T200 Track Handbook

Revised Issue 7
Effective 30th September 2022

T-ST-AM-5400

Introduction

The purpose of this handbook is for Track and other disciplines to have a handy reference point and guide when carrying out track inspections and maintenance work.

This Handbook does not supersede or amend any existing standards and staff are encouraged to be familiar with the information contained within them as well. For full documentation or explanation of any parts in this book please refer all enquiries to the Professional Head of Track, Wellington.

This T200 Track Handbook is intended for use on the KiwiRail Network only.

Important: Information in this handbook may be changed from time to time by Significant Information Notices (SIN's) or the reissue of specific principles and standards documentation.

It is the responsibility of all staff to ensure that they have up to date knowledge of any changes to the existing principles and standards documentation.

Mark Fleet
Professional Head of Track
KiwiRail
September 2022

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Definitions

Term	Meaning
CWR	Continuous welded rail
HW	Hardwood (sleeper)
GIJ	Glued insulated joint
Lateral	Sideways, outwards
Longitudinal	Lengthwise, longways
LNI	RORP Local Network Instructions
LWR	Long welded rail
NDT	Non-destructive testing
NZTA	New Zealand Transport Agency
OHS	WorkSafe New Zealand and Ministry of Business, Innovation and Employment
OJT	On the job training
PH	Professional Head
PSR	Permanent Speed Restriction
RCA	Road controlling authority (NZTA for state highways, or local council)
RORP	Rail Operating Rules and Procedures
SC	Speed category
SIN	Significant Information Notice
TAIC	Transport Accident Investigation Commission
TEIC	Track Engineering Information Circular
TPR	Treated pinus radiata (sleeper)
Transpose	Swap or interchange rails
TSR	Temporary speed restriction
TEC	Track Evaluation Car – currently the EM80
TTC	Track Technical Committee
Work Hardening	The process of strengthening a metal by plastic deformation

General

101. This handbook is intended for use by KiwiRail staff and contractors for Inspection and Maintenance purposes.

102. This handbook relates to all KiwiRail track and private sidings over which it operates.

103. When these standards cannot be met, take suitable action to either correct the condition or restrict train operations.

104. Use this handbook in conjunction with:

- Job Plans
- Rail Operating Rules and Procedures (RORP)
- Safety Plan and Hazard Summary
- KiwiRail Principles and Standards, SINs & TEIC
- Safety Instructions For Railway Staff In Electrified Areas
- Task Instructions
- Standard Drawings
- SHE documentation
- Other documentation issued from time to time or held by the Asset Engineer or Production Manager

105. The information in this handbook is to be used in line with the principles & standards, plans, Rail Operating Rules and Procedures of KiwiRail, the New Zealand laws in particular, the Health and Safety in Employment Act, the Resource Management Act and the Railways Act.

106. Any discrepancies, errors, or items that need explanation or interpretation should be discussed with your Line Manager. The PH Track will adjudicate on any interpretations.

107. Interim changes to this Handbook between reprints

will be made through the issue of amended pages by the TTC.

Note: Record amendments received in the Certificate of Amendment page at the front of this book.

Formation

Drains and Culverts

201. Make every reasonable effort to keep the track and formation properly drained at all times.

202. Keep drains open to divert the water from the formation. When undertaking renewal works including sleeper replacement, crossing renewals, undercutting and ballast cleaning operations, the formation must be designed to ensure track drainage is fully effective.

203. Construct intercepting drains, where possible, along the top of the bank to protect cuttings where drainage from the higher ground could erode slopes and affect ditches.

204. Keep outlet ends of drains open and diverted from the track so that the formation is not weakened or damaged by the scouring action of water.

205. Keep culverts open to allow water to flow freely. Waterways leading to bridges and culverts must be kept clear within the limits of KiwiRail property. Notify your Manager of any blockages in waterways leading to KiwiRail land.

206. Clear blocked drains and culverts urgently to prevent the possibility of washouts.

207. Drainage around track structures in yards, is essential. If you cannot locate blockages in subsurface yard drainage, report these to your Manager.

208. When using perforated pipe for sub-surface drainage, lay the pipe on a layer of absorbent material. Grade the trench to allow water to flow away from the area to

be drained. Back-fill the trench with gravel or other suitable free-draining material. Wrap the trench with a geotextile fabric to prevent silt from plugging the pipe, where this may be a problem.

209. Culverts are identified by their metrage, type, diameter/size and depth from rail level to bottom of culvert.

e.g.: NIMT 267.562 km Concrete box 2.4m x 1.2m
NIMT 422.371 km Steel pipe 900mm dia

210. Construct and install culverts as directed by the PH Civils.

Sub-grade

211. The construction and maintenance of track formation must conform to the type of track shown in Figure 1: Typical Formation Details.

Notes for Figure 1:

A Ballast section is defined in Figure 4 .

B Sub-ballast of fines (sand or GAP20) Minimum depth = 75mm with suitable approved geosynthetic material e.g. Bidim A39

C Vehicular access way. Level to be no higher than formation, a 3% fall graded to allow drainage away from track. Surface material to be chip or ballast cleaning fines.

D Sub-grade compaction to have a minimum CBR of 15. (approximately 15mm per blow on Scala penetrometer)

E Filling and cutting batter slopes to be as directed by PH Civils. 1 in 1.5 minimum in soil.

F Side drain width to be no less than 500mm. To be as wide and as low as practical in new construction.

G Side drain depth to be a minimum of 300mm

H Cess level to be 725mm min, 875mm max. below rail level on straights or below the low leg in curves.

I Cess level below the high rail level on curves = H + cant.

J Formation cross fall to be not less than 90mm in 3000mm (half width).

Figure 1: Typical formation details

For improvements of existing track and new work
Typical formation details

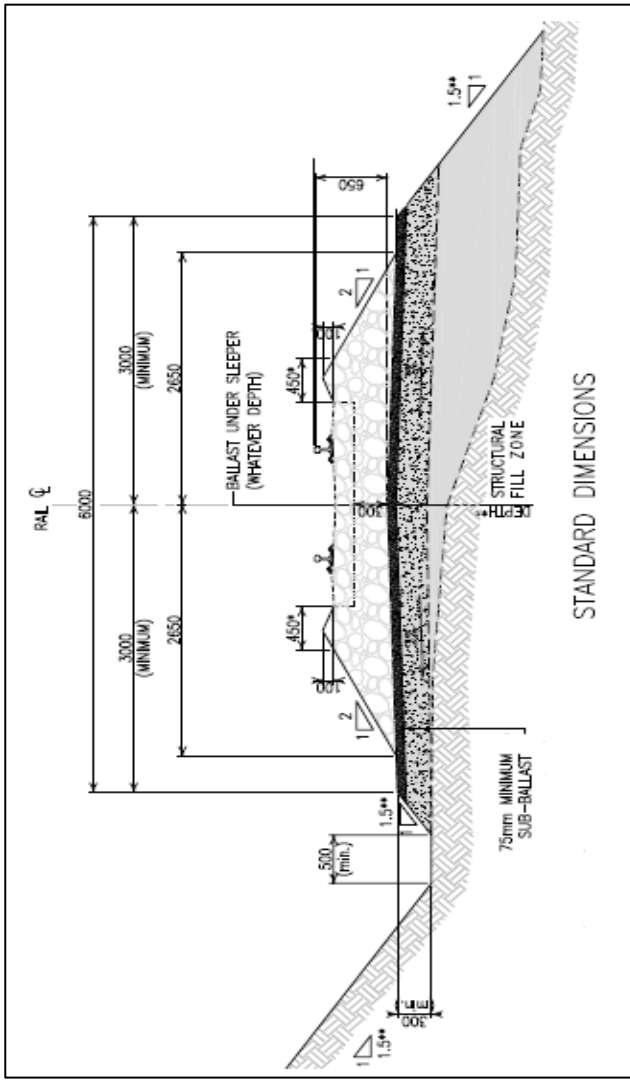


Figure 1 shows the typical details for single track. For further information including details for double track, refer to Civil standard drawings CE 100862 and 120535.

212. Do not alter the design of slopes on fill or cut sections without prior approval of the PH Civils.

213. Sub-grade failure may be indicated by the following characteristics:

1.	Noticeable line and cant irregularities in the track and a bulging area at the toe of the slope.
2.	Cracks running parallel with the track on fill areas, which gradually separate.
3.	Vegetation, trees or poles leaning outward.
4.	Water seeping from the fill.

214. Report unusual sub-grade settlement, embankment failure or failure over culverts or bridge approaches to your Manager. Do not perform work until the cause of the failure is found.

215. Do not leave rip rap and fill materials on the top of slopes. The heavy weight of this material may cause the slope to collapse.

216. Protect slopes that are likely to be affected by erosion when grading, clearing or doing other work, and seed them as soon as possible after the work is finished.

Vegetation

221. Control vegetation on railway property so that it does not:

a.	become a fire hazard to timber bridges or other trackside structures
b.	block view lines at level crossings
c.	stop railway signs and signals being seen
d.	stop railway personnel being able to do normal trackside duties
e.	clash with signal, traction, communications and power lines
f.	stop proper function of points rodding runs
g.	restrict drainage and cause fouling of the ballast section
h.	stop inspection and maintenance of sleepers, rail and fastenings
i.	grow over the rail, causing wheels of a locomotive, or other self-propelled track vehicle, to slip
j.	grow high or close enough to touch rolling stock or damage loads on wagons
k.	prevent railway personnel from visually inspecting moving equipment from their normal duty stations e.g. Loco Engineers
l.	in the case of trees, pose a risk of falling over the tracks in high winds.

222. Protect vegetation on neighbouring property when using cutting machinery.

Operators of mechanical brush cutters must ensure that cutting heads do not contact rocks, signs, rails, signalling equipment or other objects that could cause damage to the machine or debris to fly putting neighbours at risk.

223. Chemical control of vegetation must only be carried out by people who are licensed to do so.

224. People involved in handling and applying any chemicals to control vegetation must comply with all relevant safety requirements, manufacturers' instructions, local council by-laws and New Zealand laws.

225. Vegetation spraying operations may cause loss of rail adhesion as the presence of moisture or chemicals on the rail head lowers adhesion and wheels may skid. Very greasy rail conditions can be caused when additives are used. This can result in delays to trains on grades, or if normal braking power is reduced, create a potential danger. Greasy rail conditions may last up to 24 hrs.

To reduce these effects the following precautions shall be taken by staff concerned:

- Vegetation spray operations on mainline and loop are to be notified on Daily Information Bulletins.
- Advice of greasy rail condition after weed spraying operation must be notified on Daily Information Bulletins on the day of spraying and for the following day.

Track Geometry

Gauge

301. Measure gauge with a standard track gauge. All track gauges must be checked and certified every 12 months to make sure they are measuring gauge correctly. Repair or replace as required. Measure gauge at right angles to the track between points on the opposite gauge faces of rails 16 mm below the top of the railhead.

Do not use metal tape measures for gauging in track circuited areas.

302. The standard gauge of track is:

a) Tangents: 1068mm

b) Curves: see table below.

Curve Radius	Increase Over Standard Gauge	Gauge of Track
250m or Greater	0 mm	1068 mm
Less than 250m	6 mm	1074 mm

303. The gauge of track through turnouts is 1068mm on straight roads and through frogs. Refer to drawings for gauge widening in turnout curved roads.

304. Refer to clause 643 for maintenance tolerances.

305. Gauge on concrete sleepers for curves is altered progressively by the position of insulators and their heel size. The resulting gauge is shown in figures 7.5 and 7.6 for the various rail sizes.

Alignment, Grade, Top, Cant and Twist

321. Alignment is a series of straight lengths of track, called tangents, connected by transitions to simple, or compound curves.

322 Refer to Table 1: Table of Rail Bends in Circular Curves, over page.

323. Transitions will be provided at the ends of all mainline curves and between different radii of curvature on compound curves in tracks. Transition lengths are defined in Table 2: Curve Speeds and Geometry.

324. All curves on main tracks shall have the S (point of spiral) and CTP (common tangent point) monumented with the appropriate marker offset no less than 3m from track centre.

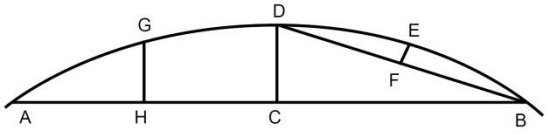
325. To correct the general alignment, e.g. removing long line swings on tangents and restoring curves, laying out transitions etc, work out the throws from field measurements. Correcting line swings or curved track alignments could generate excess rail. Adequate monitoring of CWR is covered in clauses 464-467.

326. Grade is the longitudinal rise or fall of the track in a series of straight gradient (sloped) lines connected by vertical curves.

327. Track in yards and sidings should be level where possible. The maximum permitted grades in yards and sidings is 1 in 200 (0.5%).

328. Mainline grades for new construction will be determined by the PH Track.

TABLE 1: Rail bends in circular curves



A-B CHORD
A-C & C-B HALF CHORD
E-F EQUALS ¼ C-D

C-D } BENDS OR
E-F } VERSINES
G-H EQUALS ¾ C-D

	(mm) at mid-point of chord length (m) of				
Curve Radius m	**6m**	**8m**	**10m**	**12.80m**	**20m**
90	50	89	139	228	556
100	45	80	125	205	500
110	41	73	114	186	455
120	38	67	104	171	417
130	35	62	96	158	385
140	32	57	89	146	357
150	30	53	83	137	333
160	28	50	78	128	313
180	25	44	69	114	278
200	23	40	63	102	250
220	20	36	57	93	227
240	19	33	52	85	208
260	17	31	48	79	192
280	16	29	45	73	179
300	15	27	42	68	167
320	14	25	39	64	156
360	13	22	35	57	139
400	11	20	31	51	125
440	10	18	28	47	114
500	9	16	25	41	100
600	8	13	21	34	83
700	6	11	18	29	71
800	6	10	16	26	63
1000	5	8	13	20	50
1200	4	7	10	17	42
1400	3	6	9	15	36
1600	3	5	8	13	31
2000	2	4	6	10	25

TABLE 2: Curve speeds and geometry

Radius (m)	Speed (km/h)	Cant (mm)	Transition Desirable (m)	Transition Minimum (m)	Gauge (mm)
95-115	35	70	70	35	1074
116-150	40	70	70	35	1074
151-180	45	70	70	35	1074
181-220	50	70	70	35	1074
221-270	55	70	70	35	1074
271-320	60	70	70	35	1068
321-370	65	70	70	35	1068
371-420	70	70	70	35	1068
421-480	75	70	70	35	1068
481-550	80	70	70	35	1068
551-610	85	70	70	35	1068
611-680	90	70	70	35	1068
681 - 760	95	70	70	35	1068
761-840	100	70	70	35	1068
841-920	105	70	70	35	1068
921-1070	110	70	70	35	1068
1071-1290	110	60	60	30	1068
1291-1540	110	50	50	25	1068
1541-2000	110	40	40	20	1068
2001-2400	110	30	30	20	1068
Over 2400	110	0	0	0	1068

Table 2 is to be used as a guide. All new or revised alignments must be designed from first principles. Refer to T-ST-DE-5200 Track Design Standard.

329. Cant is the difference in height of the two rails measured at the same point.

330. Transition lengths shall have cant run-out applied at a uniform rate of change, with full cant at the point of full curvature and zero cant on tangent track.

331. Whenever possible, cant runoff must be at 1mm/m. An absolute maximum of 2mm/m is permitted. Refer to Table 2.

332. Do not exceed 70mm cant unless authorised by the PH Track.

333. All changes to specified cant on curves must be approved by the PH Track.

334. Do not apply cant to siding track unless approved by the PH Track.

335. Twist is the difference in two cant measurements taken over a base length along the track.

Track Inspection - Manual Track Geometry Maintenance Tolerances

336 Apply the tolerances in Table 3 for all track, mainline and yards, according to the speed category (SC) of the line as defined by Appendix 1 of T-ST-MM-5709 Use of Track Materials

Gauge tolerances of specific turnout points are excluded. These are covered in clause 643.

Cant run in/run out for curves is specified in clause 331.

Action required for the categories	
P.1	Apply immediate 25 km/h TSR and fix within 48 hours
P.2	Apply immediate 40 km/h TSR and fix within 7 days
P.3	Consider need for TSR and fix within 4 weeks
P.4	Consider need for TSR and fix within 26 weeks
P.5	Fix within 52 weeks

TABLE 3: Priorities of track geometry maintenance tolerances

	P1	P2	P3	P4	P5
Twist					
SC1	24	18	16	14	12
SC2	24	19	17	15	13
SC3	25	20	18	16	14
SC4	26	21	19	17	15
SC5 & Yards	26	24	20	17	15
Top					
SC1	22	19	16	13	10
SC2	27	22	19	16	13
SC3	31	26	23	20	17
SC4	35	31	27	24	21
SC5 & Yards	40	36	32	28	24
Cant					
SC1	24	19	17	15	13
SC2	24	19	17	15	13
SC3	26	21	18	16	14
SC4	28	22	19	17	15
SC5 & Yards	30	24	21	18	16
Wide Gauge					
SC1	1095	1092	1088	1085	1082
SC2	1095	1092	1088	1085	1082
SC3	1096	1093	1089	1086	1083
SC4	1097	1094	1090	1087	1084
SC5 & Yards	1097	1094	1090	1087	1084
Tight Gauge (all speed categories)					
Construction standard					
1074mm	1054	1056	1058	1060	1062
1068mm	1052	1054	1056	1058	1060

Any approved manual track recorder e.g. the Amber Trolley shall use the values shown in the above table.

Consideration has to be made for the additional lateral and vertical loadings of rail traffic when compared to the static track measurements above.

The priority for twist and top faults is to be worsened by one level (e.g. P2 to P1) if the fault is measured where there are poor substructure conditions e.g. mud spots or where multiple faults can be seen and the fault is likely to be more severe than as measured statically. Voidmeters should be used to determine the actual size of the fault under load.

The priority for wide gauge is to be worsened by one level (e.g. P2 to P1) if the gauge is measured where there are clear signs of bedplate pushing on timber sleepers or insulator failure on concretes. To determine the correct priority, the inspector must ascertain whether further deterioration is likely. Where wide gauge readings are a result of high leg rail wear, the wear limits must also be within tolerances.

Any of these priorities are to be recorded on the relevant form (M125, M126, M127) and advise the Asset Engineer of the issue.

337 If any inspection reveals track geometry at or above P1 tolerances then one of the actions shown below must be taken, depending on the conditions of the track.

Options are:

1.	Place a more restrictive TSR over the affected track section
2.	Pilot trains over the affected track section until track is repaired, also applying option 1
3.	Blocking the line to rail traffic until track is repaired. **Note this applies to twist faults over 35mm and gauge faults over 1105mm no matter what Speed Category line.**

TEC Track Geometry Exceedances – Classification and Action

338 Exceedances recorded on the Track Evaluation Car (TEC) at the time of the run, are classified in the following tables, with actions to be taken by the Asset Engineer.

- Class 1** is defined as at or above the maximum allowable limit and repair must be planned as below.
- Class 1 is defined as below the maximum allowable but above the maintenance tolerance limit and repair must be planned as below.
- Class 2 is defined as at the acceptable maintenance tolerance limit & repair should be planned as a normal maintenance activity to bring within tolerance.

Table 4 indicates the response categories for the various classes of exceedance, the timescales for inspection and repair, and the required safety actions.

In the case of Class 1** wide gauge and twist exceedances (priorities U1, P1 and P2), the TSR's are to be imposed immediately following notification from the TEC.

All other prescribed safety actions are to implemented following a detailed inspection of the exceedance within the timescales shown in Table 4.

TABLE 4:TEC Repair and Safety Actions for Track Geometry Exceedances

Response Category	Class	Maximo Pty	Inspect and Verify Response	Safety Action	Repair Action
Immediate - U1	1**	1	Before next train	Close line until repaired	Before next train
Priority 1 - P1	1**	3	Within 24 hours	TSR of 25	Within 2 days
Priority 2 - P2	1**	6	Within 3 days	TSR of 40	Within 7 days
Priority 3 - P3	1	10	Within 14 days	TSR of 60[1]	Within 4 weeks
Priority 4 - P4	2	16	Within 3 months	Nil	Within 6 months
Normal (N)			Routine Inspection	Nil	Routine Inspection

[1]P3 gauge, twist, and cant exceedances require a safety action of 40kph.

Note: For speed category 3, 4 and 5 lines:

Priority 1 - P1#	1**	6	Within 24 hrs	TSR of 25	Within 7 days
Priority 2 - P2#	1**	8	Within 3 days	TSR of 40	Within 14 days

The guidelines and assessment tables below are to be used to determine the correct repair and safety actions, following a detailed inspection of the exceedance.

