(any) broken or cracked	increase monitoring
7. Check rail bolts – see figure 4.6 and note [6]	
(any) loose; 1 missing or ineffective	increase monitoring
2 missing or ineffective	Immediate repair or impose 'notch 2' speed limit
> 2 missing or ineffective	Immediate repair or impose 'notch 1' speed limit
8. Crossing flangeway - see note [7]	

Figure 4.6: Typical 'V' crossing assembly (shown for fabricated type)



Notes to table 4.4

[3] For cast manganese steel crossings (either solid or rail bound):

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

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

c) "cracked fully: not affecting running surface" means:

i. a crack that runs the full section of the crossing such that the crossing is in two pieces;

ii. all fastenings are secure; and

iii. the break does not impact on the integrity of the running surface (e.g. tang area of crossing).

d) "cracked fully: affecting running surface" means:

i. a crack that runs the full section of the crossing such that the crossing is in two pieces; and

ii. the fastenings are not secure; or

iii. the break affects the running surface integrity.

[4] For fabricated crossings:

a) "cracked: non-critical" means cracks in a location where the rails are held in alignment by the blocks, but may eventually cause a crossing to need repair.

b) "cracked: critical" means cracks that if they eventually ran the full section of the rail:

i. the rail would be in two pieces; and

ii. if the fastenings were not secure, the break would affect the integrity of the running surface.

c) "broken: not affecting running surface" means:

i. cracks that run the full section of a rail component and it is in two pieces;

ii. all fastenings are secure;

iii. the rails are held in proper alignment by the blocks; and

iv. the break does not impact on the running surface.

d) "broken: affecting running surface" means:

i. cracks that run the full section of the rail and it is in two pieces.

ii. fastenings are not secure;

iii. the rails are not held in proper alignment by the blocks;

iv. or the break impacts on the running surface.

[5] Where individual defects have been identified, a qualified worker should assess the effectiveness of the bolts. Ineffective bolts include bent, cracked, or broken bolts. Loose bolts should be tightened. Missing or ineffective bolts should be replaced be tightened. Missing or ineffectiveness bolts should be replaced.

[6] The end bolts and check blocks of all check rails should be effective.

[7] Flangeways should be checked for blockages and cleared where blocked.

RAILWAY TYPE TURNOUTS

Figure 4.7: Part section through "V" crossings (shown for fabricated type)

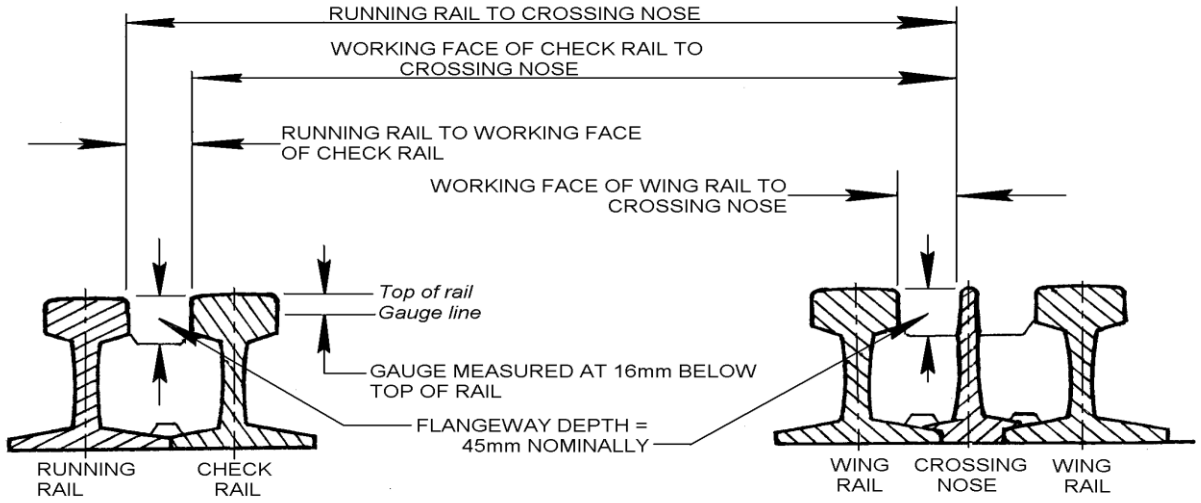
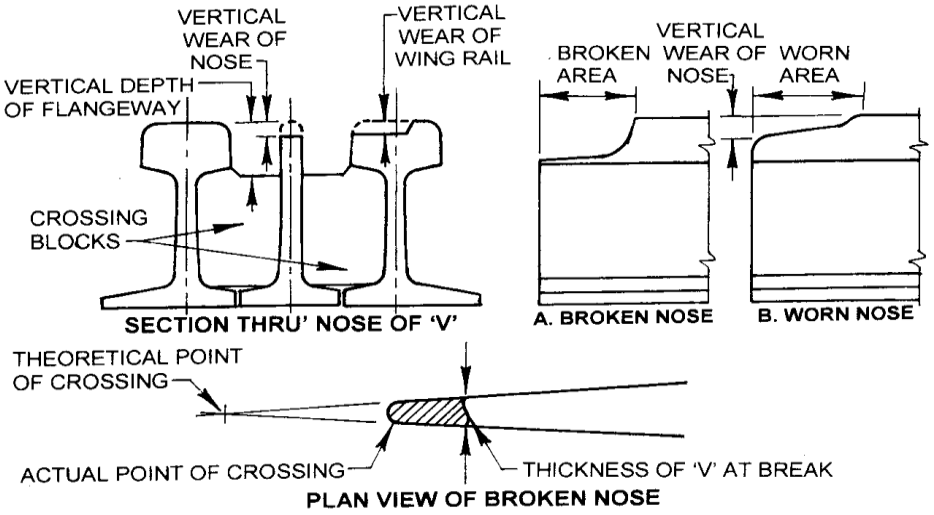
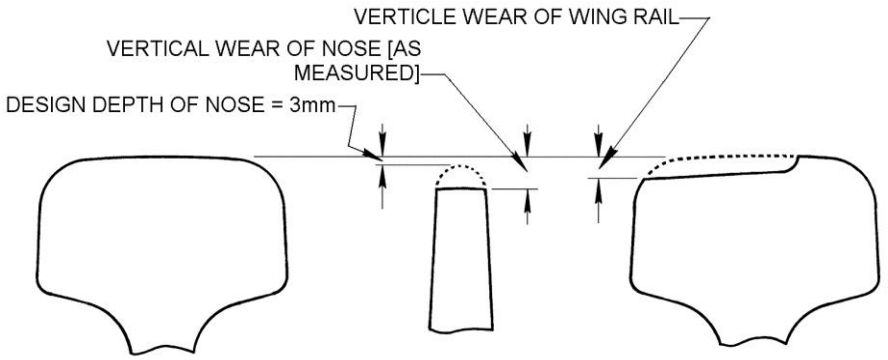


Figure 4.8: Fabricated crossings - detail of worn or broken crossing nose



ENLARGEMENT SHOWING VERTICAL WEAR



5.0 TRAMWAY TYPE TURNOUTS

5.1 ***To be developed***

6.0 TRAMWAY TYPE DIAMONDS

6.1 ***To be developed***

7.0 DOCUMENTATION

7.1 POINTS AND CROSSINGS RECORD

A record shall be maintained of all points and crossings in accordance with QP-IS-501 (Document and Data Control).

RECORD TO BE PREPARED

7.2 INSPECTION REPORTS

All inspection reports shall be maintained in accordance with CPRD/PRC/046 Records Management.