

Standard Category 1

S1159 A5

Track – Maximum permitted values and Conditions to be rectified

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1 Purpose

- 1.1 The purpose of this standard is to define the Maximum permitted values and Conditions to be rectified for track, and the actions to be taken if these are not achieved, in respect of Maintenance works.
- 1.2 The Conditions required and Maximum permitted values for track, and the actions to be taken if these are not achieved, in respect of completed works, i.e. new build and renewals, are covered in [S1179](#).

2 Scope

- 2.1 This standard applies to all track, including plain line and junctionwork in open, sub-surface and tube sections and in depots.
- 2.2 This standard does not apply to the conductor rail system, the dimensions and Maximum permitted values and actions for which are covered in [S1164](#).
- 2.3 Where it is mandatory that any of the supporting information in Section 5 of this standard is to be applied, the appropriate requirement is set in Section 3.
- 2.4 The standard does not cover the requirements associated with the inspections and maintenance of the track system, which are the subject of standard [S1158](#).
- 2.5 The standard does not cover the requirements of completed work tolerances, which are subject of standard [S1179](#).
- 2.6 The standard does not cover the requirements associated with Rail Defect management, which are the subject of standard [S1178](#).
- 2.7 The standard does not cover the requirements associated with Track Clearances and Gauging, which are the subject of standard [S1156](#)
- 2.8 This standard must be followed by Permanent Way engineering and track maintenance teams with responsibility for the track, as well as Suppliers and Contractors when inspecting and maintaining the track.

3 Requirements

3.1 General

- 3.1.1 Where information from this standard is to be used as part of a tender or contract documentation for vehicle design it shall be made clear that:
- S1179 describes requirements and quality values for completed work only; in practice the actual quality of the track system will deteriorate over time with the passage of traffic;
 - Section 3.3 of this standard describes requirements and quality values which in practice may be exceeded.

3.2 Evidence of compliance

- 3.2.1 Compliance with the requirements of this standard shall be demonstrated by the organisation responsible for the work. Additionally, compliance may be audited as part of the track surveillance regime.

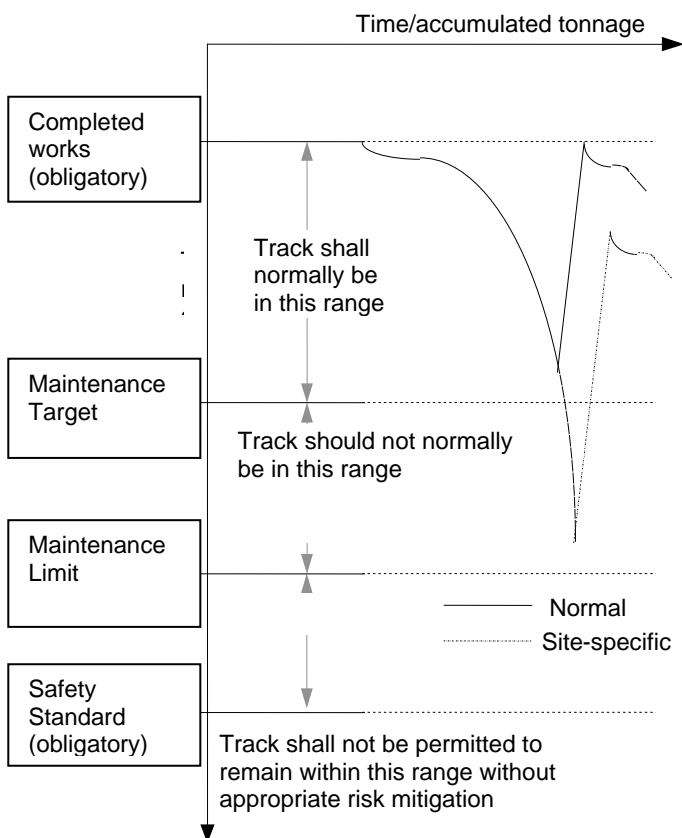
3.3 Maintenance: Maximum permitted values and Conditions to be rectified

3.3.1 Condition thresholds, combinations, and Minimum Action timescales

3.3.1.1 For each track parameter and for each track category (as defined in S1158) the tables set out below define three values representing progressive **thresholds** of deteriorating track condition, namely:

- a) the Maintenance Target;
- b) the Maintenance Limit;
- c) the Safety Standard.

Figure 1 shows the application of these **thresholds** to the maintenance process.



Track beyond the Safety Standard threshold shall generally be subject to special risk mitigation.

Figure 1 – Application of quality thresholds to the maintenance process

3.3.1.2 This standard defines the limits of degradation and minimum action for individual types of fault and it is important to recognise that where different faults exist together in **combination**, their combined effect may create a greater risk demanding a more onerous response. Guidance on the recognition of and response to **combined faults** which increase safety risk shall be provided for all staff responsible for

undertaking track safety inspections or scoping and prioritising the response to reported track faults.