The detailed inspection will take into account the condition of track components and the existence of other track exceedances in the immediate vicinity. The stability of the track and the potential for rapid deterioration of the fault should be taken into account in determining the required mitigation. Where further deterioration is eminent, a more urgent response or lower speed restriction may be warranted until repairs are completed. This is particularly relevant where:

- gauge exceedances are caused by failure of fastenings
- a twist is recorded at a mudspot or poorly drained area of formation
- large top exceedances occur at short plated joints
- cant run-out is steeper than the maximum limit

Twist	Line Speed Category				
4m	5	4	3	2	1
	< 26	26 - 40	41 - 50	51 - 70	71 - 110
<16	N	N	N	N	N
16-17	N	N	N	P4	P4
18-19	N	P4	P4	P3	P3
20	P4	P4	P3	P3	P3
21-23	P4	P3	P3	P3	P3
24	P3	P3	P3	P2	P2
25	P3	P3	P2#	P2	P2
26-27	P3	P2#	P2#	P2	P2
28-31	P1#	P1#	P1#	P1	P1
32-34	P1#	P1#	P1#	U1	U1
>34	U1	U1	U1	U1	U1

Gauge	Line Speed Category				
	5	4	3	2	1
	< 26	26 - 40	41 - 50	51 - 70	71 - 110
<1088	N	N	N	N	N
1088	N	N	N	P4	P4
1089	N	N	P4	P4	P4
1090-1091	P4	P4	P4	P4	P4
1092	P4	P4	P4	P3	P3
1093	P4	P4	P3	P3	P3
1094	P3	P3	P3	P3	P3
1095	P3	P3	P3	P2	P2
1096	P3	P3	P2#	P2	P2
1097	P2#	P2#	P2#	P2	P2
1098-1104	P1#	P1#	P1#	P1	P1
>1104	U1	U1	U1	U1	U1

GaugeT	Line Speed Category				
Rad<250	5	4	3	2	1
	< 26	26 - 40	41 - 50	51 - 70	71 - 110
>1060	N	N	N	N	N
1059-1060	P4	P4	P4	P4	P4
1057-1058	P3	P3	P3	P3	P3
<1057	P2#	P2#	P2#	P2	P2
Rad>250	5	4	3	2	1
	< 26	26 - 40	41 - 50	51 - 70	71 - 110
>1058	N	N	N	N	N
1057-1058	P4	P4	P4	P4	P4
1055-1056	P3	P3	P3	P3	P3
<1055	P2#	P2#	P2#	P2	P2

Line	Line Speed Category				
	5	4	3	2	1
	< 26	26 - 40	41 - 50	51 - 70	71 - 110
Class 2	P4	P4	P4	P4	P4
Class 1	P3	P3	P3	P3	P3
Class 1 **	P2#	P2#	P2#	P2	P2

Top	Line Speed Category				
	5	4	3	2	1
	< 26	26 - 40	41 - 50	51 - 70	71 - 110
<16	N	N	N	N	N
16-17	N	N	N	N	P4
18	N	N	N	N	P3
19-21	N	N	N	P4	P3
22	N	N	N	P3	P2
23-25	N	N	P4	P3	P2
26	N	N	P3	P3	P2
27-30	N	P4	P3	P2	P2
31	N	P3	P2#	P2	P2
32-34	P4	P3	P2#	P2	P2
35	P4	P2#	P2#	P2	P2
36-39	P3	P2#	P2#	P2	P2
>39	P2#	P2#	P2#	P2	P2

Cant	Line Speed Category				
	5	4	3	2	1
	< 26	26 - 40	41 - 50	51 - 70	71 - 110
<17	N	N	N	N	N
17	N	N	N	P4	P4
18	N	N	P4	P4	P4
19-20	N	P4	P4	P3	P3
21	P4	P4	P3	P3	P3
22-23	P4	P3	P3	P3	P3
24-25	P3	P3	P3	P2	P2
26-27	P3	P3	P2#	P2	P2
28-29	P3	P2#	P2#	P2	P2
>29	P2#	P2#	P2#	P2	P2

ROCOCD	Line Speed Category				
	5	4	3	2	1
	< 26	26 - 40	41 - 50	51 - 70	71 - 110
<200	N	N	N	N	N
200-239	N	N	N	N	P4
240-279	P4	P4	P4	P4	P4
280-339	P3	P3	P3	P3	P3
>339	P2#	P2#	P2#	P2	P2

Cyclic Line	Line Speed Category				
	5	4	3	2	1
	< 26	26 - 40	41 - 50	51 - 70	71 - 110
<3	N	N	N	N	N
3	P4	P4	P4	P4	P4
4	P3	P3	P3	P3	P3
5	P2#	P2#	P2#	P2	P2

339. Asset Engineers or one of their representatives must attend all TEC runs. This is to ensure large exceedances are prioritised for correction and all traces and exceedance reports are forwarded to the Ganger within 24 hours of the run. When only loops are being recorded, it is not necessary for a representative to be on board. However, for any unattended run, it is important that Asset Engineers ensure that arrangements are made with the Car operator for the Ganger to receive the exceedance reports within 48 hours. Class 1** gauge and twist exceedances recorded during an unattended run, which are classified as U1 or P1 priority as per the following tables, must be advised in writing to the Asset Engineer when the TEC completes the days run.

Class 1** exceedances must be individually checked on site by the Track Inspector or other competent staff within 1 week of the run to ensure repairs have been carried out, with exceptions listed and appropriate TSR's imposed. Class 1 exceedances are to be checked within 4 weeks.

Where the number of exceedances is so excessive that all cannot be individually checked, a representative sample must be checked.
This process is to be recorded on the M91 form.

Class 2 exceedances should be investigated for a root cause and planned intervention programmed within 6 months to bring the track condition within maintenance tolerances.

If it is not possible to achieve the repair on a Class 1** or Class 1 exceedance within the required timescales, it is the responsibility of the Asset Engineer to ensure that safety measures are maintained until the repair is completed. This will be through routine or special inspections, as directed by the Asset Engineer and is to ensure that the track is still suitable for the passage of trains under any operating restriction that may be in place. Inspections are to continue until the exceedance is corrected.

All outstanding exceedances not corrected prior to a subsequent run will become null and void if not re-detected. For remedial action priorities, the date of the latest run is deemed to be the date the exceedances are recorded.

Asset Engineers must review exceedance reports and compare with past recordings to identify trends for appropriate action and potential changes in the RAMP. Repeat exceedances must be given special attention. Where previous repairs have proven to be ineffective, the Asset Engineer should seek technical advice from Track Engineering.

Permanent Way – Track Asset Condition

340 Track staff such as Track Inspectors, Gangers, Field Engineers and Managers may observe track conditions such as those found in T-ST-IN-5108 Permanent Way Asset Condition Guide.

Any defects that are reported for example on an M125/6 form must have an appropriate Priority Action applied to it.

The following table gives those priorities:

Priority Action Table		
P1	Maximo 3	Repair within 48hrs
P2	Maximo 6	Repair within 7 days
P3	Maximo 10	Repair within 4 weeks
P4	Maximo 16	Repair within 26 weeks
P5	Maximo 17	Repair within 52 weeks

The associated Maximo database priorities are also given above.

Where a combination of conditions are at the same location then the actions required will be more severe than for an individual condition.

Consideration for applying an appropriate TSR is to be discussed with the Asset Engineer.

If in doubt always take action to protect trains.

Track Centres

341. Track centres are defined by the distance between centre lines of tracks running next to each other, measured horizontally and at right angles to the track.

342. Do not reduce existing track centre distances without the authority of the PH Track.

343. Maintain existing track centres between the main line, yards and sidings plus any existing track next to it to a minimum centre-line to centre-line distance of 3.67m. Report track centres measuring less than 3.67m immediately to the PH Track.

344. Use the following track centres for new construction unless the PH Track advises differently. (refer Table 5.)

TABLE 5:Track centres for new construction

Tracks	Distance Apart (mm)
• Two mainlines within station limits	5200 design 4000 min
• Two mainlines outside station limits	4000 design 3800 min
• More than two mainlines: •Between each pair of Mainlines • Between a pair of mainlines and a single mainline	5200 design 4000 min
• Mainline to loop or siding • Loop or busy siding that is shunted (requiring staff access between wagon rakes or where staff ride on moving rail vehicles)	5200 design 4000 min
• Between sidings not otherwise specified	4000 design 3800 min
• Between ladder roads and any track • Between any siding used for loading or discharging wagons and any mainline or loop or busy siding	5200 min

These distances must be increased to allow for cant and curvature and to make sure actual clearances are achieved. Refer any concerns to your Manager.

Clearances

351. Figure 2: Fixed structure gauge (main lines) and Figure 3: Fixed structure gauge (sidings) show minimum clearances for new construction.

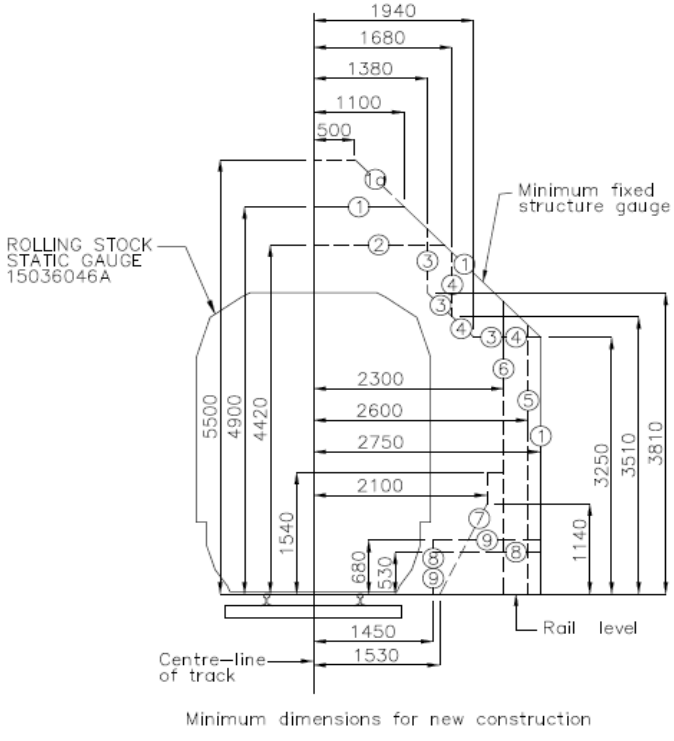
352. Stack material trackside at least 2.75m away from centre-line of main lines and loops, and 2.3m away from centre-line of sidings (with Rail Operators permission).

353. Place welded rail beside the track below running rail level. Where this is not possible, it should be at least 1.5m from track centre-line.

354. Advise your Manager of sub-standard clearances not notified in the Rail Operating Rules & Procedures.

355. Where clearances are sub-standard due to construction or other work, put an appropriate speed restriction in place or close the track to rail traffic.

Figure 2 – Clearance (mainlines)



MAIN LINES

Note: this figure refers to mainline minimum dimensions for new construction on straight track

- **Auckland Metro Platforms are 1520 mm (+10 / -0 mm) From Centre Line and 750 mm (+0 / -20 mm) High (Excluding Versine And End Throw.)**
- **Wellington Metro Platforms are 1450 mm From Centre Line and 680 mm High. (Excluding Versine And End Throw.)**

Notes for this figure are over the page ⇨

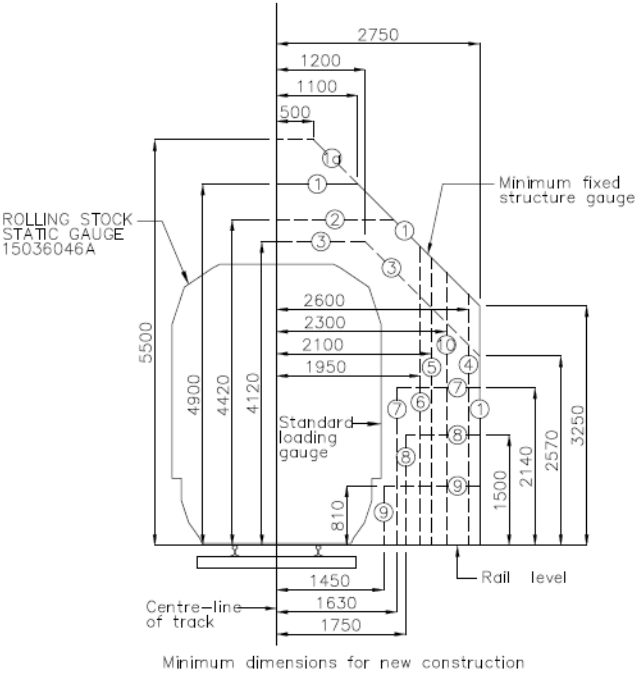
Notes for Figure 2

Line	a) Index to lines of Figure 2
1.	Minimum fixed structure gauge except for the items listed below or specially approved by the PH Track or PH Structures.
1a.	See note (d) below.
2.	Minimum vertical clearance where specially approved by the PH Track; used for temporary work and scaffolding in non-electrified areas.
3.	Station veranda's.
4.	Signals, also verandas where there is no alternative unrestricted track available for high over-gauge loads.
5.	Isolated obstructions, e.g. poles, bridge columns, traction masts, buttresses, , pedestrian mazes, hand rails on bridge footways. **Note**: Non-railway power structures are regulated by statute.
6.	Bridge truss or girder inside flange, bridge hand rails with limited clearance, signals, temporary work and scaffolding, track signage.
7.	Bridge bracing., other hand rails with limited clearance.

Notes for Figure 2 continued

8.	Passenger platforms not referred to in Line 9; point's motors and ground equipment (including 2 position ground signals).
9.	Passenger platforms at major stations, suburban stations and terminals, except Auckland Metro.
(b)	Dimensions (shown in mm) are the minimum for new construction on straight track on main lines and crossing loops. They apply also to modifications to existing structures.
(c)	The clearances shown apply to straight track only. If the track is curved, adjustments for cant and curvature must be made.
(d)	Consult PH Structures and the PH Traction: • about any structure proposed to be constructed over any electrified railway, *or* • when any structure less than 5.5 metres above railway level is proposed over any line likely to be electrified **Note:** depending on the location of existing or proposed traction structures, the proposed length or degree of skew of the new structure, a minimum clearance may be fixed at some point between line 1 and line 1 (a) with approval of the PH Traction

Figure 3 – Clearance (sidings/yards)



Note: This figure refers to sidings- Minimum dimensions for new construction on straight track

Notes for this figure are over the page ⇨

Notes for Figure 3

Line	Index to lines on Figure 3
1.	Minimum fixed structure gauge except for the items listed below or specially approved by the PH Track or the PH Structures.
1a	See note (d) to figure 2.
2.	Minimum vertical clearance in non-electrified areas where road vehicles operate. Applies also to bridges, gantries, scaffolding etc.
3.	Minimum fixed overhead structure gauge in non-electrified areas where motor vehicles do not operate. Applies to doorways, floor beams inside buildings, roof trusses, bracing, scaffolding etc.
4.	Isolated obstructions (bridge column, posts, etc.) where a clear way is required for operating staff. (See also line 10.) **Note:** Non railway power structure are regulated by statute.
5.	Inside walls of buildings (one side of track only). Handrails with limited clearance.
6.	Columns inside buildings (including door posts) on one side of track only, with loading doors closed.
7.	High level loading banks.
8.	Points levers, ground equipment.
9.	Loading platforms and banks, and ground equipment (including ground signals).
10.	Signals, gantries, temporary works, scaffolding, doorways (see note for line 6). Other structures, on one side of the track only and where staff can safely work on the other side.
b)	Dimensions (shown in mm) are the minimum for new construction. They apply also to changes to existing structures.
c)	The clearances shown apply to straight track only. If the track is curved, adjustments for cant and curvature must be made.

Track Surface and Tamping

361. Track surface is the relationship of opposite rails to each other in profile and cant. Cant is the difference in height of the tops of the heads of opposite rails as measured at right angles to the track alignment. The ideal surface is a uniform profile with zero cant on tangents and a set cant on curves.

362. Do not raise the profile of tracks being surfaced above set grades except when approved by the PH Track, who will consider required heights and clearances in tunnels, under overhead structures and bridges, at interlocked areas, platforms, stations and highway level crossings. This applies to Managed Track areas that will have data plates present that provide offsets and levels to work to.

363. Pay special attention to the surface (top) and line of track at the ends and approaches of bridges, at culverts, through tunnels, switches, crossings and platforms.

364. Take care not to break or damage bond wires, conduits or other signal connections to the track when installing sleepers, surfacing or regulating ballast around interlocked areas, insulated joints, points machines, level crossing protection starts or other signal related track connections.

365. Notify the signals section staff when tamping operations affect signal related track components, so that adjustments, repairs or inspections can be completed, if necessary.

366. The basic tools used to work out the correct surface are the track gauge and tape measure.

Test the track gauge before you use it. If it is not within tolerances, repair or replace it. A track gauge must be used to check the work.

367. Face tamping is the continuous lifting and lining of track to restore track surface, cant and alignment.

368. Spot tamping is restoring track surface, cant and alignment through short stretches when continuous lifts are not necessary.

369. When tamping curves, the high rail is the line rail and the low rail is the grade rail. Raise the high rail to give the correct cant.

370. Before disturbing jointed track in hot weather, lessen the risk of buckling by:

a.	loosening bolts and tapping fishplates at "frozen" joints and apply grease before correctly tightening and torquing bolts.
b.	using enough ballast to fully backfill track
c.	adjusting tight joints by cutting out extra rail, or re-spacing joints when required.

371. Before disturbing CWR in hot weather, lessen the risk of buckling by:

a.	keeping lifts to a minimum
b.	using enough ballast to fully backfill track
c.	complying with the Section of this Handbook covering CWR (refer clause 492-494).

372. Put speed restrictions on track that has been tamped, in line with clause 889 and Table 23 of this handbook.

Refer to Refer Track Standard T-ST-AM-5161 Mechanised Track Surfacing for the rail temperature limits.

Permanent Way

Ballast

401. Ballast has several important functions, including:

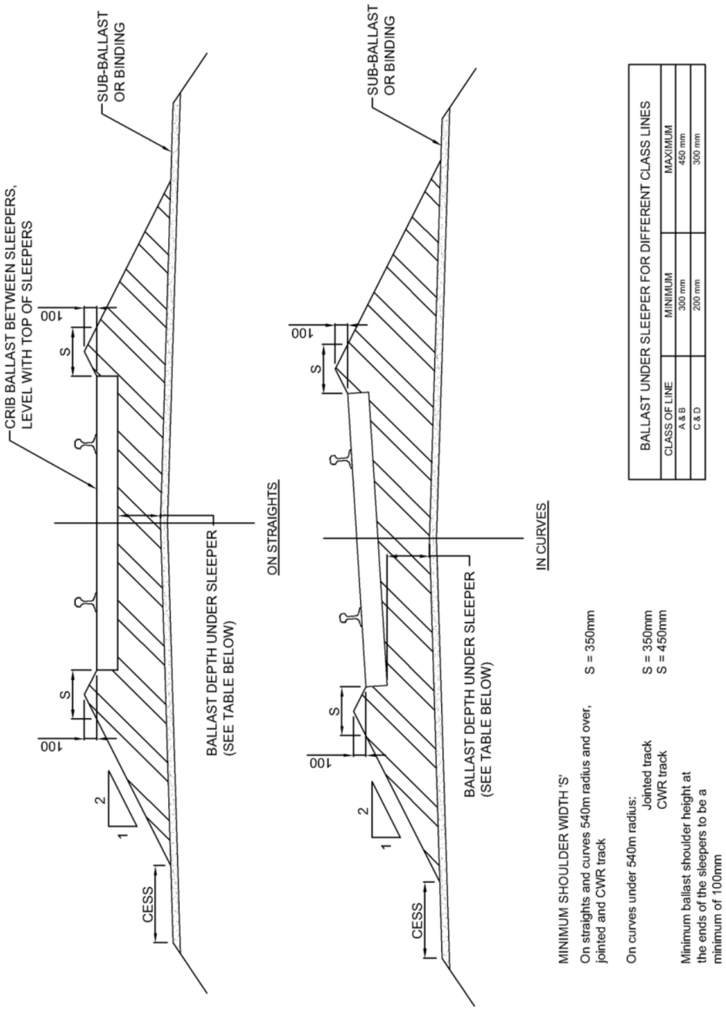
a.	letting the track be maintained in correct top and alignment
b.	providing a uniform bearing surface for sleepers
c.	spreading the load from rail and sleepers further over a maximum area
d.	providing good drainage that supports the track section, slowing down weed growth
e.	preventing sleepers moving laterally and/or longitudinally
f.	providing electrical resistance in the track structure.

402. Ballast cross sections should match Figure 4. On curves where it is not practicable to install this ballast profile, ballast glue or lateral resistance end plates are to be considered for use first seeking approval from PH Track.

403. Every effort must be made to establish the 100mm peaked profile on the ends of the sleeper. However, an additional 100mm width of level shoulder is acceptable where the peaked profile has not been formed as per the table below.

Curve Radius (m)	Jointed or CWR	Shoulder width with peak profile (mm)	Shoulder width with flat profile (mm)
>540	Both	350	450
<540	Jointed	350	450
<540	CWR	450	550

Figure 4: Ballast cross section



BALLAST UNDER SLEEPER FOR DIFFERENT CLASS LINES

CLASS OF LINE	MINIMUM	MAXIMUM
A & B	300 mm	450 mm
C & D	200 mm	300 mm

404. Leave plenty of clearance for rolling stock when spreading ballast. Remove ballast from switches or flange-ways through frogs, guard rails and crossings, because it will block proper operation or passage of wheel flanges.

405. Be careful not to waste ballast on embankment slopes that are narrow (pinnacle track). Look to lower the track ballast or sub-ballast instead.

406. Avoid pulling sub-ballast, dirt or other material into the track that would foul the crib/shoulder ballast when backfilling or spreading ballast.

407. When unloading ballast, all wagons must be evenly loaded or completely empty and doors closed and locked prior to releasing from the work site.

408. Only use ballast from a source approved by the PH Track (ref specification T-SP-MM-60140).

409. Do not use ballast that is poor quality, wrongly graded or contains quantities of screenings, dirt, fines or other foreign matter. Advise your manager immediately to source alternative material.

Sleepers

411. Sleepers have two functions. They:

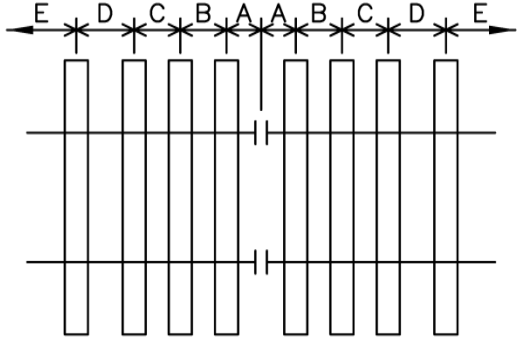
a.	make a connection between the rails, holding them to the correct gauge
b.	transfer the rail load to the ballast and formation.

412. Timber sleepers, other than turnout or bridge sleepers, are 150 x 200 x 2100 of either TPR or hardwood.

The maximum spacing for sleepers are set out in Figures 5 and 6.

For spacing of composite and steel sleepers, refer to the dimensions specified for timber.

