



AUSTRALIAN RAIL TRACK CORPORATION LTD

Discipline: Engineering (Track & Civil)

Category: Standard

Track Geometry Standards for Construction, Upgrading and Maintenance Works

ETF-05-01

Applicability

New South Wales	✓
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Primary Source

ARTC NSW Standard TCS 01, TCS 02, TMS 03
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Document Status

Version	Date Reviewed	Prepared by	Reviewed by	Endorsed	Approved
1.4	01 Jul 13	Standards	Stakeholders	Manager Standards	GM Technical Standards & Environment 02/07/2013

Amendment Record

Version	Date Reviewed	Clause	Description of Amendment
1.0	01 Dec 09		Implementation draft. Supersedes NSW Standards TCS 01 v1.2 in part, TCS 02 v1.2 and TMS 03 (RIC Standard TS 3105)
1.1	29 Mar 10	1; 3.4; 3.5; 4.2	Implementation draft update. Scope clarified; New Turnout section added; Requirements for ballast depth and condition amended; Gauge requirements updated
1.2	18 Jun 10		Banner added regarding mandatory requirements in other documents and alternative interpretations.
1.3	08 Apr 11	2, 3; 4	Track classification A,B,C and D amended to show "Heavy Haul Lines", "Interstate lines", "Intrastate Lines", and "Light Weight Lines".. Deleted reference to Class E Lines

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1.4	01 Jul 13	1; 2.2; 4.4	Update clause 2.2 to change symbol from Greater Than (>) to Less Than (<). Correction of typo's in tables in clauses 2.2 & 4.4 and other minor editorial updates.
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Mandatory requirements also exist in other documents.

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

1 Scope

This specification sets out track geometry tolerances following track construction, upgrading and maintenance works. Upgraded turnouts shall also comply with these standards.

The standards in this specification are commercial or good practice standards and reflect requirements that may be included in the technical scope of construction / upgrading / maintenance projects or contracts. At all times the base operating condition standards for track geometry and other track parameters apply.

All measurements are to be taken as specified in ETE-00-02 Track Patrol, Front of Train and General and Detailed Inspections.

2 New Track Construction

This section is applicable to new tracks or where a track is totally reconstructed and new rails are used. It does not apply;

- where a track is reconstructed using existing rails;
- to major upgrading works on the existing formation;
- to small sections of track such as local track reconditioning.

Main line tracks upgraded with recovered rails on the existing formation are covered in clause 3.

2.1 Main Line Tolerances

New track construction is to conform to the tolerances shown below.

LINE	Heavy Haul mm	Interstate mm	Intrastate mm	Light Weight mm
GAUGE-1435 nominal				
Tangent & Curve	+4/-4	+5/-3	+6/-3	+6/-3
Variation in 2m	4	5	6	7
ALIGNMENT				
Tangents & Curves. Variations in Mid-ordinate from 20m over-lapping chord (5m overlap)	+/-4	+/- 5	+ / - 7	+ / - 8
SUPERELEVATION & CROSS LEVEL				
Variation from design	+/- 5	+ /- 5	+/-5	+ /- 5
RATE OF CHANGE OF SUPERELEVATION				
Twist measured over 3m from design	+ /- 5*	+ /- 5*	+ / - 6*	+ /- 7.5*
RATE OF CHANGE OF UNIFORM SURFACE				
20m chord	8	10	12	14
6.5m chord	4	5	6	7

* Subject to a maximum rate of change of 1 in 300.

Turnouts shall similarly comply with the above except all gauge dimensions shall be within +/- 2mm of the design dimension.

2.2 Survey Tolerances

In addition to the tolerances specified in clause 2.1 new track construction is to conform to the basic surveyed design within the following tolerances for alignment and level.