- 3.3.1.3 Whilst the **Minimum Action Timescales** specified within the tables below permit certain defects to remain in the track for defined periods prior to their rectification, the standard anticipates that track is managed *within* the limits rather than *to* them.

The track maintenance management regime, including its planning and operational procedures and resource management arrangements, must support the delivery of maintenance within the defined thresholds. Specifically, the regime must not rely on breach of SS or ML thresholds as initiation triggers for normal work planning processes, but it should aim to deliver the correction of developing defects before these critical thresholds are reached.

- 3.3.1.4 Where thresholds are breached, the ALARP (as low as reasonably practical) principle of risk management requires that faults should be rectified *at the earliest practicable opportunity* commensurate with their criticality. Accordingly:

- a) breach of a Safety Standard threshold should be an isolated and unusual occurrence and the standard is clear that such a breach requires the urgent imposition of risk mitigation
- b) breach of a Maintenance Limit should be rectified at the earliest practicable opportunity (i.e. an opportunity for corrective work that *can* reasonably be made available *without* throwing immediate work schedules, and more critical priorities into disarray).

3.3.2 Track Structure and Components

- 3.3.2.1 The tables in section 3.3 specify the minimum action that shall be taken when the condition of the track structure or its components deteriorate or fail.

- 3.3.2.2 It is an **obligatory** requirement to maintain the track system in a condition which ensures (as a minimum) that the Safety Standards are not breached.

- 3.3.2.3 The ML thresholds shown are **guidance** values. Where track condition is worse than the ML, corrective maintenance shall be actioned within the terms of this standard.

- 3.3.2.4 Where normal conditions apply, the track condition specified as MT should be achieved or bettered.

- 3.3.2.5 For several of the track components covered by the tables, two limits are set concerning groups of defective or missing units:

- a) a limit is given applying to defective or missing units that are adjacent or close together (“**local clusters**”), and;
- b) a limit applying to the number of defective or missing units within a 100m length of track (“**cell limits**”, reflecting more general track condition).

Local clusters (a) above) are more likely to give rise to immediate unsafe track conditions and their continuing safety must be assessed and confirmed during the course of each visual and each measured track inspection.

Cell limits (b) above) are less likely to present an immediate safety risk and, whilst individual missing or defective components must be recorded during the course of visual and measured track inspections, their assessment against cell limit thresholds should be undertaken off-line.

Note: The Asset Condition process now focuses on discrete faults, local clusters and 10m cell condition and no longer uses 100m cell data.

In consequence some of the 100m Cell limits have been removed from this standard to aid clarity and focus on discrete and local clusters where a safety risk can arise. Some 100m cell criteria remain where appropriate when no alternative local cluster criteria was defined.

3.3.3 Track Geometry: Discrete Exceedances

- 3.3.3.1 Discrete point exceedances of critical track geometry characteristics pose a derailment risk. Accordingly, it is an **obligatory** requirement to maintain the track system in a condition which ensures (as a minimum) that the Safety Standards (SS) are not breached.
- 3.3.3.2 The tables in section 3.3 specify the **obligatory** minimum action that shall be taken when the measurement of a track geometry parameter gives a reading which is at or beyond the Safety Standard,
- 3.3.3.3 SS track geometry **gauge faults** and **2m twist faults** present more of a safety risk than vertical and lateral alignment faults: even where response timescales suggest equivalence of risk, faults in the former two categories should be given higher priority for inspection and correction.
- 3.3.3.4 Certain combinations of SS track geometry fault occurring within 10m of each other may present more of a safety risk than a single parameter at or beyond the SS limit. Such combinations are highlighted in the table below and their inspection and correction should be given priority.

Fault combinations within 10m meriting increased priority			
SS Fault	2m twist	10m twist	Vertical profile (top) $\geq 26\text{mm}$
Gauge	X	X	X
Lateral Alignment $\geq 30\text{mm}$	X	X	X
Vertical profile (top) $\geq 26\text{mm}$	X	X	
10m twist	X		

Figure 2: Fault combinations within 10m meriting increased priority

Note: When rectifying SS track geometry faults, individually or in combination as above, any separate ML geometry faults and any running rail fastening and fixing faults in the vicinity should be rectified at the same time.



Particular care and attention need to be paid to defect assessment, mitigation, and prioritisation where:

- a) one or more track gauge faults are present in combination with rail fastenings that are missing or in poor condition, or;
- b) one or more track twist faults are present in combination with poor track support conditions, especially around rail joints.

3.3.3.5 The MT and ML thresholds shown in the tables in **3.3 Part 1**, (below), are **guidance** values to be used where track is monitored using TRT (incl. TRV) or ATMS.

3.3.3.6 Where measurement of a track parameter gives a reading worse than the ML, corrective maintenance shall be planned within the terms of this standard.