Figure 5: Sleeper spacing (standard joint)

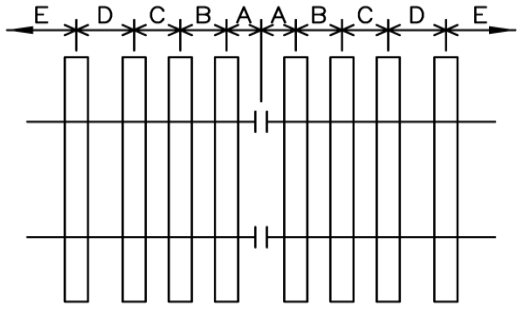


All dimensions in mm

	SITUATION	A	B	C	D	E
CLASS A & B	**CONCRETE**					
	With heavyweight rail on straight and curves down to 400m radius With heavyweight rail on curves under 400m radius	200 200	450 400	500 400	600 500	700 600
	TIMBER					
	With heavyweight rail with 660mm (long) 4 hole and 900mm 6 hole fishplates	200	400	400	500	600
	With 91lb rail or lighter with short fishplates	300	600	600	600	600
CLASS C	With 70lb rail or lighter	225	600	675	675	675
	With 72 - 75lb rail having flanged (veranda) fishplates	275	600	675	675	675
	With heavy weight rail	300	600	675	675	675
SIDINGS	With light weight rail	225	600	675	675	675
	With 70lb rail	225	600	750	750	750
	With 72 - 75lb rail having flanged (veranda) fishplates	275	600	750	750	750

	With heavy weight rail	275	600	750	750	750

Figure 6: Sleeper spacing (GIJ)



All dimensions in mm

	SITUATION	A	B	C	D	E
GIJ	Concrete Sleepers at 600mm centres.	300	600	600	600	600
	Concrete Sleepers at 700mm centres.	300	600	700	700	700
	Timber sleepers N or R type fastening	325	600	600	600	600
	Timber sleepers P type fastening	300	600	600	600	600

Refer to CCE plan 300122 sheets 1-3

Note: Shortened 10mm Insulator to be used on concrete sleepers for GIJ's CCE plan 300149.

414. Put new timber sleepers heart side down, square across the track. Centre sleepers on the track centre line.

415. Handle timber sleepers only with gloves and tools or equipment designed for that purpose to lessen damage to the sleeper and reduce the chance of injury. Support sleepers in stockpiles as per instructions contained in Track Standard T-ST-AM-5310 Sleeper Management.

416. Remove only enough wood to provide a sound and true bearing for the bedplate when adzing sleeper.

417. Sleeper boring

Read clause 616 for instructions on drilling holes in sleepers.

418. When screwspike holes in sleepers get enlarged, you may add vortok coils for improved fastening grip.

419. Store sleepers on the rail corridor in neat piles, away from vegetation and other material that will burn and in a well-drained area at least 3m from the centre line of the track, so they do not hold up operations or cause a safety hazard.

420. Sleepers laid out beside the track before installation should not be closer than 3m from the centre line, where possible. Sleepers placed closer than this must not be higher than the top of rail.

421. Do not allow scrap sleepers to build up along the rail corridor. Collect and remove sleepers as instructed by the Asset Engineer. Do not bury or burn sleepers . Scrap sleepers are to be sold only by authorised staff.

422. The minimum spacing of bridge sleepers is 300mm. Refer to clause 623 for fastening requirements.

423. Table 6 details the sizes of bridge sleepers - refer to Structures Standard B-ST-DE-3111 Table 10.1 and 10.2

424. Galvanised fastenings for timber or concrete sleepers are to be used in any areas subject to high risk of corrosion such as wet tunnels, within 150m of the high water mark in coastal areas or in level crossings. Seek clarification from Track Engineering in all cases.

425. Spikefast glue may be used to fill holes and rail seat wear in timber and composite sleepers. For concrete sleeper rail seat wear use CTR-100. Refer to Track Standard T-ST-AM-5310 Sleeper Management.

TABLE 6: Bridge sleepers

Two Leaf Bridge Spans				
Class of Line	Curvature	Spacing, Centre to Centre, of Supporting Beams or Girders		
		Up to 1.55m	1.55 to 1.70m	1.70 to 1.85m
A&B	Straights and curves ≥ 800m radius	200 x 145	200 x 145	200 x 145
	Curves < 800m radius	200 x 145	200 x 145	200 x 175
C	Straights and curves	200 x 145	200 x 145	200 x 145

Three or Four Beam Timber or Steel Spans			
Class of Line	Curvature	Three or Four Timber Beams	Three or Four Steel Girders
A,B,C	< 100m radius	200 x 145 x 2400	200 x145 x 2400

Table 6: Notes

a. Sleeper dimensions shown in mm.

b. Where the centre to centre dimension of supporting girders exceeds 1.85m, sleeper sizes to be used will be specified by the PH Structures Engineering.

c. All sleepers to be a minimum length of 2400mm.

Rail

General

431. The purpose of rail is to effectively transfer the load from the wheels to the sleepers.

432. Handle rail carefully. Do not lift or drag with metal chains wrapped around the rail and do not hit it with sledge hammers or other heavy objects.

433. Examine and classify rail before loading, stockpiling and laying. Look for any condition that will make the rail unusable. Both rails that make up the track must be of the same section. Any variations must be approved by the PH Track.

434. Rail is classified by three weight categories:

Category	Weight of Rail
Heavyweight	85, 90, 91lb/yard, 50kg/m
Medium weight	70, 72, 75lb/yard
Lightweight	53, 55, 56lb/yard

435. Rail wear is measured with a Rail Wear Gauge. Rail Wear Limits are shown in Table7 and Track Standard T-ST-AM-5330 Rail Management.

Note: Total reading = Top wear & side wear (including field side on all rail except 50kg)

Once at or beyond the wear limits a TSR is to be imposed as per Table 22.

TABLE 7: Rail-wear limits (refer to table below for 50 kg rail)

Rail Weight	New Rail Readings			Rail Wear Limit
	Side	Top	Total	
91 NZR	1	5	6	**20**
90 RA-A	1	5	6	**20**
85 RBS	0	0	0	**14**
75 RBS	0	3	3	**17**
75 ASCE	1	6	7	**21**
72 NZR	1	5	6	**20**
70 RBS	1	5	6	**20**
70 ASCE	1	9	10	**24**
70 BS	1	4	5	**19**

Rail-wear Limits for 50 kg Rail Only

Top Wear Only	18 points	
Top & Side Wear	Top 14 points	Side 16 points
Rail has reached its wear limit when either top or side wear reaches the limits above.		
(c) Where 50 kg rail has been transposed, side wear on the gauge side (inside) of the rail only is measured.		

436. When rail is very worn, be careful replacing worn or defective fishplates so there is less impact on wheel flanges. Advise your Manager if fishplates are being hit by wheel flanges.

437. Minimum rail closure lengths are as per Table 8.

TABLE 8: Minimum closure lengths

Location	Minimum Length	Installation
Main Lines & Loops	6m	Must be welded both ends
Yards	4m	Must be welded both ends
Turnout closure rails	3m	Must be welded both ends

Where welding cannot be undertaken e.g. on bridges and adjacent to frogs in turnouts, closures may be bolted one end. The minimum lengths for these closures is 4m in turnouts and 6m on bridges. In both cases, the maximum rail length available should be used.

Main line & loop closures less than 4 metres in length are to be replaced within 3 months from first reported date. In yards, closures less than 3m in length must be replaced within 12 months from first reported date.

All closures in CWR must be welded in and de-stressed. Follow the M130 process as described in clauses 465 to 467.

GIJ's with a ≥2.1m long leg as part of the GIJ unit are an exception to this clause and must be welded in track. GIJ's must be curved correctly if installed in curves < 250m radius.

Any rail length less than 12.5m is classed as a closure and is subject to the requirements above.

Closures not less than 6m long may be installed with temporary joints, see clauses 524-528 for time limits and requirements.

438. Union fishplates are permitted in certain circumstances. Refer clause 514.

439. Use rail of the same section to get rid of joints, welds and bolt holes within road crossings, paved areas, track on bridges, and within 6m of bridge ends and, wherever possible, in turnouts.

Note: joints, welds and unused bolt holes in these locations are not permitted**.**

440. Bring rails of different sections or of unequal wear to an even surface and gauge face at joints by using:

a) union joints of the correct design (temporary only)
b) an approved method of rail end welding and grinding
c) an approved method of union field welding
d) the installation of union rail of correct sections.
Refer also to clause 513

441. Once transpose limits have been exceeded then rail is to be programmed for renewal, taking wear rates in to account to establish the correct financial year to renew.

Transpose or relocate curve rail to get the most rail life out of it. Rail must be transposed at or before the following limits in Table 9 are reached.

TABLE 9: Rail-wear limits for transposing

Rail	Combined Wear
90/91lb	14 points
85 RBS	8 points
75 RBS	11 points
75 ASCE	15 points
72 NZR	14 points
70 RBS	14 points
70 ASCE	18 points
70 BS	13 points

For 50kg/m use the limits below:

50 kg Fishplated Track	
Top Wear	**Side Wear**
0 - 5	16
6 - 14	Total ≤16
50 kg Welded Track	
These are maximum limits:	
Top Wear	**Side Wear**
12	16

442. Use a rail drill with the correct size drill bit to drill rail bolt holes. Drill bolt holes completely through the rail web. Do not punch, slot or gas cut bolt holes through

the rail. Use the correct template for the rail section and drill type being used to mark bolt hole locations.

443. Where rail is buried (e.g. Sidings or Level Crossings) or in high corrosion risk areas (e.g. Tunnels) redundant bolt holes are to be eliminated.

444. Rail sections and bolt hole spacing and diameters are shown in Table 14.

445. Gas cutting of rail is not permitted under normal circumstances. In general, use an abrasive wheel-cutting saw to make rail cuts. If gas cutting of rail is needed in an emergency, follow these steps:

Emergency Gas Cutting of Rail	
a.	Limit speed to 40 km/h.
b.	Trim rail using a rail saw to remove at least 6mm of rail within one hour of making the gas cut, or have at least 150mm cut with a rail saw after one hour.

446. Follow these guidelines for cutting rail using an abrasive wheel rail saw (refer also to hazard register, safety plan):

a.	The correct support arm must be used with the rail saw.
b.	"Free-hand" cutting of rail with an abrasive wheel saw is prohibited.
c.	Blade guards must be in place on the saw.

d.	Abrasive cutting wheels must be stored in a dry place and in a way that stops them bending, warping or breaking.
e.	Correct eye and face protection **must** be worn when using the rail saw. Hearing protection **must** be worn when using petrol-powered rail saws.
f.	Pay attention to the sparks coming from the cut and take all necessary steps to stop fires.

447. Notify signals section staff:

a.	When a broken rail is found which is bonded for track circuits or when track circuit leads are broken.
b.	When a rail is removed from bonded track in signals territory or where there are signal track circuits.
c.	Before welding or heat treating rail ends in bonded track.

Note: Keep the welding earth strap firmly in place when arc welding on track so you don't damage signal related devices.

448. Head hardened rail shall be used in Class A lines on curves of radius 250m and less. Consideration will also be given to providing head hardened rail on steep grades and in specific environment conditions e.g. tunnels. This will be at the discretion of the PH Track.

Note: All 50kg rail supplied since 2017 is already head hardened Mill Heat Treated (MHT).

Continuous Welded Rail (CWR)

TABLE 10: CWR Definitions

NOTE: For technical details refer to Track Code Supplement Section 31.

Long Welded Rail (LWR)	Rail welded into lengths of 40m or more is to be treated the same as CWR, except on bridges
Continuous Welded Rail (CWR)	Continuous rail lengths greater than 76m
Tie Down Temperature	The temperature at which the rail fastenings are fixed down.
Rail Temperature	Current rail temperature taken with thermometer or pyrometer on the web on the shaded side of the rail. Magnetic Thermometers should be left for 15 minutes to get an accurate reading.
Design Neutral Temperature	The temperature at which the rail has no internal longitudinal forces. The rail is not in compression (pushing together) or in tension (pulling apart). Currently 32°C.
Lateral Resistance of Track	The ability of the track structure to resist being displaced in an outward direction. Resistance is developed through the interaction of the sleepers and ballast.

454. Keep to the following guidelines when working with CWR at all times.

CWR – Rail Anchors (also refer to Clause 581)

455. Use only the correct size and design for the rail section. Do not use rail anchors that are damaged or sprung.

456. Apply rail anchors from the gauge side of the rail, when possible. Apply the rail anchor close against the side of the sleeper.

457. When laying or adjusting the neutral temperature of CWR, install anchors after the rail has been brought to the correct rail laying temperature.

458. Install rail anchors in box pattern (1 each side) on sleepers, as follows:

- For grades ≤ 1 in 100: every 2nd sleeper
- For grades > 1 in 100: every 4th sleeper

Except:

(a) At the end of CWR strings anchoring must be provided by having 40 sleepers fully anchored, 40 sleepers 1 in 2 effective anchoring and 40 sleepers 1 in 4 effective anchoring, except where specified in Track Standard T-ST-DE-5160 CWR Design and Construction.

(b) When CWR is approved and installed on an open deck bridge, every sleeper must be box anchored both sides of the bridge for a distance equal to half the bridge length up to a maximum of 120 sleepers.

459. Rail anchors are only to be used on timber and composite sleepers except where pandrol fastenings are used, as these provide sufficient toe-load to resist longitudinal rail movement.

CWR – Installation

461. The installation of CWR and de-stressing is a complicated technical procedure, and is covered in Track Standard T-ST-DE-5160 CWR Design and Construction.

CWR must only be formed when rail temperatures are within the range of 5º to 32º C.

CWR – Maintenance

464. CWR installed and anchored at the correct tie down temperature is also at its neutral temperature. The rail develops forces in tension as it cools. Routine maintenance practices such as surface tamping, rail insertion, sleeper installation, formation repairs, ballast cleaning and train traffic result in a reduced neutral temperature over time. This makes the rail less able to withstand high rail temperatures. When the neutral temperature is greatly reduced, the possibility of track buckles due to higher rail temperature or train movements increases.

Maintenance operations may unintentionally reduce neutral temperature of the rail. Replacement of rail is one of the most common maintenance practices that causes this reduction. Follow proper procedures to monitor the length of rail installed during rail changes.

465. Do not add rail to CWR track. Record on the M130 closure installation form the places within CWR where a small section of rail or a weld has been replaced (with a closure rail, wide gap or ordinary weld). Include details of reference marks (pop marks) before and after installation (or welding). Where no reference marks are available, at least 50 metres both sides of the closure rail or weld must be de-stressed.

466. When cutting CWR, make reference marks on the rail, prior to cutting, on each side of the place where the cut is to be made. Make these reference marks where they will not be covered by fishplates or removed by changing the rail. When changing rail, place the marks at least 1m beyond the joint. Use a paint stick or other marker to mark the rail and record the distance on closure installation form.

467. After the rail has been changed or is being welded in place, make sure the distance between the reference marks is equal to or less than the original distance recorded as instructed on the M130 form. To do this using rail tensors or heating the rail is permitted. If the distance is longer than the original distance, note the amount of rail added and report it for future monitoring.

CWR – Adjusting the Neutral Temperature

471. When it is clear that the neutral temperature of a length of rail has decreased enough to cause a track buckle (refer to clause 480 - 485) the rail should be adjusted back to the design neutral temperature. The method for the adjustment (de-stressing) involves removing rail anchors, cutting the rail and removing rail to achieve the correct rail laying temperature.

The formula to calculate the required rail extension is:

$E = (T_1 - T_2) \times L \times .0115$

Where: $T_1 = 32^o$

T_2 = measured rail temperature

L = length unclipped in metres

Alternatively, use the extensions listed in Table 11.

TABLE 11: Rail extensions for destress					
Rail Temp	Extension in millimetres				
°C	5m	10m	50m	100m	500m
32	0.0	0.0	0.0	0.0	0.0
31	0.1	0.1	0.6	1.2	5.8
30	0.1	0.2	1.2	2.3	11.5
29	0.2	0.3	1.7	3.5	17.3
28	0.2	0.5	2.3	4.6	23.0
27	0.3	0.6	2.9	5.8	28.8
26	0.3	0.7	3.5	6.9	34.5
25	0.4	0.8	4.0	8.1	40.3
24	0.5	0.9	4.6	9.2	46.0
23	0.5	1.0	5.2	10.4	51.8
22	0.6	1.2	5.8	11.5	57.5
21	0.6	1.3	6.3	12.7	63.3
20	0.7	1.4	6.9	13.8	69.0
19	0.7	1.5	7.5	15.0	74.8
18	0.8	1.6	8.1	16.1	80.5
17	0.9	1.7	8.6	17.3	86.3
16	0.9	1.8	9.2	18.4	92.0
15	1.0	2.0	9.8	19.6	97.8
14	1.0	2.1	10.4	20.7	103.5
13	1.1	2.2	10.9	21.9	109.3
12	1.2	2.3	11.5	23.0	115.0
11	1.2	2.4	12.1	24.2	120.8
10	1.3	2.5	12.7	25.3	126.5
9	1.3	2.6	13.2	26.5	132.3
8	1.4	2.8	13.8	27.6	138.0
7	1.4	2.9	14.4	28.8	143.8
6	1.5	3.0	15.0	29.9	149.5
5	1.6	3.1	15.5	31.1	155.3

472. Once a cut in the rail is made to reduce rail compression when the rail temperature exceeds 32°C, remove either the rail anchors or Pandrol clips for enough length either side of the cut to allow the rail to expand. Note the new tie down temperature; if it is more than 2°C above the design neutral temperature, record the site details and include the site in future de-stress programmes.

CWR – Inspecting Track for Potential Buckles

480. Tracks buckle when the lateral resistance of the track structure holding the track in line is overcome by the longitudinal forces in the rail. Longitudinal forces (either tension - pulling apart, or compression – pushing together) develop when rail is heated by the sun during the day and cooled at night. Additional effects of trains braking or speeding up can increase rail stress. Poor sleeper/loose fastening condition, insufficient anchor pattern or condition, light ballast section or recently disturbed track will all reduce the lateral resistance of the track structure and increase the risk of the track buckling.

481. Use a calibrated rail thermometer to monitor the rail temperature when working with CWR. In times that track is likely to buckle, inspect CWR track during the hours of expected maximum rail temperature. Arrange enough inspections to cover the track. Heat inspections are also required when heat sensors are activated, as per the Heat Management Bulletin.

IF IN DOUBT, INSPECT

482. Track buckles usually happen in the afternoon and early evening hours of late spring and early summer when wide temperature ranges occur.

Track buckles can also happen in mid–summer when the maximum temperatures for the season are reached. On days with lower temperatures, track buckles can be caused by recently disturbed track, programmed track work or by train handling.

Places where tracks are likely to buckle are: at bottoms of grades; where track meets solid objects (turnouts, bridges, level crossings, etc.); areas of recently disturbed track; where sleepers or anchors are not in good condition; where ballast is dirty or there is a light ballast section; or where heavy train braking or speeding up happens.

Look for tell-tale signs of tight rail when inspecting track, such as: bunched or pushing sleepers that are ploughing ballast; rail running either through rail anchors or with the anchors; rail lifting up in the fastenings; rail pushing against both shoulders of the bedplates; canting rail and gaps at the ends of the sleepers showing track has moved laterally; or track that is misaligned.

Where rail has moved more than 50mm longitudinally and the tonnage predominantly moves in one direction, inspect the track closely for track that is misaligned and sleeper bunching. Restrict speed as required.

483. When these signs of rail under stress are clear, take immediate action to restore track stability by putting a speed restriction in place, placing additional ballast and adjusting the rail.

WHEN IN DOUBT, CUT RAIL OUT

Hot weather speed restrictions are listed in the Operations Management System typically between October and April. Pay careful attention to the weather forecast and actual rail temperatures; notify Train Control if heat restrictions need to be imposed. (Heat restrictions can be applied if necessary even when the heat alarms have not activated.) See Table 12 as a guide.

TABLE 12: Estimated rail temp using the forecasted air temp

Forecast Air Temp	Overcast	Broken Cloud	Scattered Cloud	Fine and clear
32	48	53	56	61
31	47	52	55	60
30	46	51	54	59
29	45	49	52	58
28	44	48	51	56
27	42	47	50	54
26	41	45	48	53
25	40	44	47	51
24	38	42	45	49
23	37	41	44	48
22	36	39	42	46
21	35	38	41	45
20	34	37	40	44
19	33	36	39	43
18	33	36	39	43
17	31	33	36	40
16	30	33	35	38
15	29	31	33	36
14	27	29	32	34
13	26	28	31	33
12	24	26	29	31
11	22	24	27	30
10	21	23	26	28

Note:

All temps in °C

Wind force will reduce figures

The above figures are for October to March

CWR – Preventing Track Buckles

485. Find areas where rail and sleepers have moved and places where rail was added during the winter months so they can be corrected before the weather warms up.

Inspect for missing, sprung, damaged or wrongly applied rail anchors, shy ballast section and poor sleeper conditions, which cannot hold the track firmly enough to stop lateral movement.

Track buckles can also happen in areas where track is disturbed and programme work has recently been done. Protect these areas until ballast is firmly packed. (Refer to Speed Restrictions, clauses 881-891, and Table 23).

CWR – Specific Track Maintenance Activities

491. Use speed restrictions to protect areas where track buckles are likely because of new track construction, disturbed track from repair or maintenance activities, or signal and bridge construction.

Before increasing or removing a speed restriction, inspect the track and make certain that train tonnage actually passed over the track being restricted.

Do not remove speed restrictions in the heat of the day.

CWR – Tamping

492. Any downhill (movement to the inside of the curve) rail movement will reduce the rail neutral temperature when tamping and lining curves. If the neutral temperature is reduced too much the curve will need to be destressed.

CWR with curves of radius 400 metres or less have monuments placed to make it easy to check that the curve has not moved from designed alignment, unless adjustments are made for equal uphill and downhill track movements. (Refer to Track Standard T-ST-AM-5120 Track Geometry for details of monuments.)

Monitor the rail temperature when tamping track. If the rail temperature is at or above the known rail tie down temperature, the rail may be lined but keep lifts to a minimum. Refer to Track Standard T-ST-AM-5161 Mechanised Track Surfacing for rail temperature limits.

Before increasing train speeds, the ballast section of tamped track must be fully backfilled and regulated to the profile shown in figure 4. Use the speed restrictions in Table 23 to protect disturbed track.

CWR – Sleeper Replacement & Undercutting

493. Programmed sleeper replacement and road crossing renewal work, greatly disturbs the ballast section and is likely to cause track buckles.