LINE	Heavy Haul mm	Interstate mm	Intrastate mm	Light Weight mm
ALIGNMENT				
Platforms, Tangents & Curves <600m radius	+ / - 6	+ / - 6	+ / - 10	+ / - 10
At other surveyed locations.	+ / - 10	+ / - 10	+ / - 15	+ / - 15
Variation between any surveyed locations 20m apart:	10	10	15	15
LEVEL				
Open Track	+ / - 25	+ / - 25	+ / - 50	+ / - 50
Through Platforms and overbridges.	+ / - 15	+ / - 15	+ / - 15	+ / - 15
Variation between other locations surveyed within 20m.	15	15	15	15

2.3 Siding Tolerances

The tolerances of all sidings shall be to Intrastate Line standard before being approved for traffic with the exception of the superelevation (and transitions) which are not applied to sidings.

3 Track Upgrading

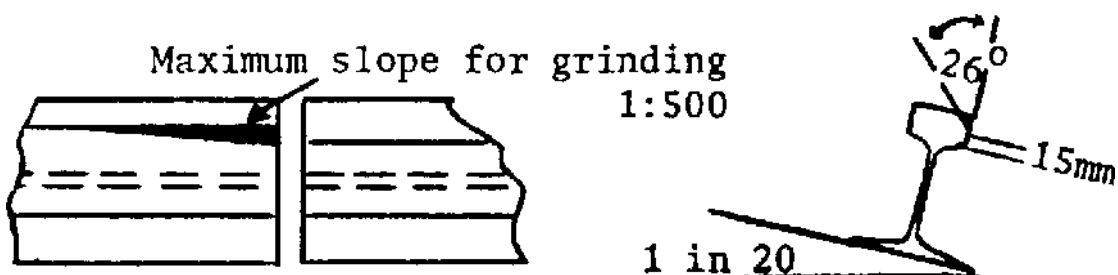
This section 3 applies to Heavy Haul and Interstate Lines which are upgraded using existing materials. The following has been assumed:

- The formation has been upgraded to the standard profile and consolidated where known to be of a low standard;
- The ballast conforms to the standards outlined in clause 3.5;
- Sufficient sleepers have been renewed to ensure that all sleepers have a minimum life of five (5) years;
- Fastenings have been correctly fitted and are appropriate to the class of line;
- Rails have been measured and comply with the wear tolerances specified in clause 3.1.

3.1 Limits of Rail Wear and Re-use of Rails - 53kg/m Rails Only

The maximum allowable curve side wear on rails to be used in upgrading work is 5mm for Heavy Haul Lines and 6 mm for Interstate Lines.

The maximum allowable rate of change of rail head sections where it is necessary to grind one rail to match the next shall be 1 in 500.



The maximum allowable angle of rail wear shall be 26 degrees to the vertical when the worn face is within 15mm of the lower edge of the rail head. This angle is to be measured with an approved gauge. Concavity of the gauge face of the rail is not to exceed 1.5mm.

Transposing of rails is permitted where rails are curve worn or have wear angle greater than allowed, and the other rail face is in 'as new' condition. The new gauge face must be reprofiled to the correct rail profile by removing any lip that has developed by grinding.

Before transposing, rails are to be ultrasonically tested over the entire length of the rail. Defects that exceed the standards are to be removed before re-use of the rail.

3.2 Main Line Tolerances

Completed upgraded track is to conform to the tolerances shown below.

LINE	Heavy Haul	Interstate
GAUGE - 1435 Nominal		
Tangent & no rail wear	+ / - 4	+ / - 5
Curves with no curve wear	+ / - 4	+ / - 5
Curves with curve wear	+ 10 / - 4	+ 12 / - 4
Variation in 2 metres	4	5
ALIGNMENT		
Tangents & Curves. Variation in mid-ordinate from 20m over-lapping chords with 5m overlap.	+ / - 4	+ / - 5
SUPERELEVATION & CROSS LEVEL		
Variation from design	+ / - 5	+ / - 5
RATE OF CHANGE OF SUPERELEVATION		
Twist measured over 3m from design	+ / - 5 *	+ / - 5 *
RATE OF CHANGE OF UNIFORM SURFACE		
20m chord	8	10
6.5m chord	4	5

* Subject to a maximum rate of change of 1 in 300 and the limits established for the appropriate speed band in the ARTC T&C CoP section 5 Table 5.5.

3.3 Survey Tolerances

In addition to the tolerances specified in clause 3.2 the track is to conform to the basic surveyed design within the following tolerances for alignment and level.