3.3.3.7 Where measurement of a track parameter gives a reading worse than the ML, the fault shall be monitored and corrective work considered within the terms of this standard. Where track is monitored using regular readings from ATMS:

- a) the deterioration rate of the fault shall be established;
- b) further monitoring shall be undertaken at a frequency (monthly, weekly, interval not greater than three days) appropriate to the established rate of deterioration;
- c) remedial work shall be planned and undertaken before the SS is breached.

3.3.3.8 Where normal track conditions apply the MT threshold should be achieved or bettered.

3.3.4 Track Geometry: Geometric track measurements relating to a length of track

3.3.4.1 Maintenance of track geometry is critical in controlling the forces that arise between train and track. Good track geometry minimises such forces and, in consequence, controls fatigue damage to the track's components and support structure. Because traffic forces are lower with good track geometry the track does not deteriorate as quickly as poorer quality track. Maintenance of good geometric track quality also reduces the incidence of discrete track geometry exceedances.

Accordingly and as **guidance**, track geometry quality as described by standard deviation (SD) values and the thresholds given in table 1.8 in section below should be managed such that:

- a) No track should fall within the **unacceptable** quality range.
- b) No more than 3% of track should fall within the **bad** quality range.
- c) At least 97% of track should fall within the **adequate** and **satisfactory** ranges.
- d) At least 90% of track should fall within the **satisfactory** range (see definition of Maintenance Target in clause 6.3).

3.3.4.2 Similarly, corrugations on the rail head lead to increased wheel-rail forces, fatigue damage to track components and faster track deterioration.

Accordingly, rail corrugation should be managed in accordance with the values and thresholds given in table 1.9 in section below.

3.3.5 Management of Inherent & Spurious Track Geometry data and Condition Registers

3.3.5.1 For requirements regarding the management of Inherent Track Geometry reference shall be made to [S1158](#) clause 3.7.7.5

3.3.5.2 For requirements regarding the management of Track Geometry Spurious data reference shall be made to [S1158](#) clause 3.7.7.4

3.3.5.3 As required by [S1158](#) and this standard Condition Registers shall be used to manage Inherent Track Geometry data and specific track conditions, for the following:

- a) Inherent Geometry
- b) Non-Compliant Flangeways
- c) Residual Switch Openings

3.3.5.4 Faults once assessed and accepted on the Condition Registers as requiring no further maintenance rectification shall not be classified as SS, ML or MT, but treated as Registered Conditions.

3.3.5.5 Registered Conditions shall, as required by the registers:

- a) Be monitored, during Patrolling and other Inspections
- b) Be included in Patrol Walkout reports and Junctionwork Walkout Reports

3.4 Tables of Maximum permitted values and Conditions

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Note: Dimensions are in millimetres unless otherwise stated.

The Maximum permitted values and Conditions to be rectified in these tables refer to track categories. The system for the categorisation of each section of track is set out in [S1158](#).

1 Discrete geometrical exceedances at individual locations – TRT (incl TRV)/ATMS

1.1 Vertical profile – TRT (incl TRV)/ATMS (discrete exceedances)

	Maximum permitted value for track category			Minimum action	Notes
	Standard	A - C	D		
The maximum permitted values of the vertical profile of the running rails as measured by the TRT (incl TRV)/ATMS. Discrete exceedances can be located manually for rectification by sighting, use of string line or optical instrument. Allowance for dynamic movements will require to be made. At platforms and other locations where track position is limited by clearance requirements or where a standard concession has been granted, the effects of the clearance standard S1156 must be considered when determining the actual track geometry which can be applied.	All lines except Central line tube sections				
	SS	± 20	± 25	Rectify within 96 hours and additionally inspect within first 24 hours from time of notification.	
	ML	± 15	± 20	Inspect and rectify within 8 weeks	
	MT	± 12	± 17	Plan maintenance if required	
	Central line tube sections only				
	SS	± 18	± 20	Rectify within 96 hours and additionally inspect within first 24 hours from time of notification.	(1)
	ML	± 15	± 18	Inspect and rectify within 8 weeks	(1)
	MT	± 12	± 17	Plan maintenance if required	(1)
	(1) On Central line tube sections any rectification of the vertical geometry must be carried out within the positional Maximum permitted values given in standard S1156 . See Table 1.8 for standard deviations of 10m & 100m section of track				