On days when the rail temperature is at or may go over the known rail laying temperature, adjust the rail in a way approved by the PH Track. This may include cutting rail and adjusting anchors or reducing the number of sleepers per track set length that are installed in a single pass.

Before increasing the operating speed over the track, make sure sleepers are fully fastened down, rail anchors are installed and the track backfilled. Apply the speed restrictions in clause 889 and Table 23.

Undercut track must have required sleepers refastened or replaced, rail anchors adjusted and enough ballast to surface and backfill the track. Adjust and line any misalignments that happen during the undercutting or sledging operations. Apply the speed restrictions in clauses 889 and Table 23 .

CWR – Smoothing Tamping

494. The Ganger in charge of smoothing tamping operations needs to determine what speed restriction is necessary as guided by clauses 881 - 892. Further details are included in Track Standard T-ST-AM-5161 Mechanised Track Surfacing.

Do not spot surface tamp CWR when the rail temperature is over 40°C unless the rail is de-stressed to the Design Neutral Temperature.

Smoothing tamping, including raising joints, adjusting cant, raising bridge approaches or other smoothing tamping that disturbs more than four sleepers in a row, must be protected in line with the speed restriction guidelines. Do not raise speeds unless the sleepers being tamped, are tied down and anchored to standard for that track class and the ballast is restored as shown in Figure 4.

CWR – Spot Sleeper Replacement

495. Sleepers must be fully fastened, anchored and tamped when installed. When 3 or more sleepers in a row are installed per 12.8m length of rail, apply the speed restrictions in clauses 881-892. Do not increase speeds until the ballast section is put back as shown in Figure 4 and the ballast is packed down firmly by the weight of trains as outlined in Table 23.

Replacing bridge sleepers and raising bridge decks may affect the way that the adjacent track next to the bridge resists track buckles. Monitor the rail temperature for this type of work and put a suitable speed restriction in place.

CWR – Rail-welding

496. Note reference marks on the rail from a previous cut before making a field weld. Measure and record the distance between these marks. When the rail ends are trimmed and the weld is made, the distance between the reference marks must not be more than the original distance measured.

When making field welds, the welder should discuss the details of the area to be welded with the Ganger and Asset Engineer to work out if there are any unusual rail conditions. The welder should also pay attention to any marks on the rail near the joint to be welded and match marks that may have been left showing rail movement, distance between the marks that should have been previously noted on the closure installation form.

All redundant bolt holes should be removed.

CWR – Jointed Rail

497. When jointed track (LWR) is in lengths of 40m or more then it is to be treated as CWR and rail gaps are to be ≤3mm irrespective of the rail temperature, It is also required to be de-stressed. 6-hole fishplates must be used and fully bolted.

498. Bring rail ends squarely together against the correct expansion gap keys before bolting and tying down.

499. Keep gap keys in joints until joints are fully bolted and rail is anchored.

500. LWR on bridges must be gap adjusted as per clause 510.

Defective Rail

501. Defective rail includes rail which shows any of the following:

- Heavy corrosion, excessive wear, wheel burns, shelling, cracks, damage, or other surface defects.

The following clauses give details for reporting and dealing with defective rail.

For further information on prioritisation, actions and mitigations for rail defects including RCF head checking, refer to the Track Standard T-ST-AM-5330 Rail Management.

502. Report defective or broken rails and welds on an M58A form. Take sufficient photographs of break to determine cause and attach to report.

NDT Operators will report defects found by testing on the NDT report forms.

Make 3 copies of M58A reports, as below:

- 1 copy to PH Track
- 1 copy to Asset Engineer
- 1 copy kept by Ganger

503. When rail is found to have any of the defects listed in Table 13, the following action is to be taken.

All NDT defects in rail must be cut out; MMA or MIG weld repairs are not permitted.

Defect Types

TD	transverse defect	**PR**	piped rail
TDX	multiple TDs	**BHC**	bolt hole crack
DW	defective weld	**SW**	split web
TDEBF	TD engine burn fracture	**HWS**	head web separating
HSH	horizontal split head	**CO**	cracking out
VSH	vertical split head	**SCR**	shatter crack rail
BR	broken rail	**CR**	corroded rail
DWFW	MMA or MIG weld defect	**HC**	Head checking RCF

TABLE 13: Rail defects and actions

Defect	Size (mm)	Description	Action to be taken
VSH	**< 50**	**Bantam**	**Remove within 52 weeks**
	50 - 200	**Small**	**Remove within 4 weeks**
	201 - 400	**Medium**	**Remove within 7 days**
	> 400	**Large**	**Immediate 25 km/h TSR and remove within 7 days**
	Any visible crack or railhead collapse >0.5mm	**Immediate**	**Immediate 25 km/h TSR and remove within 48 hours**

Defect	Size (mm)	Description	Action to be taken
HSH	< 25	Bantam	Remove within 52 weeks
	25 - 100	Small	Remove within 4 weeks
	101 - 200	Medium	Remove within 7 days
	> 200	Large	Immediate 25 km/h TSR and remove within 7 days

Defect	Size (mm)	Description	Action to be taken
PR	< 25	Small	Remove within 52 weeks
	25 - 150	Medium	Remove within 4 weeks
	151 - 300	Large	Remove within 7 days
	> 300	Immediate	Immediate 25 km/h TSR and remove within 48 hours

Defect	Size (mm)	Description	Action to be taken
DW Head or Web	< 15	Bantam	Remove within 52 weeks
	15 - 25	Small	Remove within 4 weeks (if plated then 8 weeks)
	26 - 45	Medium	Remove within 7 days (if plated then 14 days)
	> 45	Large	PLATE immediately (within 24hrs) Immediate 25 km/h TSR and remove within 7 days

Defect	Size (mm)	Description	Action to be taken
DW Foot/Base (Thermit Weld only)	< 15 < 10 if at edge	Small	Remove within 52 weeks
	15 – 35 10 – 35 if at edge	Medium	Remove within 7 days
	> 35	Large	PLATE immediately (same day) Immediate 25 km/h TSR and remove within 7 days

Defect	Size (mm)	Description	Action to be taken
TDX SCR	< 10	Small	Remove within 52 weeks
	10 - 25	Medium	Remove within 7 days (if plated then 14 days)
	26 - 39	Large	Immediate 25 km/h TSR and remove within 7 days
	> 39	Immediate	Immediate 25 km/h TSR and remove within 48 hours

Defect	Size (mm)	Description	Action to be taken
TD, TDEBF, DWFW	< 10	Bantam	Remove within 52 weeks
	10 - 25	Small	Remove within 4 weeks (if plated then 8 weeks)
	26 - 39	Medium	Remove within 7 days (if plated then 14 days)
	40 - 50	Large (not CO)	PLATE immediately (within 24hrs) Immediate 25km/h TSR and remove within 7 days
	> 40 if CO or > 50	Immediate	PLATE immediately (within 24hrs) Immediate 25 km/h TSR and remove within 48 hours

Defect	Size	Description	Action to be taken
BHC, HWS, SW	< 20	Small	Remove within 4 weeks
	21 – 45	Medium	Remove within 7 days
	46 - 75	Large	Immediate 25 km/h TSR remove within 7 days
	> 75	Immediate	Immediate 25 km/h TSR and remove within 48 hours

Defect	Size	Description	Action to be taken
HWS (NOT at rail end or weld)	< 20	Bantam	Remove within 52 weeks
	20- 40	Small	Remove within 4 weeks
	41 – 75	Medium	Remove within 7 days
	> 75	Large	Immediate 25 km/hr TSR. Remove within 7 days

Notes for all defects:

1 Plating means fitting emergency fishplates and/or temporary clamps as detailed in clauses 523 - 528.

2 Some defects need to be thought about carefully on site to decide if a more stringent action is required. This includes both short term and final corrective action.

3 Large rail defects remaining in track are to be inspected during normal scheduled inspections. Suitable mitigation is to be taken in response to any visible worsening in the defect or work carried out to repair it.

4 The TSR for broken rails and welds (BR) is covered by clause 882 and Table 22.

TABLE 13A: RCF Head Checking

HC Crack Depth	Priority	Action to be taken
D ≤ 3mm	P19	Remedial grinding within 104 weeks
3mm < D < 5mm	P17	Remedial grinding within 52 weeks
5mm ≤ D < 8mm	P16	Rerail within 26 weeks[2] PAUT re-test every 12 weeks
8mm ≤ D < 12mm	P14	Rerail within 13 weeks[2] PAUT Re-test every 6 weeks
12mm ≤ D < 20mm	P10	Rerail within 4 weeks[2] Immediate TSR 40 km/h
20mm ≤ D < 30mm	P6	Rerail within 7 days Immediate TSR 25 km/h[1]
D ≥ 30mm	P1	Block the Line to traffic

Risk Key	Light	Moderate	Heavy	Severe

Notes for RCF HC defects:

1 Temporary clamp where possible.

2 Priority and associated testing frequencies, actions and mitigations to be lifted one level for RCF HC in the profiled switch area of turnouts.

3 All other types of RCF such as squats, belgrospis, cracking caused by lipping or wheel burns shall be treated as per Table 13 for TD or TDX (where they appear within 500mm of each other); corrugations as per Section 11 contained in Track Standard TST-AM-5330 Rail Management.

504. Any failure or defect within 150mm of a weld is classed as a weld with the actual defect identified in the comments of the Rail Failure Form.

505. Callipers must be used to assist in detecting serious rail web corrosion and to enable monitoring of areas known to be affected by corrosion such as:

- Tunnels – particularly in damp and wet areas.
- Level Crossings – where rail is buried in the roadway by tarmac/panels (not easily tested).
- Areas where the environment is corrosive such as areas affected by sea spray, coal dust, other chemicals etc.

Measure the rail in these problem areas at least every 20m to identify where corrosion has started. All damp areas in tunnels must be measured and recorded.

Where the rail web is corroded (CR) the following limits apply:

Rail Size	New Rail Web Thickness	Monitor Annually	Programme for removal	Minimum Thickness Allowed
50kg, 91lb, 85lb	15mm	12mm	10mm	8mm
75lb, 70lb, 55lb	13mm	10mm	8mm	6mm

When the minimum thickness is reached a 40km/h TSR is to be applied until removal, if measured beyond the minimum then the line must be blocked to traffic.

506. Rail foot damage/corrosion.

Where the rail foot is damaged or broken out of any length, and the rail is not broken right through its cross section, the following applies:

Loss of rail foot width	Repair Action	Safety Action
7 to 12mm	Remove within 13 weeks	Monitor on weekly TI
13 to 18mm	Remove within 4 weeks	Immediate TSR of 40km/h
> 18mm	Remove within 7days	Immediate TSR of 25 km/h and inspect daily until removed

Foot gall ≤5mm monitor annually.

Foot gall >5mm, immediate 40km/h TSR until replaced.

507. Broken rails with >30mm gap or >20mm out of vertical must be immediately blocked to rail traffic.

Remove defective rail as follows:

Broken welds and rails Label with line, metrage and date. Ganger or Asset Engineer holds for inspection.
Final removal to scrap Only after approval by PH Track.
NDT defects Clearly mark rail and remove to scrap immediately except when large lengths of rail (greater than 12.8m) are affected. In this case PH Track will advise action to be taken.

508. Cut defects out of rail in line with the instructions below:

Cracked rail ends: Cut a minimum of 400mm from rail end.
Defective welds: Cut 20mm either side of weld.
Defects found mid rail: Cut a minimum of 600mm either side of defect or as marked.
Longitudinal cracks away from rail-ends: Cut a minimum of 300mm from each end of the crack.

Installation of a Rail Dolly or Fishplated Joint

509. The Ganger or Track Inspector must record every case where a rail dolly or fishplated joint bolted one end only is installed into track on M125 form and advise the relevant Asset Engineer.

Include in the report:

i. The reason for the dolly or fishplated joint bolted one end only

ii. When planned work will remove such items

iii The details of the TSR imposed.

Keep the TSR in place until the item is removed and track that meets standards is put back. Inspect items during normal scheduled inspections to make sure fishplates are not cracked, fish-bolts are tight and overall joint gap width and condition is acceptable.

Only a single rail dolly is to be installed at one joint up to a maximum of 150mm in length.

A dolly or single end bolted fishplated joint is not to be left in the track longer than 3 months. Refer to table 22 for the TSR to apply.

Rail Joints

510. The functions of a rail joint (fishplates) are to:

a.	connect rails together in a continuous flat surface
b.	stop longitudinal and lateral movement of the rail ends relative to each other
c.	allow longitudinal movement, which is needed for expansion and contraction in jointed rail.
Rail joint gaps are shown below	

For non CWR rail lengths as shown, gaps are:

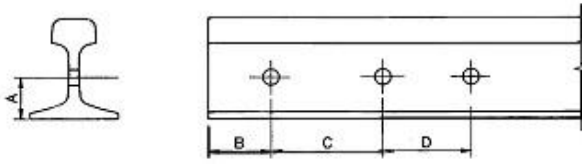
Average rail temperature ºC	Rail Length more than 10m	Rail Length less than 10m
< 10	10 mm	6mm
10 – 15	9	5
16 – 20	7	5
21 – 25	5	4
26 – 30	4	3
> 30	3	3

511. Bring rail ends squarely together against the correct expansion gap keys before bolting and tying down.

Keep gap keys in joints until joints are fully bolted and rail is anchored.

512. Rail drilling dimensions are shown in Table 14.

TABLE 14: Dimensions for fish-bolt holes in rails



RAIL SIZES	MARKING OUT DIMENSIONS (mm)					
	A	B	C	D	HOLE SIZE	BOLT SIZE
53, 55, 56 lb/yd	44	48	95	—	22	19
ALL 70 & 72	52	48	95	—	25	22
75 ASCE 'NORTH ISLAND'	54	48	95	—	25	22
75 ASCE 'SOUTH ISLAND'	54	51	102	—	25	22
75 RBS	54	48	102	—	25	22
85 RBS	58	54	114	—	28	24
90RA-A, 91 NZR	65	54	114	—	28	25
100 lb/yd	64	54	114	—	28	25
70R 660 long	52	92	165	—	24	20
85R 660 long	58	92	165	—	24	20
91 NZR Long four hole	63	92	165	—	24	20
50 kg/m Long four hole	63	92	165	—	24	20
91 INSULATED six hole	65.5	94	114	114	28	25.4
50 INSULATED six hole	63	94	114	114	28	25.4
50 INSULATED four hole	63	94	114	—	28	25.4
91 NZR six hole	63	92	165	130	24	20
50 kg/m six hole	63	92	165	130	24	20

513. Bolted rail joints consist of standard, non-glued insulated joints and union fish plates held in position by track bolts that have enough tension to firmly support rail ends. Fix bolted joints with vertical or gauge mis-match by grinding or welding before a train passes within the limits set out in clause 522.

514. Union fishplates are approved in the following circumstances:

- in yards and sidings, fully bolted
- as a temporary construction joint in Class A and B lines for up to 72 hours with a 40km/h TSR in force (ref Table 22)
- as a permanent joint in Class C lines and loops where a step weld cannot be fitted and where the maximum permitted speed is ≤40km/h – fully bolted

This applies only to 50kg / 91lb union plates and 6 hole medium weight union designs introduced in 2021 and 2022 (refer drawings CE 300209, 300210, 300211, 300218).

In all cases, all four bolts are to be tightened to the required torque setting. The use of huck bolts is not permitted.

A temporary construction joint between 50kg and 91lb rails may be fastened with the two outer bolts and two G clamp's replacing the inner bolts, while awaiting thermit welding for a period of up to 72 hours.

All permanent installations must have sleeper spacing's maintained at those prescribed in T200 Figure 5.

All installations in main lines, whether temporary in Class A and B lines or permanent in Class C lines, must be visually inspected at least once per week.

515. Use only fishplates of the correct design for the rail section, drilling pattern and bolt type. Six hole fishplates must be used for permanent joints on A & B class lines. If welding is to replace the joint within 72hrs then the centre two bolts of a 6 hole plate may be omitted.

Fishplates must be greased before installation, excluding Insulated Joints.

516. All fishplates in jointed rail territory must be secured with the full number of correctly sized bolts or speed restricted as shown in Table 22.

517. Replace broken or cracked fishplates no matter whether they are in mainline or other tracks. Replace fishplates if wear allows either rail to move up or down when all bolts are tight.

518. Tighten track bolts with manual torque wrenches to ensure they are tightened to the correct torque value. Over tightening of bolts can cause the threads to strip or shank to break, providing no clamping force. Under tightening can lead to rapid loosening of bolts. Set the correct torque settings as follows:

Bolt dia (mm)	Rail Weight	Use	Torque Dry (Nm)	Torque Greased (Nm)
Class 8.8 Bolts				
20	85/91lb, 50kg	Fishbolts	372	260
22	70/72/75 lb	Fishbolts	519	363
-	all	G-clamp bolt	519	-
-	all	C-clamp bolt (Robel)	580	-
24	91lb, 50kg	50kg turnout brace plates, switch stops & check rail bolts. 91lb checkrail bolts.	640	448
Class 10.9 Bolts				
24	91 lb, 50 kg	Turnout switch heel block & frog bolts	914	640

Torque wrenches must be calibrated as per the

manufacturer's recommendation, at least annually. Any suspect or damaged torque wrenches should be sent back to the manufacturer for a check.

519. On Class A and B lines bolts should be tightened following programmed track surfacing. Replace bolts that are frozen, stripped, damaged or missing with a bolt of the correct type and size.

520. Do not place fishplated joints in new track construction or rail renewals closer than 6 metres from an open deck bridge or 10m from a level crossing. There must not be any bolt holes within the sealed areas of level crossings. Non insulated joints may have a stagger of up to 1 metre.

521. Joints on bridges should not be within 2m of the ends of the bridge or 6m on the shore side.

522. Measure maximum allowable end batter in a joint with a 1m straight edge placed centrally over the joint. Limits for batter and mis-match (out-of-line) are in Table 22.

For speed category 1 and 2 lines, horizontal mis-match of more than 1.5 mm should be programmed for work. When the mis-match reaches 3 mm a TSR is required.

523. Emergency fishplates for temporarily securing broken welds or vertical rail breaks come in 3 types:

a) The weld reinforcing fishplates fits both 91 lb and 50 kg rail sizes. They may be bolted through existing fishbolt holes, or clamped in place using fishplate G-clamps. It is made from a 50 kg fishplate.

b) The joggled fishplates come in both 91lb and 50 kg rail sizes and use the clamps provided in the kit.

c) Robel C-clamps for use without fishbolts on 91lb and 50kg 660mm long fishplates only. These do not require speed restrictions to be imposed. They cannot be used on broken welds or veranda

fishplates.

The Track Inspector must inspect all emergency fishplated joints as part of their inspection and retighten if necessary.

In cold weather, fit rail anchors to at least 40 sleepers on each side of the joints (not required for concrete sleepers).

Note:
This does not apply to weld reinforcing fishplates fitted to defective welds that have not failed or NDT's that are clamped as part of safety mitigation.

Universal Fishplate Clamps

524. This type of clamp is meant to be used to temporarily secure rail joints without the use of bolts. They are not for use with joggled fishplates; special joggled fishplates and clamps are supplied for this purpose. Universal fishplate clamps are usually used when rail-ends have been cropped before weld up joints, or when you do not want to drill the rail for fish-bolts.

Apply universal fishplate clamps with a minimum of 2 to a joint, fitted into the fishplate boltholes. The clamp is designed to fit all standard fishplates.

They must be planned to be removed within 3 months and must be inspected during normal inspections and retightened if necessary.

525. Signals staff attending a broken rail or weld may fit clamps/temporary fishplates to allow train movements to continue. They must be suitably trained and deemed as competent to do so.

If the gap between the rail ends is more than 30 mm and the faces of the break are more than 20 mm off vertical, call track staff to deal with the failure. Trains are not to run over the defect until repaired.

Signals staff must set a speed restriction of 25 km/h and advise track staff within 24hrs. Track Inspectors and/or Gangers are to inspect the fitted fishplates as soon as possible to make sure they are fitted correctly and review the speed restriction. See clause 528 and Table 22.

526. Track fitted with emergency fishplates or C-clamps must have a speed restriction of 40km/h when clamped or 60 km/h if fully bolted. Refer speed restriction section and Table 22.

Robel clamps fitted correctly do not require a speed restriction to be imposed.

527. Where there is a rail break or temporary joint, they must always be bonded if in traction or track circuited areas.

528. Temporary fishplates and clamps are not to be left in the track longer than 3 months. Installation is to be recorded in Database and checked weekly by TI for tightness.

Insulated Joints

531. An insulated joint is a device that stops the flow of electrical current in a track circuit passing from one rail to the next rail.

532. Keep insulated rail joints and joint components dry and clean when not in use.

533. Factory made glued insulated joints are only supplied in 50kg rail profile and are of set lengths (7.4m & 8.6m) . Butt up to rail with sawn ends only.

534. Do not apply insulated rail joints to rail covered with scale, dirt, metal filings or other foreign matter, or to rails with battered ends.

535. Non-glued insulated joints must have bolt holes accurately placed and drilled, and fishplates fully

bolted on, connections should be huck bolted.

536. Remove all rough edges and burrs from bolt holes and rail ends before applying joint. Also ensure all swarf is removed.

537. Trim excess material off the new end post when applied to head worn rails.

538. Do not drill bolt holes in rails with the insulated fishplates in place. Line up rails and fishplates properly before bolts are put through ferrules. Take care when applying bolts to avoid damaging insulation.

539. Tighten bolts one after the other and equally with hand or power wrenches. Hammer the bolts often while being tightened. If the joint is of the base-supported type, it is important to drive in the base often while tightening bolts to get the full base bearing.

540. Do not place a bedplate within 310mm of an insulated joint. Refer to Figure 6.

541. Do not take out or move insulated joints without the approval of the Signals Field Engineer.

542. Glued insulated joints, where needed, will:

a)	Be used at any place where practical.
b)	Be installed when insulated joints are needed within 6m of a bridge or public level crossing.
c)	Be field welded in place and anchored as soon as possible.
d)	Have correct track fastenings and sleeper spacing in place.
All other cases must be approved by the PH Track.	

543. Do not use bolted insulated joints in CWR or 50kg track relays.

544. Use bolted insulated joints in jointed rail sections, in turnout closure rails and in rail sections where glued insulated joints are not available.