The alignment is to be within +/-15mm. The variation between any surveyed locations 20m apart is not to be more than 15mm.

On open track the level is to be + 50/-100mm of the approved grade level, provided the minimum ballast depths defined in clause 3.5 are achieved.

Through platforms and overbridges the level is to be within +/-20mm of the approved grade level.

The variation over any 20m section is to be not more than 15mm.

3.4 Turnouts

Upgraded turnouts shall similarly apply to these standards.

3.5 Ballast Depth and Condition

For Heavy haul and Interstate Lines where sledding or reconditioning has been carried out, the minimum depth of ballast below the underside of the sleeper should be 250mm and 200mm respectively.

On completion Interstate Lines must have a minimum ballast depth below a timber sleeper of 150mm of which the top 75mm must be free draining ballast.

When using concrete sleepers, the top 200mm must be free draining ballast.

Free draining ballast includes ballast with fines such as sand, brake dust and other fine material which does not restrict water flow.

4 Track Maintenance

4.1 General

This section 4 specifies the minimum standard of track geometry of main line tracks and sidings to be achieved following maintenance works such as mechanical surfacing, manual lining and component renewal.

Track measurements may be carried out using manual measuring methods or continuous track recording.

This section sits below the construction standards in section 2 and the upgrading standards in section 3.

It recognises:

- construction and upgrading tolerances in some cases are not achievable because existing worn infrastructure is being used
- works on track should be performed to a better standard than the Base Operating limits. This allows deterioration of condition with usage before the BOS thresholds are reached.
- The ARTC may accept a lower standard where circumstances warrant

4.2 Gauge of Track

The following limits are to be applied when new sleepers are installed or when timber sleepers are cross bored or regauged.

Maximum allowable wide gauge is 5mm wide to the design gauge of 1435mm. The minimum allowable tight gauge is 5mm compared to design gauge (including head flow).

Where gauge widening has been applied on curves by design, the limit is +/-5mm to the widened design gauge.

Rail play is not permitted.

Work is to be carried out to correct "foot gauge" \pm 5mm. Where rail flow would give more than 5mm tight gauge, authorisation must be obtained from the Infrastructure Manager or nominated representative. Correction of wide gauge on curve worn rail by tightening the "foot gauge" is not permitted without authorisation from the Infrastructure Manager or nominated representative.

The maximum deviation at a discontinuity such as at a joint ("foul joint") is to be 1mm. Particular care is required to ensure that new joints cut into the track have matching profiles at the gauge face and running surface.

The maximum allowable rate of change in gauge shall not be greater than 2 mm per metre.

4.3 Line and Alignment

The following limits are to be applied to mechanised resurfacing and manual lining activities on tangents and curves.

Track	Tangent Mid-ordinate (mm) from overlapping chords and maximum versine (mm)	Curve Mid-ordinate variation (mm) in successive overlapping chords (Note 1 and 2)
	for 10m chord with 2 m overlap	
Main line		
Heavy Haul	2	3
Interstate	3	3
Intrastate	3	5
Light Weight	5	6
Siding		
Heavy Haul	5	6
Interstate	5	6
Intrastate	6	11

Note 1: On curves the high rail is to be used for assessing compliance to chord based measurements

Note 2: Where the curved section is in a transition, the designed variation in versine is to be considered when determining compliance

For manual methods, if the above limits cannot reasonably be met then at least the limits in the ARTC T&C CoP Section 5.3 for each speed band must be met and the ride of the first train over the section observed.

The track alignment is to be no more than $\pm 15\text{mm}$ of the designed alignment indicated on any survey monuments on both single and multiple lines.

Tracks at station platforms, bridges and other similar structures with restricted clearances are to be kept within the standards set for that location.

4.4 Superelevation

The following limits are to be applied to mechanised resurfacing or manual fettling activities.

The superelevation at any curve is prescribed to suit the traffic and the speed and is detailed on 'F' (or 'G') sheets. Where design information is not available, advice must be obtained from ARTC on the procedure to be adopted.

The superelevation measured is to be within the following limits from the prescribed superelevation.