1.2 Lateral alignment – TRT (incl TRV)/ATMS (discrete exceedances)

	Maximum permitted value for track category			Minimum action	Notes
	Standard	A - C	D		
<p>The maximum permitted values of the lateral alignment of the centre line of the two running rails as measured by the TRT (incl TRV)/ATMS.</p> <p>Discrete exceedances can be located manually for rectification by sighting, use of string line or optical instrument.</p> <p>Allowance for dynamic movements as well as designed track curvature will require to be made. At platforms and other locations where track position is limited by clearance requirements or where a standard concession has been granted, the effects of the clearance standard S1156 must be considered when determining the actual track geometry which can be applied.</p>	Open and subsurface sections				
	SS	± 30	± 30	Rectify within 96 hours and additionally inspect within first 24 hours from time of notification.	
	ML	± 19	± 21	Inspect and rectify within 8 weeks	
	MT	± 10	± 17	Plan maintenance if required	
	Tube sections				
	SS	±20	±20	Rectify within 96 hours and additionally inspect within first 24 hours from time of notification.	(1)
	ML	±15	±18	Inspect and rectify within 8 weeks	(1)
	MT	±10	±15	Plan maintenance if required	(1)
	<p>(1) On Central line tube sections any rectification of the lateral geometry must be carried out within the positional Maximum permitted values given in S1156.</p> <p>NB: The crossing within junctionwork can cause spurious high TRT (incl TRV)/ATMS exceedances at individual location. Such high readings must not be dismissed since they may relate to genuine lateral faults at or adjacent to junctionwork.</p> <p>See Table 1.8 for standard deviations of 10m & 100m section of track</p>				

1.3 Dynamic crosslevel – TRT (INCL TRV)/ATMS (discrete exceedances)

	Maximum permitted value for track category			Minimum action	Notes
	Standard	A - C	D		
No longer required – superseded by revised 2m twist limits					

1.4 2 metre twist – TRT (incl TRV)/ATMS (discrete exceedances)

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
<p>The maximum permitted values of the twist on a 2 metre base as measured by the TRT (incl TRV)/ATMS.</p> <p>Discrete exceedances can best be located manually for rectification by the use of a cross level gauge to measure cant at 1 metre intervals or at each sleeper and comparing these values across a base of 2 metres.</p> <p>Allowance for dynamic movement will require to be made.</p> <p>At platforms and other locations where track position is limited by clearance requirements or where a standard concession has been granted, the effects of the clearance standard S1156 must be considered when determining the actual track geometry which can be applied.</p>	All lines			
	SS	18	Rectify with 72 hours and additionally	(1)
	ML	15	Inspect within first 24 hours from time of notification	(2) (3) (4)
	MT	12	Inspect and rectify within 8 weeks	
			Plan maintenance if required	
	<p>(1) If 2 metre twist is over 22 mm for defined areas^ impose 10 mph speed restriction and correct within 24 hours.</p> <p>(2) If 2 metre twist is over 22 mm for non-defined areas^ notify TransPlant and Technical Delegated Authority for Track Recording and Analysis to impose stock specific restrictions on specific wheel loading intolerant Engineer's vehicles until rectified and rectify within 24 hours or TANC.</p> <p>(3) If 2 metre twist is over 33 mm for non-defined areas^ impose 10 mph speed restriction and correct within 24 hours.</p> <p>(4) Any faults no greater than 25mm for non-defined areas^ reported prior to 31 March 2023 can be eligible to be treated, subject to risk assessment, as a registered condition and managed by the Registered condition process until 31 March 2024.</p>			
	<p>The defined areas^:</p> <p>(a) Bakerloo Line</p> <p>(b) Central Line and Waterloo & City Line</p> <p>(c) District Line – East Putney to Wimbledon, Acton Town to Ealing Broadway</p> <p>(d) Piccadilly Line</p> <p>(e) Metropolitan Line – Rayners Lane to Uxbridge</p> <p>^Ntfl Track plus East Putney to Wimbledon</p>			
	<p>See Table 1.8 for standard deviations of 10 & 100m section of track</p>			
	<p>Particular care and attention must be paid to defect assessment, mitigation, and prioritisation where one or more track twist faults is present in combination with poor track support conditions, especially around rail joints.</p>			

1.5 10 metre twist – TRT (incl TRV)/ATMS (discrete exceedances)

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
<p>The maximum permitted values of the twist on a 10 metre base as measured by the TRT (incl TRV)/ATMS.</p> <p>Discrete exceedances can best be located manually for rectification by the use of a cross level gauge to measure cant at 1 metre intervals or at each sleeper and comparing these values across a base of 10 metres. Allowance for dynamic movement will require to be made.</p> <p>At platforms and other locations where track position is limited by clearance requirements or where a standard concession has been granted, the effects of the clearance standard S1156 must be considered when determining the actual track geometry which can be applied.</p>	Ballasted track			
	SS	40 (1 in 250)	Rectify within 96 hours and additionally inspect within first 24 hours from time of notification.	(1)
	ML	33 (1 in 300)	Inspect and rectify within 8 weeks	
	MT	30 (1 in 333)	Plan maintenance if required	
	Concreted track			
	SS	40 (1 in 250)	Rectify within 96 hours and additionally inspect within first 24 hours from time of notification.	(1)
	ML	37 (1 in 270)	Inspect and rectify within 8 weeks	
	MT	35 (1 in 286)	Plan maintenance if required	
	(1) If 10 metre twist is over 50 mm impose 10 mph speed restriction and correct within 24 hours.			