545. Always use glued IJ's and six hole huck-bolted insulating fishplates on 91lb and 50kg rails.

546. Maintain insulated rail joints in a way that stops track circuit current from flowing between the rails separated by the insulation and causing a failure of the track circuit.

547. Insulated rail joints must have proper drainage and sleepers must be in good condition, properly spaced and tamped.

548. Keep bolts tight. Tighten nuts several times during the first month after installation until all joint parts are firmly set.

549. Maintain rail ends so that the running surface of the rail does not flow over the end post.

550. Maintain end post condition so that there is enough thickness to cover the rail end and stop the two rail ends touching.

551. Make sure replacement parts are for the type and size of insulated joint that they are being applied to.

552. Inspect the insulation when rail ends of an insulated joint have been welded or ground. Replace if damaged.

553. When installing pairs of insulated joints, the stagger between centres of the insulated joints should not be more than 1m apart in ordinary track and 1.5m in turnouts.

554. Insulated joints at signals must have one joint within 600mm of the signal. The other may be staggered up to 1m as per clause 553.

555. Insulated joints next to level crossings in new track work or renewals must be 10m-20m from the edge of seal, unless the signal location requires a different

location.

556. Anchor insulated joints on 10 sleepers both sides of the joint in a 1 in 2 pattern.

557. All main line turnouts requiring in-rail insulated joints must be fitted with GIJ's. GIJ's are also preferred for off main line situations. Under no circumstances shall turnout bedplates be cut to attempt to create electrical isolation in the track circuit. The use of a standard glued insulated joint (GIJ) should be used to give the correct placement of the insulated joint. Refer to Track Standard T-ST-AM-5210 Track Structures for further details.

Union Rails and Step Welds

561. Use union rails and step welds to connect different rail sections. Only use approved step welds available from stores, these are 50/91, 50/85. The 75lb mold will fit 85lb rail with careful rubbing in.

562. Union fishplates may be installed as specified in clause 514, however approved union rails or welds are preferred.

563. Permanent union rails are normally supplied in minimum 8m lengths where 2 rails are joined or 12m if 3 rails are joined together.

564. Temporary union rails may be shorter than 12.8m and have in-between rail sizes missing. Programme these rails for removal as soon as possible and restrict speed to 40km/h.

565. Union rails must be fully supported with the correct sized bedplates under the matching rail section.

566. Do not install union rails or welds within 6m of an open deck bridge or level crossing.

567. Any union rails removed from the track must be clearly identified and set aside for re-use.

Bedplates

571. Bedplates perform these important functions:

a)	Reduce wear on the sleeper caused by movement of the rail.
b)	Spread the rail load more evenly.
c)	Provide a firm fastening of the rail to the sleeper.
d)	Provide cant for a more uniform wear pattern on the rail head.
e)	Provide gauge restraint.

572. Apply bedplates to all timber sleepers on A and B class lines. Where a fastening system requires a pad to be installed, this must be done. Replace obsolete type fastenings such as A, S, E & D with bedplates when sleepers are renewed.

573. Do not re-use broken or damaged bedplates.

574. Do not re-use bedplates with badly worn screwspike holes or shoulders.

575. Use bedplates for the correct rail section unless the PH Track advises differently.

576. Install bedplates so that:

a)	the plates have full, even bearing on the sleepers
b)	the field side plate shoulder is square against the field side base edge of the rail

c)	the plate is centred on the sleeper
d)	the rail is canted toward the centre of the track
e)	each plate has the same cant.

577. Where a bedplate must have a pad between itself and the rail foot, install the pad (R&R and P type only).

Do not in any circumstances put a weld over a bedplate or concrete sleeper.

578. For fastenings on bridges refer to clauses 619 - 624.

Rail Anchors

581. Rail anchors are used in conjunction with non-resilient fastenings to control the movement of the rail due to temperature, grade and train forces.

To ensure rails are controlled properly, apply anchors evenly along the rail and against condition 3 or better timber or composite sleepers.

Apply anchors in a pattern as per clauses 593-599.

582. Apply anchors only to the rail section that they are designed for. They are available for 50kg; 90/91lb; 85lb; 70/72lb; 75lb. Anchors should not be applied to corroded rail.

583. Rail anchors are not required where resilient (Pandrol) fastenings are used as these provide sufficient toe-load to resist longitudinal rail movement.

584. Apply rail anchors to all insulated joints on timber/composite sleepers by installing anchors on 10 sleepers either side of the joint in a 1 in 2 pattern.

585. Box anchor the same sleeper on each rail (one anchor on each side of the sleeper, on both rails)

586. Apply anchors to the gauge side of the rail and tightly against sleepers.

587. When changing rail or renewing sleepers, reapply all anchors that were removed.

588. Do not install sprung or damaged rail anchors.

589. Use only the proper tools or machines when applying or removing anchors to avoid damaging the anchor, rail or being injured.

590. When installing anchors, ensure the anchor is fully in place on the rail base, with the rail base inside the lip of the anchor. Drive on rail anchors must not be overdriven.

591. Lack of even anchorage can result in unequal distribution of rail expansion forces and may lead to distortion of gauge, line and top.

Where there is evidence that the rails are moving under traffic or thermal forces, adjust the rail and apply additional anchors in a more aggressive pattern, i.e. 1:4 to 1:2.

592. When a fishplate, insulated joint or weld does not allow an anchor to be applied, adjust the anchor pattern on the opposite rail to allow for this.

593. Apply rail anchors:

For grades ≤ 1 in 100:	every 2nd sleeper.
For grades > 1 in 100:	every 4th sleeper.

594. Apply rail anchors to all non-Pandrol turnouts in CWR track in line with standard drawing CE No. 300113.

595. Minimum requirements for anchoring non-resilient fastenings in non-CWR track is 1 in 4 sleepers effectively anchored.

For track adjacent to CWR, use the rules in clause 596.

596. There must be an anchoring pattern at the end of CWR lengths.

This applies to unreinforced turnouts, and non-CWR bridges.

When CWR is approved and installed on an open deck bridge, every sleeper must be box anchored both sides of the bridge approaches for a distance equal to half the bridge length up to a maximum of 120 sleepers.

The anchor pattern from the end of CWR is:

40 sleepers = 100% anchored: 40 sleepers = 1 in 2 effective anchoring: 40 sleepers = 1 in 4 effective anchoring.

The graduated anchor length of 120 sleepers described above may be substituted for a single length of 60 sleepers (approximately 40 metres) where all sleepers are concrete i.e.100% PCE condition 3 fastenings or better.

If fastenings in the anchor length show signs of movement during the de-stress process then either the length of pull is reduced or the anchor length is increased in 20 sleeper increments.

597. Do not apply anchors on or within 25mm of a flash butt or field weld.

598. CWR track on bridges must have the approaches anchored in line with clause 458.

599. Adjust rail properly gapped or at neutral temperature (SFT) before applying anchors.

Sleeper Fastenings

601. Sleeper fastenings used on the rail network are shown in Figures 7.1 to 7.6.

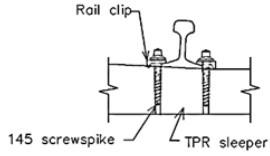
When installing new/replacement timber/composite sleepers in plain track, but not on bridges or in level crossings, the fastening system shall be as follows:

In curves of 400 m or less These sleepers must have a fastening system using Pandrol bedplate assembly type P and screwed as per clause 603.
In curves of more than 400 m These sleepers may have N, R or RR type fastening systems.

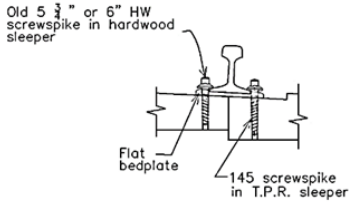
Resilient (spring steel) fastening systems including Pandrol must be galvanised where the track will be covered by rubber level crossing panels or subject to heavy corrosion (in tunnels, within 150m of high water mark etc).

As resilient fastenings are very susceptible to corrosion induced fatigue, they must not be used where the fastening system is covered by road metal or ballast such as in yards or tarmacked level crossings. Galvanised N type, without spring washers, is the only permitted fastening system in these locations.

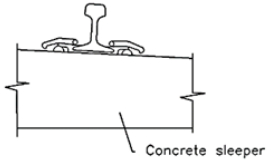
FIGURE 7.1: Sleeper fastenings – legacy



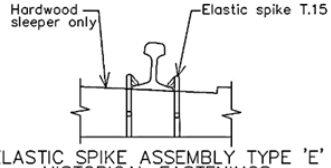
SCREWSPIKE ASSEMBLY TYPE 'S'
HISTORICAL FASTENINGS



FLAT BEDPLATE ASSEMBLY TYPE 'F'
HISTORICAL FASTENINGS



FASTCLIP CONCRETE
SLEEPER TYPE FC
HISTORICAL FASTENINGS



ELASTIC SPIKE ASSEMBLY TYPE 'E'
HISTORICAL FASTENINGS

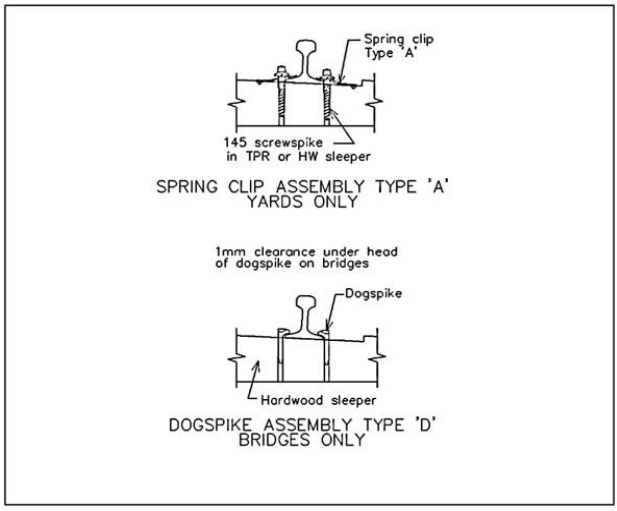
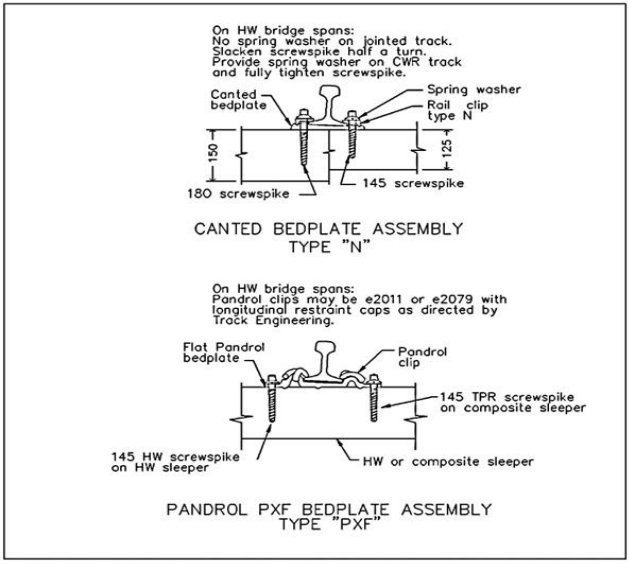
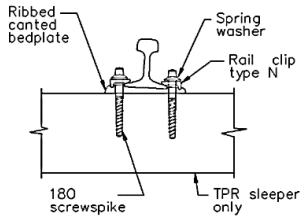
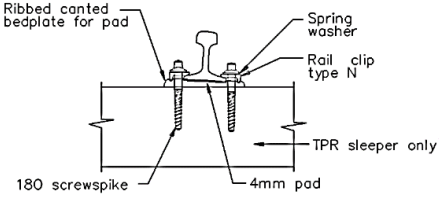


FIGURE 7.2: Sleeper fastenings – HW / TPR / COMPOSITE

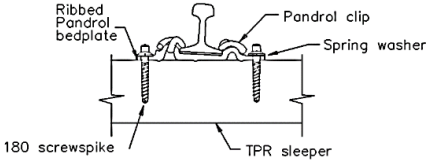




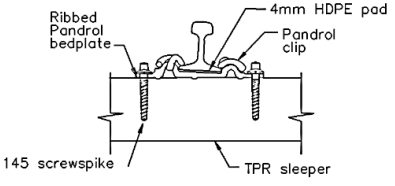
RIBBED CANTED BEDPLATE ASSEMBLY TYPE "R"



RIBBED BEDPLATE AND RUBBER PAD ASSEMBLY TYPE "RR"

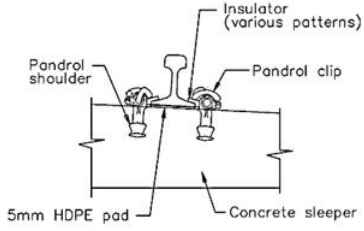


PANDROL PX BEDPLATE ASSEMBLY – W/O PAD TYPE "PX"



PANDROL RIBBED BEDPLATE WITH 4mm PLASTIC PAD ASSEMBLY TYPE "PT"

FIGURE 7.3: Sleeper fastenings – Concrete



PANDROL ASSEMBLY ON
CONCRETE SLEEPER
TYPE "PCE"

FIGURE 7.4: Screwspike Head Coding

HEAD CODING	SLEEPER USED WITH	DIA.	LENGTH
	HW	$\frac{7}{8}$"	$5\frac{3}{4}$"
	HW	22mm	180mm
	TPR/COMP	$\frac{7}{8}$"	7"
	TPR/COMP	$\frac{7}{8}$"	$5\frac{3}{4}$"
	TPR/COMP	22mm	145mm
	TPR/COMP	22mm	180mm

FIGURE 7.5: Gauge pattern 25t sleeper

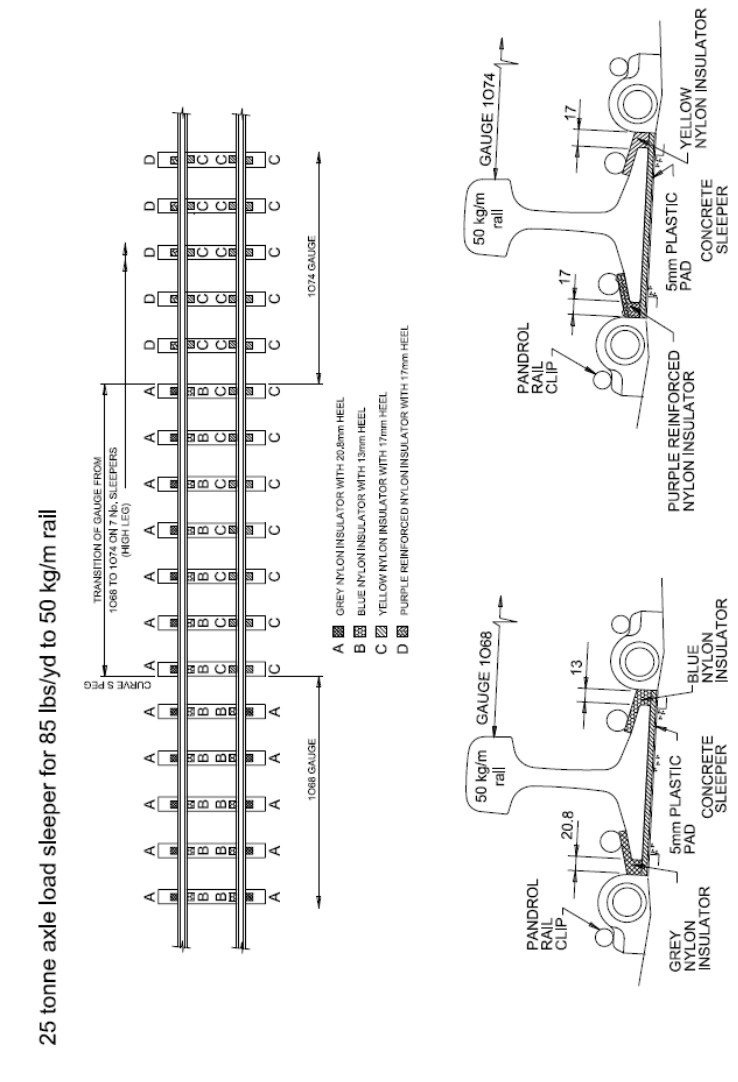
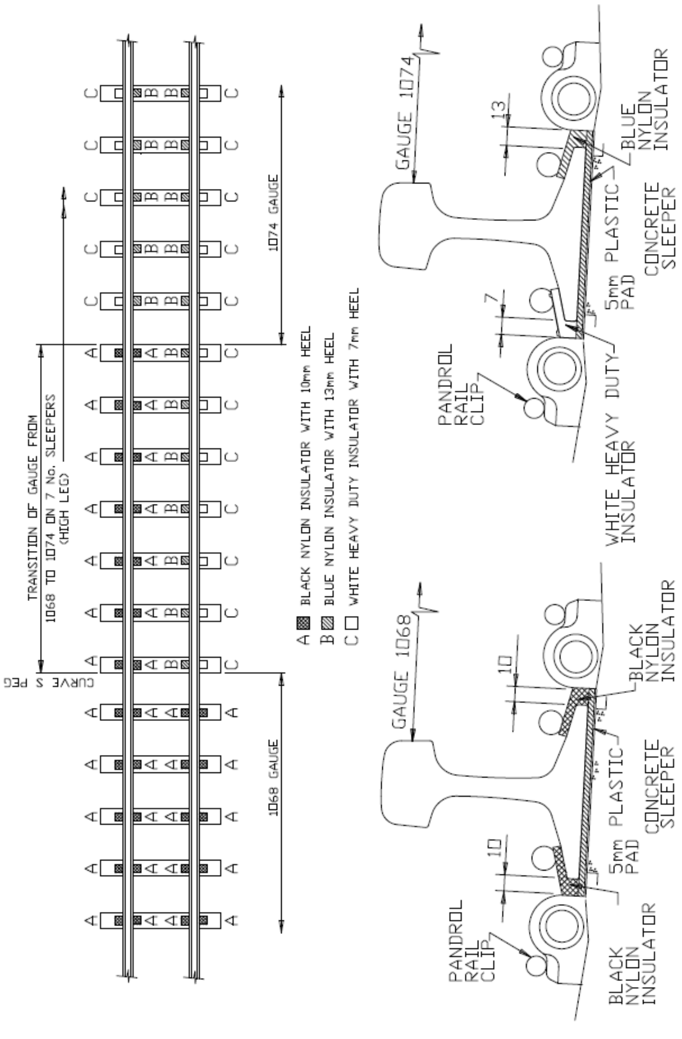


FIGURE 7.6: Gauge pattern 22.5t sleeper

22.5 tonne axle load sleeper for 85 lbs/yd to 50 kg/m rail



602. Screwspike each rail to the sleepers with a minimum of two screwspikes per sleeper, diagonally opposite each other so that the outside screwspikes for each rail are on the same side of the sleeper and a uniform fastening pattern is maintained.

603. Curves of less than 400m radius on class A or B lines must have two screwspikes installed on the field side of the high leg and one on the gauge side.

In areas of high risk of corrosion (level crossings, tunnels, yards) bedplates are to have all holes fitted with screwspikes.

604. Insert screwspikes into sound wood, which includes plugging holes with standard vortok coils.

605. Before screwspikes are inserted, sleepers should be properly lined up and gauged with bedplates centred on sleepers.

606. Maintain uniform gauge within allowed limits when inserting screwspikes. Use a track gauge to check.

607. Do not install screwspikes at the ends of insulated fishplates in any way that would cause the insulated fishplates to become electrically connected to the rail.

608. Insert screwspikes only with a standard hydraulic Power Unit or equivalent, or with a T spanner.

609. When tying down the rail, do not hit the rail, fasteners or signal appliances with hammers.

610. Pick up and sort second-hand screwspikes for reuse in line with the current policy on second hand fastenings.

611. Existing turnouts may have a minimum of two screwspikes per bedplate on opposite corners.

All new or refurbished turnouts shall have screwspikes fitted to all bedplate holes.

612. When dog-spikes cannot be loosened with a claw bar, use a spike lifter.

613. Do not hit claw bars with a sledge hammer or other tools.

614. Inspect dog-spikes for derailment damage, narrowed throats or other defects that could cause injury when pulling spikes.

615. Do not install dog-spikes in track except to replace torpedo rails on bridges.

616. Bore: 14mm pilot holes for TPR.

16mm pilot holes for old Hardwood.

18mm pilot holes for new Hardwood.

16/22mm stepped pilot holes for Axion Composite.

16mm pilot holes for standard Lankhorst Composite.

17mm pilot holes for high strength Lankhorst Composite.

19mm pilot holes for Ss8 (Martinus turnout) screws in Composite.

A two stage pilot hole is needed in Azobe hardwood sleepers to prevent cracking.

Top section 22mm dia x 25mm depth and finish with 18mm.

The hole needed for N, R, RR and P type fastenings depends on the sleeper type. Track Engineering will advise details.

617. Screwspikes must be screwed into the sleeper. Do not drive screwspikes with a hammer.

618. During normal maintenance (i.e. fastening maintenance, not planned renewals) replace all fastenings with identical fastening types except where A clips are installed in A and B class lines Replace these with a suitable fastening system using bedplates.

619. Fastenings on open deck bridges are as follows:

Fastenings On Open Deck Bridges
Non CWR
To allow thermal expansion of the rail, rail sleeper fastenings must be firm in the sleeper but not fully tightened down. P type bedplates are to have e2079 clips and zero load toe caps fitted, screwspikes fully tightened. For all other fastening types screwspikes should be left half a turn back from fully tight and dogspikes a little less than fully driven to give a 3mm gap. Leave out the spring washers on rails up to 76 metres long.
To avoid signal circuits being short circuited, screwspike ends must be at least 10mm above the bottom of the sleeper.
CWR
CWR on bridges may only be formed with the approval of the PH Track and the PH Structures via an M129 form. This is to allow the effect of CWR stresses in the bridge to be evaluated.
Where approval has been given, after completion of de-stressing an M37 report must be forwarded to the PH Structures for entry into the bridge database.
Fastenings must only be type N, P or R. The spring washer must be installed in all cases and the screwspike fully tightened, e2011 clips are to be used. In addition the creep strap must be changed to 80 x 80 x 6 angle .