Track	Deviation + - (mm)
Heavy Haul	6
Interstate	6
Intrastate	8
Light Weight	10

Sidings are not normally designed with superelevation.

For manual methods, if the above limits cannot reasonably be met then at least the limits in the ARTC T&C CoP Section 5.3 for each speed band must be met and:

- the ride of the first train over the section observed and

- the clearance to any adjacent structure potentially affected is checked.

On multiple tracks with centres less than 4000 mm where variations in the superelevation roll the vehicles towards each other, the sum of the variations in superelevation is not to exceed 12 mm.

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

4.5 Surface

The following limits are to be applied to mechanised resurfacing or manual fettling activities.

4.5.1 Twist

Twist is the variation in cross level between any two points in the track. Note that the AK Car measures the actual variation and not the variation from design.

Track	Twist (mm) measured over (Variation from design twist)	
	2m	14m
Main Line		
Heavy Haul	6	12
Interstate	6	12
Intrastate	8	16
Light Weight	10	20
Siding		
Heavy Haul, Interstate and Intrastate	10	20

Where the track is being assessed is within a transition the designed variation in superelevation (ie a designed twist) is to be considered when determining compliance.

Irrespective of any allowance in the table above the limits for each speed band in the ARTC T&C CoP must not be exceeded.

4.5.2 Top Unevenness

Top unevenness is seen as a dip in both rails.

Track	Top (mm) (mid ordinate of 10m chord)
Main Line	
Heavy Haul	17
Interstate	22
Intrastate	28
Light Weight	28
Siding	
Heavy Haul Interstate and Intrastate	28

If there is variation in top unevenness in one rail, this is measurable as a twist.

On open track the level is to be no more than +75 mm or -125 mm of the approved grade level, provided the minimum ballast depths are achieved. If ballast depths do not meet minimum requirements, manual maintenance work should, at least, retain existing track levels, and mechanised resurfacing should be used to increase ballast depths.

Through platforms, tunnels and overbridges the level is to be no more than +25 mm or -10mm of the approved grade level.

For manual methods, if the above limits cannot reasonably be met then at least the limits in the ARTC T&C CoP Section 5.3 for each speed band must be met and the ride of the first train over the section observed.

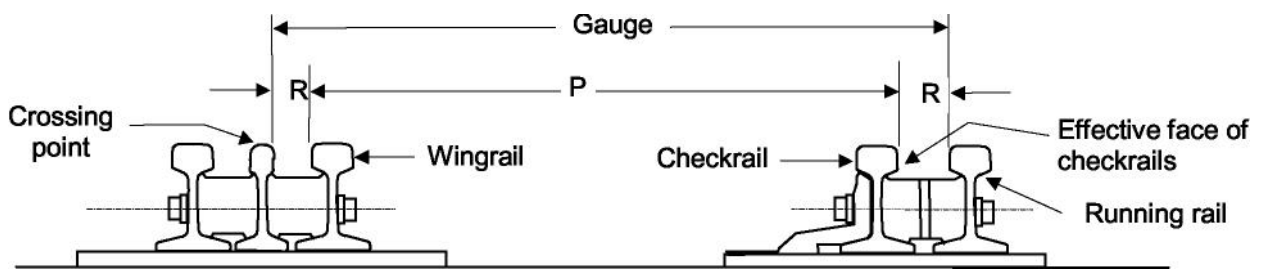
4.6 Turnouts and Special Trackwork

The limits specified below should be applied to manual regauging of turnouts or component renewal.

For signalled points the clearance between the back of an open switch point and the gauge of the running stock rail is to meet the requirements of signalling staff. For non-interlocked points the clearance is to be 120 ± 2 mm.

Crossings and check rails on all tracks shall be within the following limits:

Flangeway Depth (min) (mm)	Flangeway Width R. (mm)	Gauge (mm)	Crossing Nose To Check Rail Q. (mm)
38 min	44 +2 -1	1435 +2 -1	1390 min 1392 max



The relative locations of the four crossings in a diamond must be within 25mm of the designed distances.

Crossing intersection point (Theoretical Point) must be within 15mm of the position defined by Reference pegs or Survey monuments.