1.6 Wheel unloading factor – TRT (incl TRV) (discrete exceedances)

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
<p>The critical percentages of wheel unloading at which obligatory action is required, are 60%, 70% and 90%. For the same track twist faults different vehicles will experience different wheel unloading %.</p> <p>Currently the TRT (incl TRV) can only replicate one vehicle type and therefore for different vehicles, different TRT (incl TRV) wheel unloading factors represent the 60%, 70% and 90% actual wheel unloading percentages.</p> <p>NOTE: The figures shown opposite in normal type are the wheel unloading factors currently reported by the TRT (incl TRV). The figures in brackets are the actual wheel unloading percentages.</p> <p>Wheel unloading is a combination of 2 metre twist and 10 metre twist.</p>	(1) District Line – East Putney to Wimbledon.			
	SS	65 (90)	Stop trains or impose speed restriction ≤ 10mph, and rectify within 24 hours. Rectify before speed restriction removed	
		50 (70)	Rectify with 72 hours and additionally Inspect within first 24 hours from time of notification	
		45 (60)	Rectify within 1 week and additionally inspect within first 24 hours from time of notification.	
	ML	43	Inspect and rectify within 8 weeks	
	MT	No longer applies – superseded by revised 2 metre Twist limits		
	(2) Central line - All of line			
	SS	90 (90)	Stop trains or impose speed restriction ≤ 10mph, and rectify within 24 hours. Rectify before speed restriction removed	
		70 (70)	Rectify with 72 hours and additionally Inspect within first 24 hours from time of notification	
		60 (60)	Rectify within 1 week and additionally inspect within first 24 hours from time of notification.	
	ML	58	Inspect and rectify within 8 weeks	
	MT	No longer applies – superseded by revised 2 metre Twist limits		
	(3) All other lines			
	No longer applies – superseded by revised 2 metre Twist limits			

1.7 Gauge - TRT (incl TRV)/ATMS (discrete exceedances)

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
<p>Maximum permitted deviation from nominal track gauge as measured by the TRT (incl TRV)/ATMS outside junctionwork.</p> <p>The deviation from gauge is based on 1435mm which is the nominal gauge of the TRT (incl TRV)/ATMS system.</p> <p>See also Table 3.1 for different gauges and manual measurements. Dynamic TRT(incl TRV)/ATMS readings giving a more adverse value shall take precedence unless proven to be spurious. Care must be taken to verify exceedance is genuine. Track Recording engineers should be consulted on validity of reading.</p> <p>Particular care and attention must be paid to defect assessment, mitigation, and prioritisation where one or more track gauge faults is present in combination with rail fastenings that are missing or in poor condition.</p>	SS	-15 +27	Inspect within 24 hours. Rectify within 1 week	
	ML	-10 +22	Inspect within 4 weeks. Rectify within 6 months	
	MT	-8 +11	Monitor gauge	

1.8 Maximum permitted values for geometric track quality expressed as Standard Deviations (SD) TRT (incl TRV)/ATMS - all parameters, all lines						
The geometric quality of the vertical profile of the running rails, the lateral alignment of the centre-line of the two running rails, the cross level variations in the track and the twist on a 2m base as measured for a 10m & 100m track section. The quality is expressed as a standard deviation in mm. The values cannot be checked manually.						
Parameter	Maximum permitted value for all lines			Status	Minimum Action	
	Adequate	Bad	Unacceptable		Item already identified and monitored	New item identified
Vertical Profile SD	2.75 (2.75)	3.75 (5.0)	4.5 (5.5)	Track shall not be permitted to remain at or worse than the Unacceptable Maximum permitted value	<p>For an exceedance of one or more of the defined parameters at “unacceptable” level: <u>At 4-weekly intervals, or the recording interval if greater:</u></p> <ul style="list-style-type: none"> Check the individual exceedance reports to identify exceedances within the 10m or 100m cell; Identify any combinations of exceedances that act together to increase risk of derailment; Review Trace (and, if available, Video) records for the 10m or 100m cell concerned to determine whether a condition based or precautionary TSR is required; Inspect on site; Check deterioration rate; Taking account of deterioration rate, plan remedial works and other actions to rectify and prevent a further breach of the Unacceptable Maximum permitted value. 	<p>For an exceedance of one or more of the defined parameters at “unacceptable” level:</p> <ul style="list-style-type: none"> Check the individual exceedance reports to identify exceedances within the 10m or 100m cell; Identify any combinations of exceedances that act together to increase risk of derailment; Review Trace (and, if available, Video) records for the 10m or 100m cell concerned to determine whether a condition based or precautionary TSR is required; Inspect on site within 7 days; Check deterioration rate; Taking account of deterioration rate, plan remedial works and other actions to rectify and prevent a further breach of the Unacceptable Maximum permitted value.
Lateral Alignment SD	1.95 (2.75)	2.7 (4.0)	4.5 (5.5)			
Dynamic Cross Level SD	Not used – superseded by revised 2 metre twist					
2 metre Twist SD	2.75 (2.75)	3.75 (4.25)	4.5 (5.0)			