620. Ballast deck bridges must have the same fastenings as the approach track.

621. Use only fastening systems approved by the PH Track on direct fastened concrete bridges.

622. Vortok coils may be used on bridges provided the bottom of the coil is at least 10mm above the bottom of the sleeper. This is to stop signal circuit from being short-circuited.

623. Fastenings on new steel span bridges are as follows:

Leave out spring washers unless CWR approval has been granted (see clause 619).

Fastenings On New or Refurbished Bridges
Hardwood sleepers
Class A & B lines 1 in 20 canted bedplates, flat bottom type fastenings on straight track & curves of 400m radius or more bedplates shall be on alternate sleepers.
On curves less than 400m Bedplates shall be installed on all sleepers.
Class C lines Rails shall be laid vertically except where N type fastening is used.
On straights and curves of 400m radius or more Type N at joints and alternate sleepers.
On curves less than 400m radius Type N on all sleepers.

624. Minimum track standards on existing bridges are detailed below. Programme to upgrade bridges below these standards when any sleeper renewal or fastening maintenance is carried out.

See clause 623 for standards when resleepering or fitting bedplates on existing bridges.

Minimum Track Standards on Existing Bridges
Hardwood sleepers
1. Class A & B lines
On straights and curves 800 metres radius and more, joint sleepers and alternate sleepers to be fastened with type N fastening assemblies.
On curves 400 metres to 800 metre radius, all sleepers must be fastened with type N assemblies.
On curves of less than 400 metre radius all sleepers must be fastened with type N or P assemblies.
2. Class C Lines
On straights and curves 400 metre radius or more, joint sleepers fastened with N assemblies and alternate sleepers must be fastened with type N or D assemblies.
On curves less than 400 metre radius, all sleepers to be fastened with type N assemblies.

Table continued over page ⇒

Minimum Track Standards on Existing Bridges cont.
TPR Sleepers
1. Class A & B lines
On straights and curves of radius 400 metres or more, alternate sleepers to be fastened with type N assembly, both joint sleepers to have bedplates.
On curves less than 400 metre radius, all sleepers to be fastened with type R assembly.
2. Class C lines
On straights and curves of radius 400 metres or more, joint sleepers and alternate sleepers to be fastened with type N assemblies.
On curves less than 400 metres radius, all sleepers to be fastened with type R assembly.
Note: All sleeper centres to be 300 mm unless otherwise specified. Screwspike spring washer to be left out in all non CWR assemblies, except type P bedplates.

Pandrol Fastenings

625. The Pandrol fastening is a spring clip used with a baseplate on timber/composite sleepers and with a plastic pad under the rail on concrete sleepers. The Pandrol plate with an X marked on it does not require a pad under the rail. The PX bedplate should only be used on TPR sleepers, with the PXF bedplate to be used on hardwood and composite sleepers.

Pandrol clips must be installed with the correct insulator for the fastening system to be fully effective. Pandrol clips must not be overdriven – hammers are not to be used to install clips.. A clip is correctly tensioned and located when there is a clearance of about 3mm between the edge of the baseplate or shoulder housing and the inside surface of the curved part of the leg which is driven into the housing.

An overdriven clip can wear a notch in the tensioned curved part of the clip causing it to break without warning.

Table 15 shows the types and usage of Pandrol clips currently used in track.:

TABLE 15: Pandrol clip types

Pandrol Type	Description	Plan View
e2011	Material no. 1036497 The standard clip used for general use. 20mm diameter bar Colour black	
e2011 (galv)	Material no. 1036065 Galvanised clip used in corrosive conditions. 20mm diameter bar Colour Silver/grey	
e2079	Material no. 1034809 Used with a cap on Pandrol bedplates to provide ZLR on bridges as required 20mm diameter bar Colour black	
e1627	Material no. 1034808 Used for clipping up around GIJ's on timber or composite sleepers. 16mm diameter bar Colour Red Clay	

e1631	Material no. 1081571 Used for clipping up around GIJ's on concrete sleepers. 16mm diameter bar Colour Yellow	
Fast Clip	Material no. 1082111 Supplied fitted with an insulating toe. 15mm diameter bar Colour black	

Note: Pandrol 'PR' series clips although obsolescent are still in use throughout the network. These shall be removed as part of normal renewals or maintenance activities and replaced with e2011 clips.

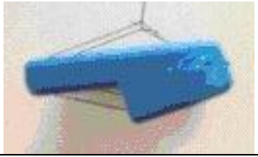
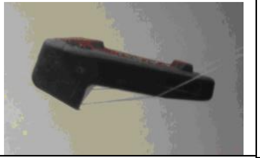
Pandrol PR 401 Clip

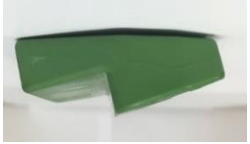
Concrete Sleeper Insulator Types

626. Different types of Concrete Sleeper Insulator types are shown in the following two diagrams:

TABLE 16: 22.5 tonne concrete sleeper gauge insulators

Insulator Type	Description	Plan View	Profile View
Black Nylon (10mm)	Material no. 1036902 Used where there is no gauge widening. Have 10mm heels.		
Shortened Black Nylon (10mm)	Material no. 1081572 Used to maintain electrical insulation at glued joints on concrete sleepers in conjunction with yellow e1631 Pandrol		
White Nylon (7mm)	Material no. 1036102 No longer used. These failed with repetitive loading on curves.		

Blue Heavy Duty (13mm)	Blue Nylon (13mm)	Iron Reinforced (10mm)	Iron Reinforced (7mm)
Material no. 1103509 Used on outside of high leg on curves to tighten the gauge caused by rail wear. Have 13mm heels.	Material no. 1038751 Used in transitions and curves, only in low loaded areas, such as inside of the track. Also for 25T sleeper. Have 13mm heels.	Material no. 1081483 Used on curves to tighten the gauge caused by rail wear. Have 10mm insulator.	Material no. 1027384 Used to resist wear from lateral loading. Replaces White 7mm heel insulator.
			
			

Green Nylon (27mm)	Shortened Blue Nylon (13mm)
Material no. 1103508 For use with 70 BS rail on 22.5T sleepers Have 17mm heels.	Material no. 1083441 Used to maintain electrical insulation at glued joints on concrete sleepers in conjunction with yellow e16131 Pandrol clip. Have 13mm heels.
	
	

25 tonne concrete sleeper gauge insulators

Insulator Type	Description	Plan View	Profile View
Grey Nylon (20.8mm)	Material no. 1082861 Used where there is no gauge widening. Have 20.8mm heels.		
Yellow Nylon (17mm)	Material no. 1082860 Used in transitions and curves, only in low loaded areas, such as inside of the track. Have 17mm heels.		
Purple Heavy Duty (17mm)	Material no. 1082955 Used to resist wear from lateral loading. Have 17mm heels.		

Turnouts

630. The installation of turnouts or crossovers in curves can only be done with the approval of the PH Track.

631. Turnouts are shown by their weight, frog strike, hand and switch length (plus manufacturer for monoblocs).

632. Standard turnouts with stocked parts are:

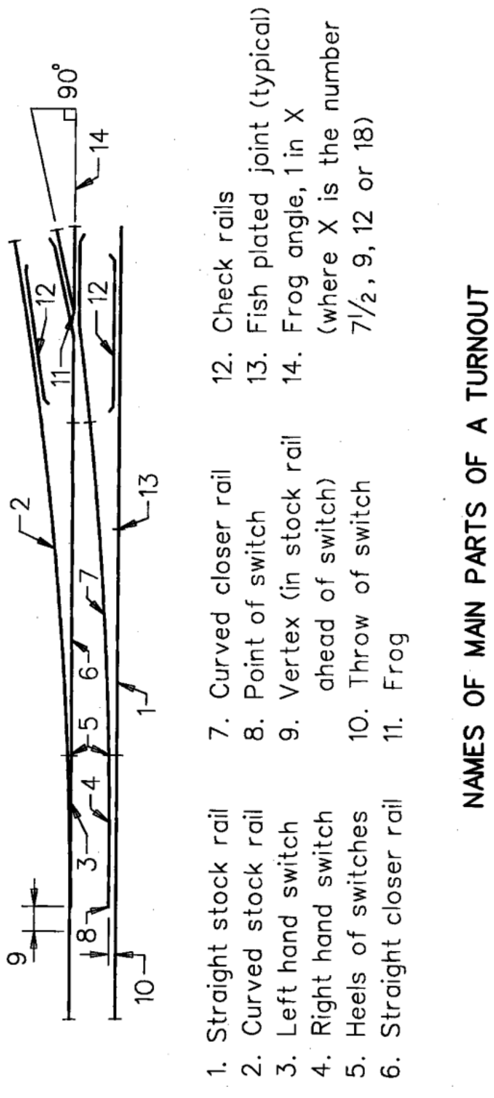
91lb Turnouts	50 kg Turnouts
1 in 7½ turnout, (9'6") 2.90m switch	1in 7½ turnout
1 in 7½ turnout, (14'-0") 4.27m switch	n/a
1 in 9 turnout, (18-0") 5.49m switch	1 in 9 turnout
1 in 12 turnout, (25'- 0") 7.62m switch	1 in 12 turnout
1 in 18 turnout, (28'-0") 8.53m switch	1 in 18 turnout

633. Special track structures in the system include:

1 in 7½ turnout (18'-0" switch)
1 in 7½ single slip
1 in 7½ double slip
1 in 7½ , 1 in 9 and 1 in 12 scissors crossings
1 in 7½ double turnout
1 in 7½ three-throw turnout
Diamond Crossings

634. Turnout components are shown in Figure 8.

FIGURE 8: Turnout components



635. The Asset Engineer holds copies of turnout drawings or dimensions can be found in Track Code Supplement 63.

636. Renewal of turnouts needs to be included in the Track Renewals plan approved by the PH Track. Options to life extend turnouts including sectional replacements e.g. new front end, are detailed in Track Standard T-ST-AM-5210 Track Structures.

637. Turnouts must have a minimum switch length of:

Line Class	Switch Length
A&B Mainline	4.25m (14')
C Mainline	3.65m (12')
Yards/Sidings	3.65m (12') & 9'-6"

Installation of turnouts on a line class with a switch length less than above needs approval of the PH Track.

638. When turnouts are placed in curved track, the cant of the rails behind the frog must be adjusted so that the run-off is no more than 1mm per metre.

639. When turnouts are being constructed or maintained, do not allow trains to move in either direction until:

a)	The main track switch point is spiked and/or clamped against the stock rail. When possible, install both switch points before allowing trains to pass over the turnout in the normal position. Refer to S&T Task Instruction S-TI-PM-2218 Security of Turnouts for full requirements for installing or removing turnouts
b)	The free end of the stock rail is fastened to stop movement and then only under suitable speed restriction.

640. Install and maintain rail anchors on all mainline turnouts without Pandrol fastenings in line with drawing CE No. 300113.

641. Do not lace sleepers in turnouts or crossovers. Install sleepers as shown on the turnout drawing.

642. Gauge in Track Structures must be provided as shown on the drawings and Track Standard T-ST-DE-5200 Track Design Appendices 1.1 and 1.2 for 50kg/m and 91lb/yd designs respectively.

643. Turnouts sometimes need to be re-gauged, the same as any track. However there are some critical locations to monitor gauge and carry out repairs as shown below.

Location within turnout	Maximum allowable gauge Main Line	Maximum allowable gauge Yards
At point of switch - straight road	1080	1080
At heel of switch - straight road	1080	1080
At heel of switch - turnout road[1]	12mm more than construction standard	12mm more than construction standard
Body of Turnout – straight and curved roads	Ref clause 336	
From nose of the frog (towards the back of frog) throughout the frog wing rails on both roads	1072	1080

[1] 91lb 1 in 7.5 and 1 in 9 turnouts, and most 50kg designs have 6mm gauge widening at the switch heel on the curved road. Refer to Track Design Standard T-ST-DE-5200.

644. Take care when unloading and transporting turnouts when they are constructed or are delivered pre-fabricated on ETC wagon racks, as follows:

a)	Secure completely panel turnouts to the racks of the wagons whenever the wagon is moved.
b)	Know the weight of each panel and compare to the load chart of the crane before attempting a lift.
c)	Secure fully each panel in the wagon until it is ready to be lifted from the wagon. Release the panel only when the crane lift lines are secured to the panel.
d)	Remove panel tie-down chains from behind the turnout panel.
e)	No one is allowed on a panel turnout wagon when the panel is being lifted.
f)	Tie a tag line to each panel to help handle and move it.
g)	Put panels where they will not affect safe railway operations or public safety.
h)	Place all tie-down chains on the wagon when it is empty as set out in current KiwiRail policy.

645. Ensure turnouts are adequately supported when lifting to ensure they are not bent out of shape.

Switches

650. Switches are the part of a turnout used to guide the wheels to the selected route by working a manual switch stand lever or by the operation of a points machine mechanism.

651. Insert points rodding and connecting rod bolts with the nuts on the top side and secure with cotter pins or locking bolts. Make sure the connecting rod jaw openings, bolt holes and bolts match the right switch rods. Switch brackets on 1 in 7½ and 1 in 9 91lb turnouts must be secured with a bolt and nylock nut as per Track Standard T-ST-AM-5210 Track Structures.

652 The KiwiRail Network uses Wynn Williams levers, frame levers, and National Box switch stands.

653. Keep switch stands straight and firmly fastened onto the sleepers. Drilling of concrete sleepers is permitted for fitting of track and signals equipment such as points motors, switch levers and rollers - refer Track Standard T-ST-AM-5210 Track Structures.

654. Wherever possible, put switch stands and points machines on the closed point side of the track when the switch is set for the main track.

655. Inspect and operate switches to make sure they are working correctly, as follows:

a.	Keep switches free from blockages at all times and free from snow and ice in winter.
b.	Keep riser plates clean and lubricated with an approved lubricant.
c.	Points rodding and horn-plates must not contact the side of the sleeper or the riser plate.
d.	Special attention must be given to providing proper drainage especially for interlocked switches.

656. Check switches, switch stands and throwing rods during yard inspections. Renew all broken, damaged or missing parts immediately. Replace switch latches before they are worn enough to let the switch be opened without removing the padlock

657. Turnouts that work with spring points boxes are to open the switch rails by at least 100mm. Lost motion by worn pins, stretched connecting rod fork ends and worn switch brackets all reduce the amount of switch opening. Fit new pins to all pin joints with more than 3mm slackness, or replace worn parts.

Motor points give varying amounts of switch point openings.

These are adjusted by Signals section staff and will usually be in range 110mm – 140mm depending on the type of points machine installed.

658. Check switchblades and connections often. It is important that stockrails are properly seated in the switch plate, have no lateral movement in the switch plates and that switch plates have no movement on the sleepers. Make regular inspections and adjust when needed to make sure that braces are tight and switches are properly adjusted. Take care not to over-drive and rotate the stockrail out of the plate when adjusting braces.

659. Maintain surface and alignment through the switch point and heel block area to make sure the switch works properly.

660. Do not heat and bend or mould switchblades to a stockrail. Replace the stockrail and switch if it is too worn to accept a new switchblade.

661. Keep switches ground to make sure proper transfer of wheels.

Mark the switch at a point 400mm from the tip of the switch. There are to be no major chip outs beyond this point. If there are then the switch is to be changed out.

The definition of a major chip out is where the chip out leaves a wheel contact height on the side of the switch of less than 20mm.

If before the 400mm point a chip out leaves a dangerous condition so that wheel climb could occur, the switch is to be changed out or re-profiled by grinding

662. Do not make changes in track or switches that affect the normal working of signals or interfere with automatic train control without previous arrangement with the PH Signals.

663. Turnouts taken out of service must have the switch-blades bolted and locked with a PS padlock by Signals section staff.

664. Mack switch protectors may be installed on 91lb turnouts under the following conditions:

Maximum allowed speed must be 25km/h or less.
Must be fitted to the straight stockrail.
Only 1 Mack protector per turnout is allowed.

Frogs

671. Frogs are shown by strike according to angle. Use with turnouts of the same number.

Frogs in use are
1 in 7 ½
1 in 9
1 in 12
1 in 18

672. Keep all bolts tight and replace any broken bolts immediately with the correct length bolt.

673. Flowed metal must be ground from turnout frogs and crossing frogs. Frog welding in the field should be completed as soon as practicable, as once wear reaches limits then the life of the frog is limited. Any frog welding must be carried out by an authorised contractor/staff. Refer Track Standard T-ST-AM-5210 Track Structures.

Preventive Grinding of Switches and Frogs

681. Safety goggles, or shields, and leather leggings **must** be worn while grinding.

682. Preventive grinding should be carried out whenever a turnout is maintained, regardless of the work carried out.

683. Manganese and carbon steel ‘work hardens’ under load. During the work hardening process, the steel will

flow, developing thin beads or lips along the edge of the running surface. Inspect track parts often and do preventive grinding to stop early spalling, breaking or cracking.

684. The plastic flow will cause lips along the flangeway edges of the wings and point on frogs and crossing diamonds. If the deformed material is not ground off, the wheels will break off pieces of the wing and point, possibly causing cracks to develop in the flangeway.

685. If the metal flow on the gauge side of stock rails and back side of switch points is not ground off, it will cause pressure against the switch point that will break off parts of the tip of the switch point and the gauge corner of the stockrail.

686. Rail will develop a flow or lip on the rail end. When rails spread out (expand), the lip on one rail will often overlap the lip in the other rail in the joint, causing the rail ends to chip out under traffic.

687. Inspect and grind all new frogs and crossing diamonds within 30 days of installation. These parts must be inspected closely for up to one year, until the work hardening process is complete.

688. Switch-blades and stock rails should be treated by grinding when 3mm of rail flow has formed. Refer clause 692.

Manganese Frog Grinding

689. Smooth and blend small deformities in the running surface of frogs by grinding. Remove all flowed metal that has developed along the flangeway edges of the wings and point. Grind all edges to match the original profile.

Use a slotting type wheel grinder to remove flowed metal from the following areas:

a) Between the manganese wings and the binder rails.

b) Between the heel extension and the heel rails.

c) The rail ends connected to the frog.

Manganese and Bolted-Rail Crossing Diamond Grinding

690. Smooth and blend small deformities in the running surface of crossing diamonds by grinding.

Remove all flowed metal that has developed along the flangeway edges of the frog. Grind all edges to the original profile.

Use a slotting type grinding wheel to remove flowed metal from the following areas:

1) All joints in and connected to the crossing frog or diamond.

2) Between the joining rails and the crossing frog or diamond.

Bolted-Rail Frog Grinding

691. Remove all flowed metal that has developed along the flangeway edges of the wing rails and frog point. Grind to the original profile.

Use a slotting type wheel to remove flowed metal from the following areas:

1) Between the primary and secondary point.

2) The rail ends connected to the frog.

Clauses 681–692 refer to preventive grinding and Code Supplement Section 51 (Rail Surface Repair by Welding), for repair welding. The following table 17 defines requirements for inspections, maintenance and repair.

TABLE 17: Frog rail-wear

Wear (mm)		Crossing nose, vee and wing rails	Action
Main line	Yards & Sidings		
Up to 5	Up to 8	Routine inspections	Carry out grinding as required. Clauses 683 – 691 refer. Make sure frog area is well packed and all bolts in place and tight
5 – 10	8 – 12	Plan rectification work and increase inspections as required.	The actions will depend on the wear. Grinding shall be done as required. Repair welding needs to be done when close to 10 mm wear. Increased inspections may be needed when wear is at 7 - 8 in mainlines or 9 – 10 for yards and sidings.
More than 10	More than 12	Increased inspection required until rectification work is completed.	Set TSR of 40 km/h on mainlines until repair work is completed. This will assist in reducing impacts and slowing down the wear.
More than 15	-	Generally wear of more than 15 is unable to be repaired in track and the frog may have developed cracking.	Set TSR of 25km/h on mainlines until repair/replacement is completed.

Frog wear is measured

i. At the visual point on both wing rails

ii. At frog profile transition points as per drawings. Refer Track Standard T-ST-AM-5210 Track Structures.

The wear values quoted above apply to actual frog wear, i.e. they do not include the initial designed difference between the height of the wing rail and the nose of the frog, which varies between the different manufacturers.

Measurements taken with a Lehmstedt gauge or similar need to allow for this difference when determining the amount of weld build-up required. It should also be noted that the Martinus profile is measured with a cambered gauge.

When weld repairs are undertaken, frog / wing rail profiles should be restored to those specified for the various manufacturers.

Switchblade and Stockrail Grinding

692. Remove all flowed metal that has developed on the gauge side of the stockrail, from the point where the switch point and stockrail separate to 50mm in front of the tip of the switch point. Also remove any flowed metal from the field side of the stockrail.

Remove all flowed metal that has developed on the backside of the switchblade, from the point where the switch point and stock-rail separate to the tip of the switch point.

Remove all flowed metal from the gauge side of the switch point and restore the bevel to the point and the sharp edge to the very tip of the point (refer to clause 661).

Work the switch to make sure that it is working properly and that both switchblades fit properly against their stockrails. Adjust the switch, if needed, before putting it back in service.

Check Rails

701. Install and maintain frog check rails in line with standards and keep them securely fastened to stop movement under traffic.

702. Install frog guard rails with check rail gauges as follows:

• Lay with flange-ways opposite the noses of frogs at the correct flange-way width for the turnout.
• Keep no more than 3mm slack of the correct flange-way width which is 38-41mm for most structures - refer Figure 12.2 Track Standard T-ST-AM- 5210 Track Structures.
• Must not be more than 6mm above height of the running rails.

703. Keep flange-ways and cribs under frog guard rail clamps free of ballast and other rubbish.

704. Fit shims to 50kg turnouts to maintain the correct gap and replace checkrails when worn beyond limits. Inspect checkrail blocks for wear in 91lb turnouts when changing checkrails – replace if necessary.

705. Curves less than 100 metre radius on plain line track must be fitted with a continuous check rail on the low leg only. The flange gap must be installed at 50mm clearance (-0mm +3mm) with a maintenance intervention of ≥55mm, with a 10km/h TSR in place and programme for adjustment within four weeks if reads ≥60mm.

Inner Bridge Guard (Torpedo) Rails

711. Install guard rails on all bridges as follows:

• All straight bridges 6m or longer.
• All curved bridges.
• If any bridge design specifies it

Guard rails are not required on the following bridges:

Line speed is 25km/h or less.
Ballast deck bridges (unless design specifies it)
Straight bridges less than 6m long.

712. Fasten guard rails with type F or S assemblies as follows:

On bridges – every 2nd sleeper.
On approaches – every sleeper.
Pre-bore and offset screwspike holes to stop timber splitting.

Refer to drawings 300177 and 100440 for details of PXF and other bedplates**.**

713. Guard rails are to have complete nosings installed at both ends of a bridge regardless of normal direction of traffic. Connecting fishplates may have only two bolts fitted, these must be on opposing connecting rails.

714. Inner guard rails are to be parallel to, and 230mm from, the gauge face of running rails on the entire length of structure to be protected. Inner guard rails are to extend 2m beyond the end of the ballast guard and end in the middle of the track, with rail nosings bevelled, bent down or fitted in line with drawing CE No. 91424. This will divert a derailed wheel but not catch dragging equipment.

715. Use Class 3 rail for inner guard rails.

716. Inner guard rails should be of an equal or lighter rail section than the running rail. Rail height must be lower than the running rail.

Weight of Running Rail	**Weight of Guard Rail**
Heavy	Heavy or Medium
Medium	Medium or Light
Light	Light

717. If any guard rail or part thereof is not fitted as per Clause 711-716 then it must be repaired/replaced before the passage of the next train or a 25km/h restriction be applied.

Traps and Derailing Blocks

721. Install trap switches only with the approval of the PH Signals and Track, in line with the S&I or yard diagram.

722. Lay trap switches at 1068mm gauge at the point of switch and 1080mm gauge at the heel.

723. The curved stock-rail must extend beyond the heel of the switch at least 1.2m and must be bent down 40mm and outward 75mm over at least 300mm.

724. Install permanent derailing blocks only with the approval of the PH Track. Approval is also required from the PH Signals where derailing blocks protect the main line or loop. Installation must be in line with the S&I or yard diagram.

725. Install permanent derailing blocks so that any derailed vehicle is diverted to an area where the least damage will be caused.

Track-side and Related Equipment

Level Crossings

731. Pay special attention to maintaining road crossings for safe train operation and safe condition of the crossing for road and pedestrian traffic.

732. Existing crossings are defined as either public or private crossings.

733. Level crossings shall be built or refurbished in line with Track Standard T-ST-AM-5360 Level Crossings.

734. Keep crossings clean and pay attention to:

a.	Flangeways: keep regularly clean of debris and obstructions, it will also stop seal bulging upwards between the rails.
b.	Drainage: slope the surface of the highway away from the track, if possible, and build perforated pipe or subsurface drains where required.
c.	Surface water: redirect water flowing along the highway before it reaches the track.
d.	Roadway approaches to the track: these are to be on a smooth grade, with no abrupt breaks, so that road vehicles with low road clearance may pass over the crossing without touching the rails or surface of the crossing.
e.	Highway grades: consider where highways cross multiple tracks, especially on canted railway curves.

735. Pay special attention to crossings near the bottom or on downward highway grades so that material from the highway does not wash onto the rail or get dragged down by vehicles or highway maintenance equipment.

736. Maintain the approach views in both directions as clear as possible along the track.

Refer to G-ST-LC-9120 Level Crossing Management for further information. Where there is any doubt, arrange for an engineering assessment.

737. The Roading Control Authority is responsible for road marking at crossings, except in yards or KiwiRail-maintained crossings.

738. KiwiRail is responsible for the following signage at crossings:

TABLE 18: Level crossing signage

Type	Ref	Application	Clause
Give way Combination (new type)	RPX3	Unprotected Crossings	Fig 9
Stop Sign Combination (new type) **#2**	RPX2	Unprotected Crossings	Fig 9
Railway (obsolete type - superseded by RPX3 for unprotected crossings)	PW-15	**#1**	Fig 9
Stop (obsolete type - superseded by RPX2) **#3**	RG-5	Unprotected Crossings	Fig 9
Number of Tracks	WX7	Two or more tracks	741
Low Overhead Clearance	RJ2E	Overhead Electrification Lines	740
Flashing Light signal Combination (new type)	RPX1	Crossings with warning devices	742

Refer to NZTA Traffic Control Devices Manual pt9 Level Crossings in all cases.

#1 Applicable to all crossings except where old RG 5 stop sign or new RPX1, RPX2 or RPX3 signs installed.

#2 When provided do not use an RPX3 sign

#3 When provided do not use a PW 15 “Railway” sign.

Figure 9 illustrates these signs.

739. Immediately repair or replace all signs and other forms of protection at level crossings when damaged, not facing the correct way or when sign wording cannot be read. If the repair cannot be completed immediately and KiwiRail does not maintain them, advise the relevant authority.

740. Safe height signs in electrified areas must be installed at both private and public crossings. Traction staff are in charge of signage on private crossings and the road controlling authority for public crossings.

741. Where there are two or more tracks, “Number of tracks” signs are to be put on the same post as RPX1, RPX2, RPX3 or obsolete type “Railway” or “Stop” signs. Track staff maintain these except as below in clause 742.

742. Signals section staff are in charge of signs at crossings with automatic warning devices (half arm barriers or flashing lights and bells).

743. Make sure work on all roads and crossings causes as little as possible disruption for roadway traffic. Take care to protect the public in line with safety rules and laws.

Pole Lines

751. Report to Train Control and to the Traction or Signals section staff in charge any pole line conditions that need fixing, such as broken wires, wrong clearance, uprooted trees or broken branches in wires, or broken or leaning poles.

752. Report to 155 and your Manager any poles or lines on railway property and not owned by KiwiRail Network that appear dangerous to rail operations or trains.

753. Keep trees/vegetation near pole lines trimmed or remove when they are rotten and unsafe, so they do not get in the way of wires or the view of signals.

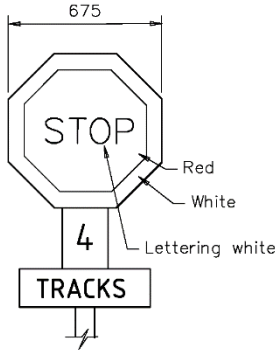
Track-side Signage

761. Boards, signs and posts that Track staff are responsible for are listed below. The relevant Rules, Handbook Clauses and standard forms are also shown.

TABLE 19: Track-side Signs

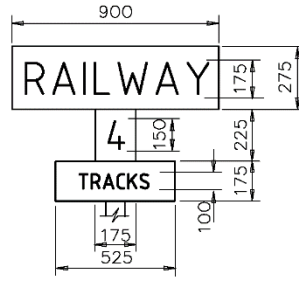
Sign Type	Rule	Handbook	Form or Advice
Curve Boards And Curve Warning Boards	911	772	M186
Permanent Speed Boards	911	780	M186, RORP LNI
Temporary Speed Boards	912	-	-
Track Workers Stop Signal	904	-	Bulletin
Compulsory Stop Protection Boards	905	-	Bulletin
Whistle Boards	73(b)	-	RORP signal rules 3.3 M186, RORP LNI
Miniature St Andrews Signs	-	765	M186
Rolling Stock Limit Boards	-	769	RORP LNI
Kilometrage Posts	-	791	-
Bridge Clearance Signs	-	795	-

FIGURE 9: Types of level crossing signs



TYPE RG–5

LEGEND : Reflectorised white
BACKGROUND : Reflectorised red
BORDER : Reflectorised white
REVERSE : White



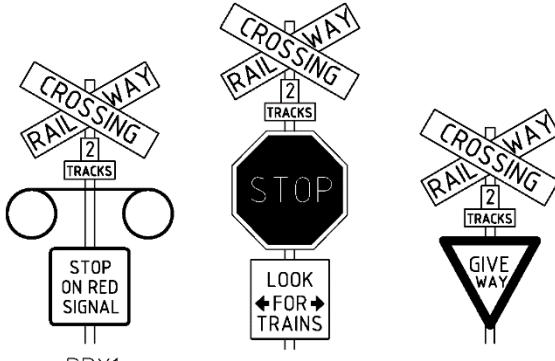
TYPE PW–15

LEGEND : Matt black
BACKGROUND : Reflectorised white

Supplementary boards to be provided at multiple crossings, the figure showing the number of tracks.

Surfaces are reflectorised except black lettering.

OLD SIGNS



NEW SIGNS (RPX1,RPX2 & RPX3 ASSEMBLIES)

TYPES OF LEVEL CROSSING SIGNS

762. All mainline trackside signage is to be no closer than 2.3m from track centre line to the nearest sign edge.

Where signage cannot be put at this minimum distance because of cuttings, tunnels or bridges, seek permission from the PH Track.

The height of the top of track signs from the highest rail level shall be 0.85 metres for curve and curve warning boards, and 2.0 metres for PSR and TSR boards.

These sign locations shall be recorded on M186 report for inspection/audit.

Whistle Boards

763. Whistle Boards are erected in selected localities where a special warning of the approach of trains is necessary or where for a particular reason it is necessary that a warning device is sounded. Installation of these signs will be approved by the PH Track and will be recorded in the asset database.

764. Notification of where these boards are is in the RORP Local Network Instructions (LNI) or by Bulletin. . Install Whistle Board signs on the RHS side of the track (when looking at the sign), 200 m from the feature/crossing, but not less than 20 m from the last crossing.

Miniature St Andrews Signs

765. Install these signs as approved by the PH Track on the approaches to level crossings.

766. In circumstances where a locomotive engineer's visibility of an approaching level crossing is limited on approach (e.g. cuttings, curves or areas susceptible to

fog). The provision of a mini St Andrews sign will provide them advanced warning to be alert for crossing users, an audible warning may be used at or past this sign.

767. Install miniature St Andrews signs on the RHS side of the track (when looking at the sign), 200m from the crossing, but not less than 20m from the last crossing.

768. Refer to T-ST-AM-5360 Level Crossings for further details.

Rolling Stock Limits Boards

769. These are put at places set by either Regional Ops Manager or PH Track that need limits on rolling stock. These could be wharves, yards/sidings or private sidings.

770. Boards showing rolling stock limits into buildings are the responsibility of the Manager working within that building.

Level Crossings

771. Refer to clause 738 and Figure 9 for signage that KiwiRail is responsible for and where it is installed.

Curve Boards and Curve Warning Boards

772. Curve speed boards and curve warning speed boards must be erected in compliance with RORP Rule 911 and as shown on the M186 form.

773. The highest speed value for curve boards on any route will be 5km/h below the authorised maximum speed for that portion of the line as laid down in the RORP. Similarly the highest speed value boards for curves

within a permanent speed restriction will be 5km/h below the restricted speed.

774. Removal, addition or alteration of boards must be approved by the PH Track and recorded in the Asset Management System.

775. Do not, under any circumstances, cover these boards unless instructed to do so by the PH Track. For further details see Track Standard T-ST-AM-5121 Speed Restrictions.

776. Site curve boards as follows:

(a) General Refer Rule 911
Wherever practicable the board must be erected on the right hand side of the track at a distance up to 40 metres before the curve “S” point for viewing in the direction of travel, except as stated following:
(b) Short Straight
Where the authorised speed for a curve is equal to, or greater than that for the speed on a preceding curve,, and where there is less than 80 metres of straight between the two curves, then the curve board must be placed at the curve “S”.
(c) Compound Curve
Unless the flatter radius part is more than 200 metres long, and is also significantly flatter than the sharper part, the whole curve shall be considered to be one curve of the sharper radius for speed posting purposes, and the cant on the flatter radius should be reduced appropriately.
(d) In Multi-track Areas
Boards may be installed on the left hand side of the track and on electrification poles if present. They must be installed to meet the conditions noted above.

777. Curve warning boards are required:

On the approach to all curves where rail traffic speed must be reduced by more than 15km/h.
Where a driver's clear view of the curve board is less than 80m.
When a curve board cannot be put up to 40m before the "S" and a speed reduction of 10 or 15 km/h is needed. A curve warning board must be given for the lower speed even though the reduction is less than written in Rule 911(c)

778. Approach speeds that could be attained over the preceding 300m have to be taken into consideration for assessment of the speed reduction required..

Where not limited by other considerations (such as line speed, speed restrictions and speed on a preceding curve) the attainable speed on ascending gradients may be assumed as follows:

Grade	Attainable Speed
1 in 120 or flatter	100 km/h
1 in 110 to 1 in 119	90 km/h
1 in 100 to 1 in 109	80 km/h
1 in 90 to 1 in 99	70 km/h
1 in 80 to 1 in 89	60 km/h
1 in 70 to 1 in 79	55 km/h

779. Install curve warning boards as follows:

	Wherever Possible, Curve Warning Boards to be put up:
a.	On the right hand side of the track facing the direction of travel (unless the approach view is very limited) or on the left side in multi-track sections.
b.	No less than 200 metres ahead of the "S" of the related curve.
c.	So that the approaching driver can clearly see at least 260 metres of the start of the curve where the approach is straight or curved at more than 400m radius.
d.	With minimum clearance of 2.30m from track centre line.
e.	In accordance with Clause 776.

Permanent and Temporary Speed Boards

780. Permanent speed boards and their locations must be shown on the M186 form.

781. Any new permanent speed boards must be requested by the Asset Engineer and then approved by PH Track for entering into the RORP LNI or Bulletin.

782. Install temporary speed boards in line with current RORP LNI & Bulletins.

783. Track staff must make sure kilometrage of boards are the same as notified in the RORP LNI or Bulletin.

784. Speed values to be used for permanent boards are 10, 15, 25, 30, 40, 50, 60, 70.

Speed values to be used for temporary boards are 10, 25, 40, 60, and 80.

Kilometrage Posts

791. The kilometrage (also referred to as metrage) is the distance along all Main Lines or Branch Lines measured from the zero (0km post) point of that route. Posts are also placed to mark half kilometre (500 metre) intervals.

792. It is sometimes necessary for short or long kilometres to be used to avoid changes to overall line kilometrage, the second 500m of any km shall be adjusted. The asset management system identifies where these locations are present.

793. Posts must:

a.	Show the correct number at each full kilometre distance from the start of the line and a plain yellow marker at all half kilometre intervals between.
b.	Be located to the left side of the track (when facing low metrage). If features like cuttings, tunnels or bridges prevent location at the standard distance, the posts are to be set back as far as possible, but no less than 2.3m.
c.	Be restored promptly if accidentally removed, fallen or knocked down. When kilometrage posts must be removed for any reason, a peg is to driven into the formation to mark the exact replacement location.
d.	Not be disturbed, nor removed where the track has been deviated, without authority from the PH Track .
e.	Be installed at least 2.6m from track centre line, except as stated in (b) above.

Bridge Clearance Signs

795. The placement of both the clearance signs on bridges and the approach signs is the responsibility of the RCA.

796. The distance shown on the signs must be at least 50mm smaller than the lowest measured +clearance.

Lubricators

801. Track side lubricators shall be installed where directed by PH Track.

802. Track staff are in charge of supplying grease to lubricators. Plant fitting staff are in charge of maintaining lubricators.

803. Lubrication of track by hi-rail vehicles is to be carried out by competent staff following the operators manual and maintenance handbook.

CIMW and RailBAM Sites

811. Definitions:

CIMW	Coupled in-motion weighing
SITE	Track 200m both sides of installation
STATION	Track 10m both sides of track equipment array
RailBAM	Bearing Acoustic Monitor

812. Maintain CIMW sites carefully. Any repair or maintenance work is to be discussed and planned with the Signals Field Engineer. Any track or formation work will likely necessitate a re-calibration of the site.

813. Keep fishplates tight with all bolts in place at all times and eliminate joints within the site length as soon as possible. No fishplates are to be installed within the station.

814. Keep fastenings to sleepers tight at all times.

815. Make sure pads between the rail and sleepers are in place. Replace if worn.

816. Replace damaged sleepers. Use only concrete sleepers within the station.

817. Sleeper spacing is important. Sleepers must be within ±50mm of specified spacing. If any adjustments to sleeper spacing then the PH Signals is to be informed who will report dimensions to CIMW Supplier (Trackside Intelligence).

818. Ballast must be clean and have the correct profile. Dirty ballast is a sign of formation failure and must be reported to your Manager. Mud spots / pumping cribs with movement greater than surrounding sleepers are to have ballast replaced and repacked. This is dependent on evaluation of effect of the movement on site performance - to be undertaken prior to confirming that work is required.

819. Report broken rails at CIMW sites as soon as possible.

820. Take care not to damage any of the equipment attached to the rails, including cables (possibly buried in the ballast).

821. Rail Grinding, mechanical tamping, regulating and stabilising are banned at CIMW stations, unless authority is given by Track Engineering. Rail Grinding may only be undertaken once machinery clearance of instrumentation and covers has been confirmed - cabling to be protected from grinder shrapnel and

sparks.

822. Track geometry must be maintained as originally set out.

Cant must be 0 ± 5mm.
Line must be within ± 15mm of existing design.
Top at joints must be no more than 5mm low.
Top elsewhere must be maintained as set out and causes of loss of top established and repaired.

823. CIMW sites must be checked regularly and maintained to make sure they work correctly.

824. Void space under load bar to be kept clear of ballast to ensure free movement of rail between sleepers

825. If any new welds are to introduced into the station the Signals Field Engineer is to be informed who will report exact location CIMW Supplier (Trackside Intelligence). Where possible 12.8m sections of rail are to be used with weld locations to match existing.

826. Rail Condition is to be smooth. Corrugations, blemishes, defects to be removed by re-railing dependent on evaluation of effect of rail condition on site performance - to be undertaken prior to confirming that re-railing is required and approved by PH Track. See note ref grinding in clause 821.

Structures

Bridges

831. Diagrams showing bridge parts are on the following pages.

832. Keep bridge piers and approaches clear of rubbish, branches etc. at all times. This is to prevent scour.

833. Check any disturbance in top or line on a bridge. The cause is most likely to be found under the bridge. Report what you find to the Structures Inspector or to your Manager immediately.

834. Record flood levels at maximum height and report to the Structures Inspector or your Manager, who will then report to the PH Structures.