1.9 Corrugations (short wavelengths - 20 to 100mm) – TRT (incl TRV)/ATMS

	Maximum permitted value for track category			Minimum action	Notes
	Standard	A - C	D		
<p>The values are the magnitude of the largest peak to peak corrugation in microns (1/1000mm). The limiting values may be taken manually from a chart estimating an average over a typical grinding length.</p> <p>Note: where measurement is made using the TRT (incl TRV)/ATMS speed should be over 35 km/h for the records to be valid. See Table 4.6 for manual measurements.</p>	ML	80	150	Examine rail within 8 weeks for grinding or replacement	(1)
(1) Damage and nuisance will occur					



2 Geometric standards – manual measurements

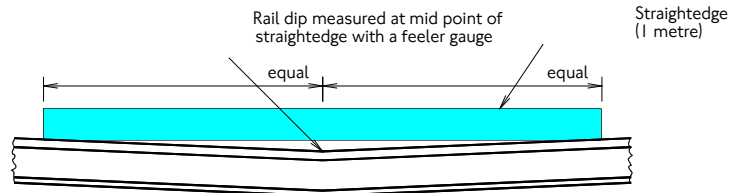
2.1 Vertical

	Maximum permitted value for track category			Minimum action	Notes
	Standard	A - C	D		
2.1.1 Vertical profile (long undulations - 5 metre intervals) Maximum permitted deviation between consecutive levels on any rail, measured at 5 metre intervals. These values are for level track and allowance should be made for variations in design level for transitions, vertical curves and gradients.	SS	10	15	Check and rectify within 1 week	
	ML	7	10	Check and rectify within 4 weeks	
	MT	5	8	Plan maintenance if required	

2.1.2 Vertical profile (short undulations - 1 metre straightedge) Maximum permitted vertical error in the rail, using a 1 metre long straightedge. The gap is measured between the rail head and the straightedge using a feeler or other suitable gauge. For a dipped joint, see 3.3 Table 2.1.4.	ML	3	5	Check and replace rail within 8 weeks if required.	
	MT	2	3	Plan maintenance if required	

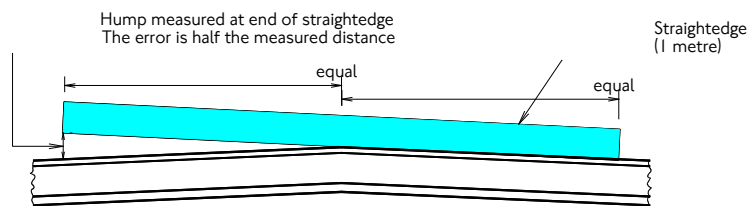
Measurement of rail profile

Rail dip

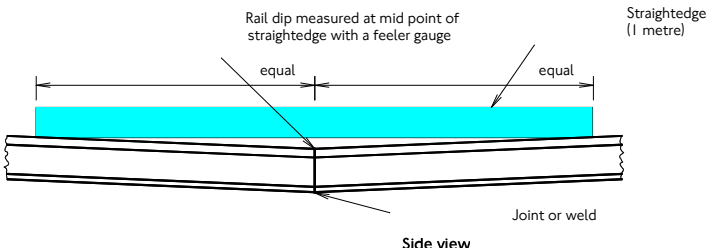
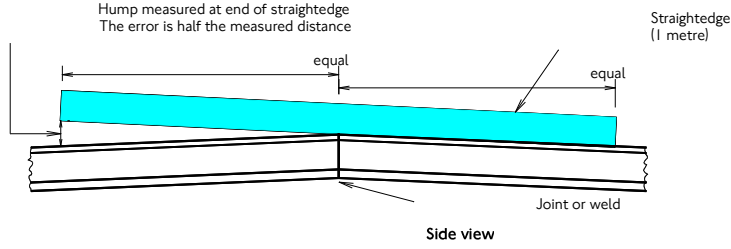


Side view

Hump



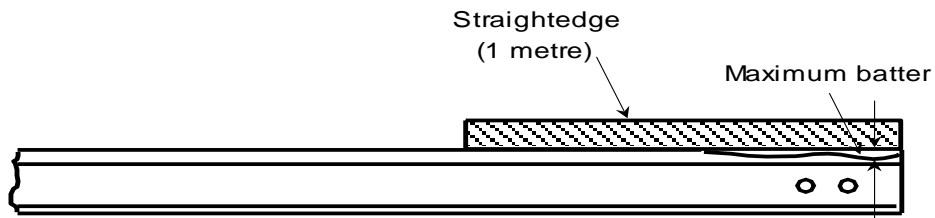
Side view

	Maximum permitted value for track category			Minimum action	Notes
	Standard	A - C	D		
2.1.3 Vertical profile - welded joints	SS	+3 -8	+4 -8	Rectify within 8 weeks	
	ML	±2	±4	Plan rectification	
<p>Maximum permitted error in straightness of vertical profile of the joint using a 1 metre straightedge as shown in the drawing and measuring the gap between the rail head and the straightedge.</p> <p>Note: positive value denotes hump at joint and negative denotes dip at joint.</p>	<p>Measurement of joint geometry</p> <p>Rail dip</p>  <p>Rail dip measured at mid point of straightedge with a feeler gauge</p> <p>Straightedge (1 metre)</p> <p>equal</p> <p>equal</p> <p>Joint or weld</p> <p>Side view</p> <p>Hump</p>  <p>Hump measured at end of straightedge The error is half the measured distance</p> <p>Straightedge (1 metre)</p> <p>equal</p> <p>equal</p> <p>Joint or weld</p> <p>Side view</p>				

2.1.4 Vertical profile - plated joints (dipped joint)	Non-insulated joints				
	SS	-12	-12	Repair joint within 2 weeks	(1)
	ML	+6 -8	+6 -8	Check and rectify within 8 weeks	(1)
	(1) This limit includes dip and rail end batter. If batter present refer also to 2.1.5.				
	Insulated joints				
SS	-8	-10	Repair joint within 2 weeks	(1)	
ML	+3 -5	+3 -7	Check and rectify within 8 weeks	(1)	
(1) This limit includes dip and rail end batter. If batter present refer also to 2.1.5.					
Maximum permitted upward or downward vertical step between running rail ends	SS	2	2	Repair within 2 weeks	
	ML	1		Check and rectify within 8 weeks	(2)
(2) No ML specified for track category D: SS action to be applied at 2mm.					

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
2.1.5 Rail end batter - plated joints Maximum permitted rail end batter measuring the gap between the rail head and a straightedge with a feeler gauge.	SS	6	Replace/crop rail within 2 weeks.	
	Open sections ML	4	Plan rectification	(1)
	Subsurface sections ML	3	Plan rectification	(1)
	Tube ML	2	Plan rectification	(1)
	(1) For non-insulated joints, if batter added to dip (see 2.1.4) is greater than 8 mm repair joint within 2 weeks. (2) For insulated joints, if batter added to dip (see 2.1.4) is greater than 5 mm repair joint within 2 weeks.			

Rail batter



Side view

	Maximum permitted value for track category			Minimum action	Notes
	Standard	A - C	D		
<p>2.1.6 Vertical position of rail relative to design position</p> <p>Maximum permitted deviation from the engineer's marked vertical position (excluding sites where the rules for 'rail level' plates apply, section 3.3 Table 2.1.7).</p> <p>The geometric Maximum permitted values given in the previous sections also must not be exceeded.</p> <p>At platforms and other locations where track position is limited by clearance requirements or where a standard concession has been granted, the effects of the clearance standard S1156 must be considered when determining the actual track geometry which can be applied.</p>	Tube sections (except Central Line)				
	SS	-18 +5	N/A	Check and rectify within 4 weeks	
	ML	-16 +5	N/A	Monitor position	
	MT	-14 +5	N/A	Plan maintenance if required	
	Tube sections (Central Line)				
	Refer to S1156				
	Sub-surface sections				
	SS	-20 +10	N/A	Check and rectify within 4 weeks	
	ML	-18 +8	N/A	Monitor position	
	MT	-16 +6	N/A	Plan maintenance if required	
	Open sections				
	SS	-25 +20	-30 +20	Check and rectify within 4 weeks	
	ML	-23 +18	-25 +18	Monitor position	
	MT	-20 +15	-20 +15	Plan maintenance if required	

<p>2.1.7 Maximum rail level plates</p> <p>Maximum permitted vertical deviation of the running surface from the maximum rail level mark on the plate.</p> <p>Note that the running surface should normally be 50mm below level mark.</p> <p>At platforms and other locations where track position is limited by clearance requirements or where a standard concession has been granted, the effects of the clearance standard S1156 must be considered when determining the actual track geometry which can be applied.</p>	SS	+10	+10	Inspect and rectify within 1 week	(1)
	ML	-10 -100	-10 -100	Inspect and rectify within 8 weeks, if required	
	MT	-25 -75	-25 -75	Plan maintenance if required	
	(1) There is no lower safety limit on the level of the track with respect to rail level plate datum				
<p>The diagram illustrates the vertical alignment of rail level plates for three track categories: MT (Main Track), ML (Main Line), and SS (Sub-surface). A horizontal line represents the 'Plate datum'. For MT, the upper level is 25mm above the datum and the lower level is 75mm below. For ML, the upper level is 100mm above and the lower level is 100mm below. For SS, the upper level is 10mm above and there is no lower limit. A 'Correct position' is shown 50mm below the datum. A note states 'SS there is no lower limit'.</p>					