835. Advise changes in river courses to Structures Inspectors.

836. Bridge numbers must be visible on the right hand side of the front of each ballast guard.

Figure 10: Timber bridge members

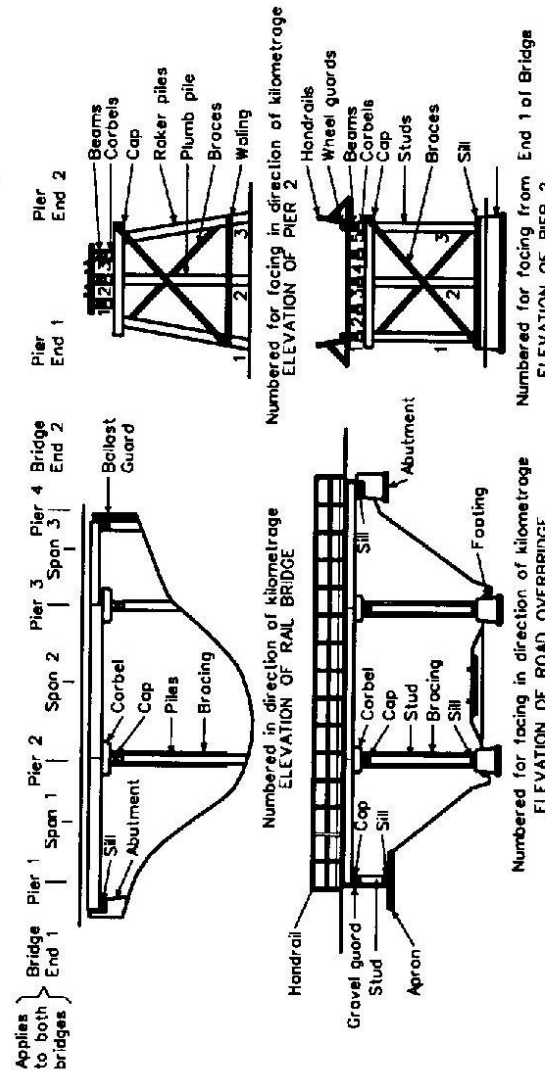


Figure 11: Steel truss members

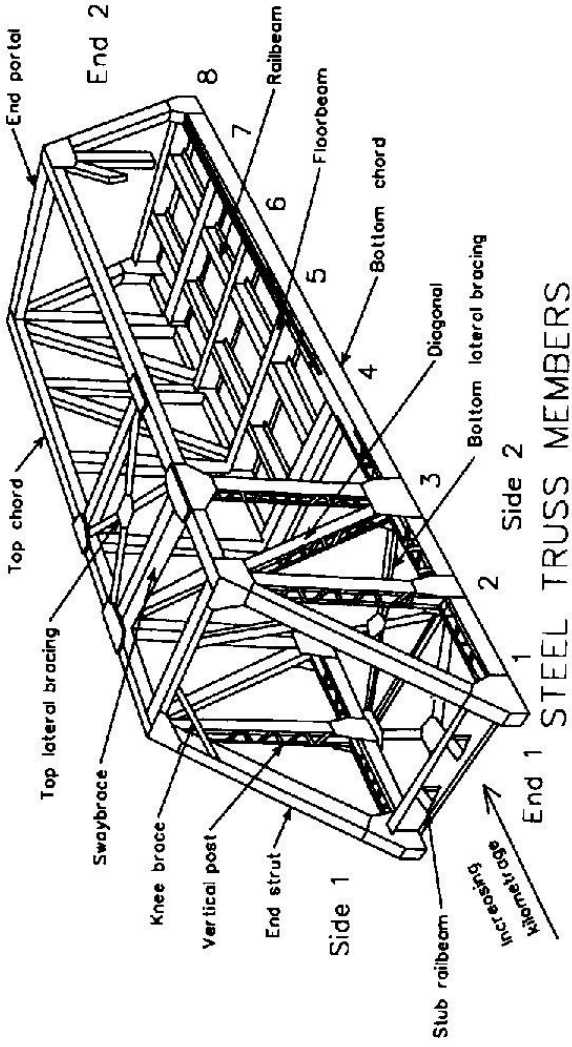


Figure 12: Steel plate girder members

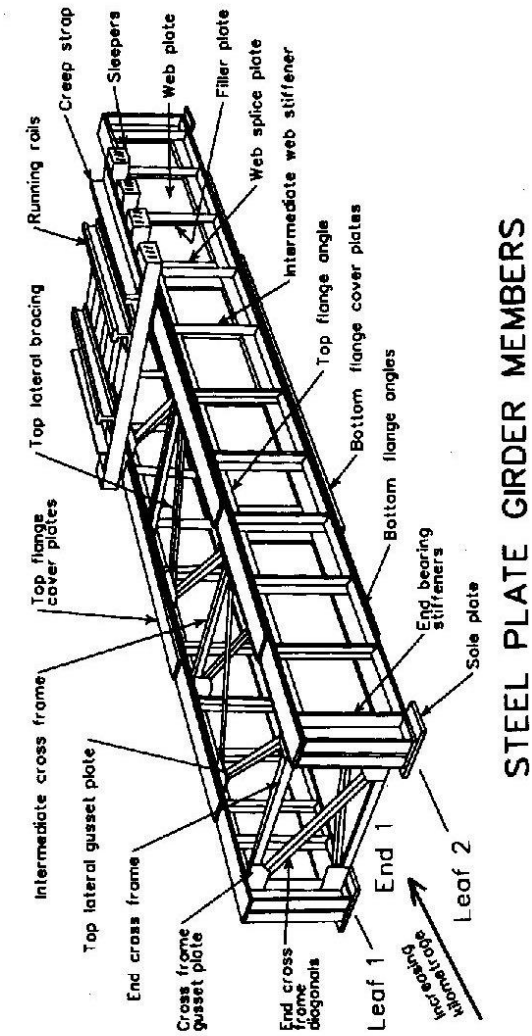
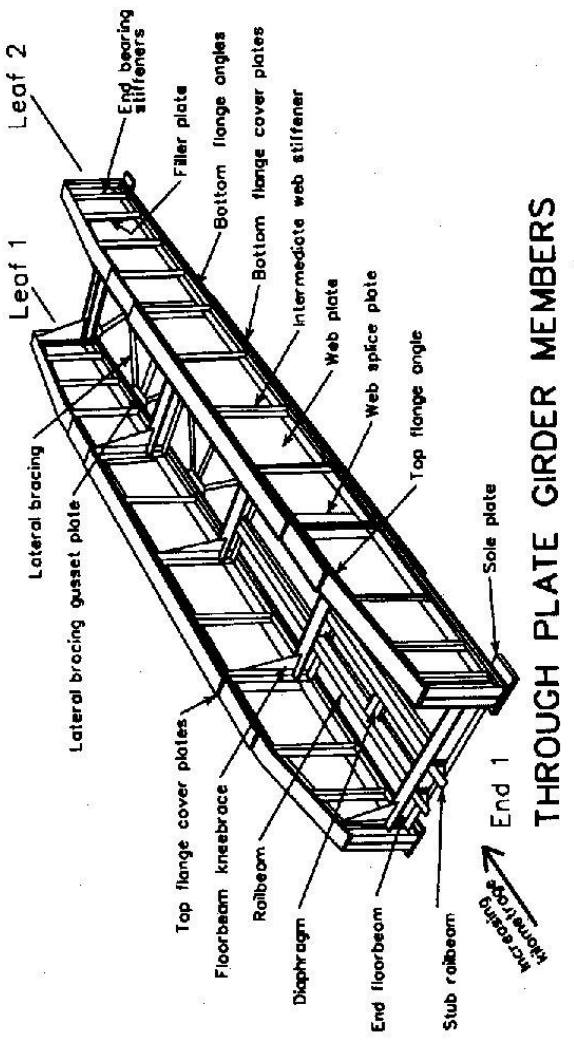


Figure 13: Through plate girder members



Tunnels

841. Report damage or cracking in tunnel linings to the Structures Inspector as soon as possible.

842. Keep tunnel refuge markers clean so they can be seen easily.

843. Water in tunnels can be very corrosive and must be prevented from dripping on rails and fastenings.

844. Tunnel numbers must be clearly visible on portals on the right hand side.

Working with Lifting Devices and Cranes

851. Lifting devices, appliances and cranes owned by KiwiRail must be inspected, tested and repaired by Plant or Mechanical Engineering staff.

852. Lifting devices, appliances and cranes supplied by others must have suitable current certificates.

853. Before using any lifting device, appliance or crane staff must make sure:

a.	The equipment has clear notices showing “safe working load ..... kg” and “keep clear of suspended loads”.
b.	Mechanical condition and servicing record of equipment is satisfactory.
c.	All guards for geared wheels or other parts are secured in place.
d.	All lifting ropes, chains, slings, hooks and other tackle are certified with safe working loads and are in good condition.

Do not use any equipment that does not meet these conditions. Report the problem as soon as possible.

854. No crane or lifting device may work within 4m of live overhead wires of any kind.

855. Rail mounted cranes must be used as follows:

a.	Operated by certified and competent crane drivers.
b.	Attached to a locomotive when lifting or moving on a grade steeper than 1 in 250.
c.	On gradients steeper than 1 in 100, the locomotive must be on the uphill side of the crane and 4 sleepers must be secured to the rail no more than 50m downhill from the crane.
d.	When working next to an opening in the track (e.g. a bridge missing a span) sleepers must be screwed on top of the rail or rail stops fitted to prevent the crane from being pushed over the edge.
e.	Before travelling on a train, it must be checked by the crane operator to make sure all running gear and wagons are properly secured.

856. Before lifting device or crane work starts, the operator and other staff must talk to each other to:

a.	Make sure the rated capacity (SWL) of the device will not be exceeded.
b.	Check the track and formation is in a suitable condition to take the loads of crane plus lift.
c.	Make sure load bearing pads for outriggers are used correctly.
d.	Ensure the authorised, qualified slinger and operator understands work to be done and signals to be used (use of job plan forms).

857. Lifts must not be started until lifting equipment are correctly applied and load balanced.

858. Cranes must work within the safe radius for the loads applied.

859. Two cranes must not lift at the same time unless specifically authorised by the person in charge.

860. Rail cranes must not operate on canted track unless:

a.	When cant is more than 50mm, or full rated capacity is needed on a smaller cant, the cant must be cut to zero by lifting the low leg. On ballasted track, sleepers must be properly packed. On bridges other than ballast deck bridges, the track must be tied down with chains after removing cant.
b.	When cant is 50mm or less, the lift is not more than ¾ of the appropriate rated load and outriggers are used.

861. Rail cranes must not work from a bridge unless approved by the PH Structures.

862. Lifting devices, appliances and cranes must be used in line with this document and any other legal requirements (e.g. Health and Safety Regulations).

Derailments

870. The cause of each derailment must be found and reported by the designated Site Investigator, including:

Submitting the completed draft MLD.1 form to PH Track within 3 working days.
Submitting the Final Report to the PH Track within 10 working days.
Carrying out a complete derailment measure up and investigation as set out in Track Standard T-ST-EM-5610 prior to any repair work being undertaken on the track.

871. The derailment site will be under the control of a Rail Incident Controller (RIC). The RIC will liaise with external agencies (Police, TAIC, NZTA, OHS) to establish the Point of Derailment (POD), and decide when the site is to be released. The RIC will tell you when you can begin working on the site, do not enter the site without permission from the RIC.

Where the root cause of the derailment has not been established and agreed upon in writing on site by all parties (Freight Operations, Infrastructure, and RSAS) a 25km/h TSR is to be established for 100m either side of the POD before the line is re-opened to traffic and until such time the root cause has been established and any track repairs required have been carried out to the satisfaction of PH Track.

All evidence must be preserved until such time as the RIC has given approval to undertake repairs.

872. The RIC, person in charge of the site or site investigator should be different people. It is important to clearly establish who they are on-site .

873. Be careful not to damage or change the site for a distance of 119m before the POD and 40m after the POD before a derailment measure up has been completed.

874. Locomotives must not be moved until the Tranzlog event recorder data has been recovered and permission has been given by the Mechanical Engineering person in charge.

Guidelines to Actions After Earthquakes

Introduction

875. This guide is based on the Modified Mercalli Earthquake Intensity Scale (MM) combined with measured Peak Ground Accelerations (PGA). PGA is a measure of earthquake acceleration on the ground at a given location. MM uses personal reports and observations to measure earthquake shaking intensity but PGA is measured by instrument, and it correlates reasonably well with the MM. Together they provide a better measure for our responding to earthquakes.

For the purposes of this guide, the MM is outlined, then the expected effect on the railway and the action needed for MM and PGA is given.

Refer to C-ST-GN-4101 Earthquake Response for Infrastructure for more detailed information on how to respond to earthquakes

Modified Mercalli Intensity Scale over page⇨

TABLE 20:
The Modified Mercalli Intensity Scale (MM)

1. Not felt.
2. Felt by persons at rest, on upper floors, or favourably placed.
3. Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration may be estimated. May not be recognised as an earthquake.
4. Generally noticed indoors but not outside. Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy ball striking the walls. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of 4, wooden walls and frames crack.
5. Felt outdoors as well; direction estimated. Sleeping wakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate.
6. Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knick-knacks, books, and so on, off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry cracked. Small bells ring (church, school). Trees, bushes shaken visibly, or heard to rustle.
7. Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to weak masonry including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones, tiles, cornices, unbraced parapets, and architectural ornaments. Some cracks in unreinforced masonry. Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.
8. Steering of motor cars affected. Damage to unreinforced masonry; partial collapse. Some damage to reinforced masonry; none to structural masonry. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and walls. Cracks in wet ground and steep slopes.

9. Weak masonry destroyed; unreinforced masonry heavily damaged, sometimes with complete collapse: reinforced masonry seriously damaged. General damage to foundations. Frame structures, if not bolted, shifted off foundations. Frames racked. Conspicuous cracks in ground. In alluvial areas sand and mud ejected, earthquake fountains, sand craters.
10. Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dykes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land.
11. Underground pipelines completely out of service.
12. Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air.

Relating the Scale to Requirements for Inspections

877. The scale above talks about a number of things that a person will see or feel both during and after an earthquake.

In smaller sized earthquakes, experience has shown that minor damage to track can result. Therefore staff that are used to looking for minor track movement (such as those who carry out Heat 40 inspections) are ideally suited to carrying out post-earthquake inspections on tracks.

Additionally, structures with known weaknesses should be inspected by personnel with adequate structures knowledge. Known at risk slopes and embankments should also be visually inspected.

In larger scale earthquakes both track and structures should be inspected, refer to the guidelines in Table 21.

When and What to Inspect

878. To use Table 21 refer back to the Modified Mercalli Scale in Table 20. For PGA, the KiwiRail RapidAlert application http://www.rapidalert.nz provides access to PGAs, measured ground accelerations, for significant earthquakes (4.0 or greater Richter Scale earthquakes).

The intensity column relates to damage we would expect, whether a special inspection is needed and what the person doing the inspection should be looking for.

Table Over Page ⇒

TABLE 21: Earthquake size and inspection priorities

MM Scale Intensity / PGA*(g)	Expected Damage to Railway Infrastructure	Special Inspection required?	What to look for
MM1, PGA less than 0.0017	Nil	No	Not Applicable
MM2, PGA 0.0017–0.014	Nil	No	Not Applicable
MM3, PGA 0.0017–0.014	Nil	No	Not Applicable
MM4, PGA 0.014–0.039	Nil	No	Not Applicable
MM5, PGA 0.039–0.092	Nil	No	Not Applicable
MM6, PGA 0.092–0.18	Minor damage to track and bridges possible	Maybe	Cracking in weak masonry piers. Potential movement of track.
MM7, PGA 0.18–0.34	Minor damage to track, formation and bridges possible	Yes	Cracking in masonry, weak concrete piers. Damage around bearings. Slumping possible on edges of formation, particularity in areas of fill and around river banks. Movement of track, possible misalignment /buckling. A few small to moderate land-slides on steeper slopes (> 30˚) such as gorges, coastal cliffs, cuts and excavations which might block the track.
MM8, PGA 0.34–0.65	Damage to track, bridges, piers, signalling and tunnels possible. Cracks in ground, lumping likely.	Yes	Damage to bridge bearings and members coming into them. Signals, poles and trees likely to have fallen over. Power loss likely. Cracks in tunnels, especially around portals. Slumping possible around bridges, fill areas on formation and steep slopes. Slips may be activated. Significant land sliding likely in susceptible areas. A few large landslides from coastal cliffs, and

MM Scale Intensity / PGA*(g)	Expected Damage to Railway Infrastructure	Special Inspection required?	What to look for
			possibly rock slides and avalanches from steep mountain slopes. Evidence of soil liquefaction common and localised lateral spreading and settlement along banks of rivers, lakes and canals etc. Movement of track and misalignment/buckles.
MM9, PGA 0.65–1.24	Damage to track and bridges very likely. Damage to formation as with 8 but worse. Liquefaction likely.	Yes	Structural damage to bridges including damaged piers, members and track buckles. Numbers of slips and slumps in formation. Landsliding widespread and damaging in susceptible terrain, particularly on slopes steeper than 20°. Liquefaction effects widespread, and extensive lateral spreading along banks of rivers, lakes, canals etc. Spreading and settlement of river stopbanks likely. Lines potentially impassable.
MM10, PGA > 1.24	Damage to all bridge components highly likely. Tunnel damage. Formation and track highly likely to be damaged.	Yes	Very high chance of significant bridge damage. Tunnels cracked or buckled. Slips and landslides very likely to block track. Engineering assistance will be required. Lines likely impassable.
MM11, PGA > 1.24	Damage to all infrastructure. Railway likely to be unoperational.	Yes	Lines impassable. Engineering assistance required.
MM12, PGA > 1.24	High amount of damage Railway unoperational	Yes	Lines impassable. Engineering assistance required.

Severe/ Adverse Weather Inspections

879. Information on the reporting of severe and adverse weather conditions is located in the Rail Operating Rules and Procedures Section 1 Rule 6.

In certain areas information contained in the local and train control instructions may need to be considered.

Information contained in the rules and procedures may be changed at any time by semi-permanent bulletin, it is the responsibility of rail personnel to ensure that they read and understand all current bulletins affecting them.

IMPORTANT In the event of any obstruction or defect being located it is the responsibility of the person finding it to provide adequate protection in accordance with the rules and procedures.

Refer to clause 880 for what to inspect when undertaking severe/adverse weather inspections

880. The essential features list for the section of track being inspected must be used as a reference to locate previously identified issues and decide when inspections should take place

Below is a list of what to look for when undertaking a special inspection.

Formation: Signs of subsidence or slipping. Cess and side drains blocked. Scour at bridge ends.
Cuttings: observe slopes and hillsides above the track that may be at risk of slipping, in particular look for unusual water runoff and evidence of movement or changes from normal
Drainage: culverts and water courses are not blocked and working correctly. Build-up of debris at or on the approach to bridge piers. Water moving through the formation or above the head of the rail.
Vegetation: Any vegetation that is over hanging or obstructing the track
Traction & signal equipment: Any defects that are visible or suspected found during an inspection must be reported to train control immediately

Reports: M127

All inspections for severe or adverse weather require a report to be completed and forwarded to the Asset Engineer.

If no issues are discovered during the inspection the M127 is to be noted simply with “No Issues Found”.

Reports: M127h

All heat run inspections require a report to be completed and forwarded to the Asset Engineer.

Speed Restrictions

881. Speed restrictions are required for the safe operation of the network. They must be at least 110m long to allow for a 50m buffer either side of the reason for the restriction which must be a minimum of 10m long.

882. The correct speed restriction is worked out by using Tables 22 and 23, but can be further restricted by the Asset Engineer or the Production Manager and/or Gangers based on their knowledge of the Line Classification, track condition, site and normal line speed.

883. There are two main types of speed restriction:

a) Permanent (Rule 911)

b) Temporary (Rule 912)

Permanent speed restrictions are shown in the RORP LNI.

884. As a general guide, speed restrictions are set for several reasons, including:

a) Emergency work, e.g. slips, derailment damage.

b) Planned work.

c) General worsening of track condition and awaiting planned maintenance or renewal.

d) Risk of track misalignment due to high rail temperatures. (Heat 40).

e) After tamping or construction, to allow for settlement.

f) Failure of level crossing alarms.

885. There is a need to look at speed restrictions regularly to avoid:

- unnecessary speed restrictions
- speed restriction value being too low/high or in place for too long a distance
- speed restriction being placed in a difficult operational area, e.g. on an uphill grade.

This should mainly be done by Asset Engineers, but Gangers also need to keep a close watch on the need, placing and speed value of speed restrictions.

886. All TSR's must be reported through Train Control including detailed reasons for the placement of the speed restriction. Asset Engineers must also be advised of any speed restriction imposed Asset Engineer to allow for planning of resources needed to remove the speed restriction.

887. Speeds of the following value are to be used for temporary speed restrictions: 10, 25, 40, 60, 80 km/h. No other speed values are to be used unless the PH Track gives specific approval.

888. Table 22 gives the requirements for temporary speed restrictions. If any track conditions are beyond these set out, then the line must be blocked to traffic until repaired. There may be other reasons for a speed restriction that are not set out in the table. These are to be mitigated by a 10 km/h TSR until risk assessed by a competent engineer.

889. Table 23 gives the requirements for speed restrictions after tamping or other track disturbance.

All track is to be inspected before the passage of the first train and before each change of speed.

Where the track disturbance is at a resleepering job, the speed restriction applied must allow for the track geometry.

Allowance must be made for the consolidation of the ballast after the replacement or significant disturbance of the ballast substructure. Tamped track settlement restrictions listed in Table 23 may be modified for sites where the dynamic track stabiliser has been used. Refer to the Track Standard for further instructions.

890. Higher speed values from those in Table 22 and 23 may be used following suitable detailed risk analysis of the site conditions. This process must be recorded and sent to the PH Track for approval before imposition. This may require issue of a code exemption.

891. TSR's for TEC exceedances and repair by times are to be found in Table 4.

Notes to Ineffective Sleepers - Table 22

- In (B), the ineffective sleepers are not necessarily consecutive but the number ineffective in a group of 20 consecutive sleepers.
- In any situation where both (A) and (B) apply then the lowest TSR shall be applied.

TABLE 22: Speed restrictions for track defects or temporary works

Feature	Speed (km/h)
Rail	
Rail – At or beyond wear limits or corrosion. For gas cut ends. Refer to clause 445	40
Rail - broken rail or weld- not plated - <30mm gap and/or out of vertical ≤20mm	10 Supervised
Single rail dolly fitted	40
Rail ends out-of-line (also batter/mis-match joints)	
> 3≤ 6 mm (SC 1, 2 lines)	40
> 6 ≤ 9 mm (SC 1,2,3,4 lines)	25
>9 < 13 mm (SC 5 & yards)	10
Fishplates	
Fully bolted fishplate at break - < 30mm gap	60
G - Clamped fishplate at break - < 30mm gap	40
Weld joggle plate at break - < 30mm gap	25
Union fishplate – fully bolted – on Mainline	40
Four hole fishplates with 2 bolts & bolted both rail ends; where rail < 8 m	40
Six hole fishplates with 4 bolts (no centre bolts only)	60
Pull apart – still plated. 2 bolts one end only & tight: gap < 30 mm	25
1 bolt only and tight : gap < 30 mm	10

Sleepers and Fastenings		
Consecutive ineffective sleepers or fastenings (A)	TSR in km/h	
	Curve R≥600	Curve R<600
4	60	60
5	40	25
More than 5	25	10
% of ineffective sleepers or fastenings (B)	TSR in km/h	
	Curve R≥600	Curve R<600
40 % or 8 in 20	60	60
50 % or 10 in 20	60	40
60 % or 12 in 20	40	25
70 % or 14 in 20	25	10

Skeletonised Track	
1 in 2 remaining	40
1 in 3 and 1 in 4 (straights only)	25

TABLE 23: Speed restriction after track disturbance

Principal lines	Rail temperature at or under Neutral Temperature#	Rail temperature above Neutral Temperature (or where NT is unknown)
1st train and 24 hours	40km/h for 10,000 tons - 15 trains and at least 24 hours*	25 km/h for 10,000 tons - 15 trains and at least 24 hours*
Intermediate	60 km/h for next 30,000 tons - 40 trains and at least 48 hours*	40 km/h for next 30,000 tons - 40 trains and at least 48 hours*
Removal	Normal after above and inspection	Normal after above and inspection

Secondary lines	Rail temperature at or under Neutral Temperature#	Rail temperature above Neutral temperature (or where NT is unknown)
1st train and 48 hours.	40 km/h for 10,000 tons - 15 trains and at least 48 hours*	25 km/h for 10,000 tons 15 trains and at least 48 hours*
Intermediate	60 km/h for next 30,000 tons - 40 trains and at least 96 hours*	40 km/h for next 30,000 tons - 40 trains and at least 96 hours*
Removal	Normal speed after above and inspection	Normal speed after above and inspection

Note * = TSR to stay on until the latest requirement is attained.
Note # = Minimum temperatures apply – refer to Track Standard T-ST-AM-5111
For SAT restrictions following tamping – refer to Track Standard T-ST-AM-5161

Appendix

TABLE 24: Compliance documents	
MLD1	Mainline derailment report
YD1	Shunting derailment report
M58a	Rail failure
M91	EM80 code compliance check
M122	Private siding/yard compliance inspection
M123	Turnout detailed inspection form
M124	Engineering inspection summary report
M125	Mainline compliance inspection
M126	Yard compliance inspection
M127	Special inspections adverse/ severe weather
M127h	Heat inspection
M129	Installation of CWR on Bridge Request form
M130	Rail failure repair in CWR – local de-stress
M131	Thermit welding return
M132	De-stress pull calculation sheet
M133	Rail wear measurement return
M134	Pre-works survey form
M135	Site completion audit check list
M136	Final completion certificate
M137	Welded Track Diagram
M138	Stability analysis checklist
M140	Level crossing detailed inspection
M142	Rail surface repair welding return
M143	Code Exemption request
M144	RWD Long Welded Rail report
M150	Track buckle/ misalignment report
M151	Track buckle/ misalignment investigation report
M152	Stress Free Temperature form
M154	NDT test – Joints
M155	NDT test - Welds
M160	Pull-apart report
M186	Curve board inspection checklist