2.2 Lateral					
	Maximum permitted value for track category			Minimum action	Notes
	Standard	A - C	D		
2.2.1 Lateral alignment (long base 10-metre chord versine) Maximum permitted variation between regular overlapping 10-metre versines measured at 5-metre intervals. Allowance must be made for designed transition curves.	SS	15	30	Check and rectify within 1 week	
	ML	10	20	Check and rectify within 4 weeks	
	MT	8	18	Plan maintenance if required	
2.2.2 Lateral alignment (short base versine – 1 metre straightedge) - not joints Maximum permitted error in lateral alignment measured using a 1-metre straightedge. Allowance must be made for designed track curvature.	SS	4	7	Replace rail within 8 weeks	
	ML	3	6	Consider replacement of rail	
	MT	2	5	Plan maintenance if required	
2.2.3 Straightness lateral alignment (1 metre straightedge) - all joints Maximum permitted error in straightness of alignment of joint using a 1-metre straightedge. Allowance must be made for designed track curvature. S1158 covers additional features concerned with the maintenance of joints	SS	5	7	Rectify within 48 hours	
	ML	2	5	Check and rectify within 1 week in accordance with S1158	
Maximum permitted lateral step between running rail ends in the direction of running.	SS	±5	±5	Impose 10 mph speed restriction and repair joint within 24 hours.	(1) (2)
	ML	+1 -0	+2 -1	Check and rectify within 1 week in accordance with S1158	(1)
	(1) Outwards in direction of running is + (2) If rail end protruding into 4' does not face the direction of running, (i.e. the rail end is not being struck by wheel flanges), then rectify within 72 hours				

	Maximum permitted value for track category			Minimum action	Notes
	Standard	A - C	D		
<p>2.2.4 Lateral position of running edge</p> <p>Maximum permitted deviation from engineer's marked lateral position, provided that the geometric Maximum permitted values are not exceeded.</p> <p>At platforms and other locations where track position is limited by clearance requirements or where a standard concession has been granted, the effects of standard S1156 must be considered when determining the actual track geometry which can be applied.</p>	Open sections.				
	SS	±15	±25	Inspect and rectify within 1 week	
	ML	±11	±20	Inspect and rectify within 8 weeks	
	MT	±10	±15	Plan maintenance if required.	
	Sub-surface sections.				
	SS	±15	±25	Inspect and rectify within 1 week	
	ML	±10	±20	Inspect and rectify within 8 weeks	
	MT	±9	±15	Plan maintenance if required.	
	Tube sections (except Central line)				
	SS	±13	N/A	Inspect and rectify within 1 week	
	ML	±10	N/A	Inspect and rectify within 8 weeks	
	MT	±8	N/A	Plan maintenance if required .	
	Tube sections (Central line)				
	Refer to S1156				

2.3 Cross level (cant)

	Maximum permitted value for track category			Minimum action	Notes
	Standard	A - C	D		
<p>Maximum permitted deviation from marked cant averaged over 5 sleepers.</p> <p>Note that variation in cross level must meet the standards for two-metre twist (see 3.3 Table 1.4 and 3.6.2 Table 1.4) and ten-metre twist (see 3.3 Table 1.5, and 3.3 Table 1.5).</p> <p>At platforms and other locations where track position is limited by clearance requirements or where a standard concession has been granted, the effects of the clearance standard S1156 must be considered when determining the actual track geometry which can be applied.</p>	Open and sub-surface sections				
	SS	±30	±50	Inspect and rectify within 1 week	
	ML	±15	±20	Inspect and rectify within 8 weeks	
	MT	±10	±20	Plan maintenance if required	
	Tube sections (Except Central Line Tubes)				
	Maximum permitted deviation from marked cant				
	SS	-15 +10	N/A	Inspect and rectify within 1 week	(1)
	ML	-12 +10	N/A	Inspect and rectify within 8 weeks	(2)
	MT	-10 +8	N/A	Plan maintenance if required	(3)
	(1) ±15 on straight track (2) ±12 on straight track (3) ±10 on straight track				
	Tube sections (Central Line)				
	Refer to S1156				

2.4 Twist 2 metre base (cross level variation)

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
The maximum permitted values of twist on a 2-metre base Voids should be measured where possible or estimated and included in the twist calculation. See 3.3 Table 1.4 for method of measurement.	All lines			
	SS	18	Rectify within 24 hours.	All
	ML	15	Check and rectify within 8 weeks	All
	MT	12	Plan maintenance if required	All
	(1) If 2 metre twist is over 22 mm for defined areas^ impose 10 mph speed restriction and correct within 24 hours (2) If 2 metre twist is over 22 mm for non-defined areas^ Notify TransPlant and Technical Delegated Authority for Track Recording and Analysis to impose stock specific restrictions on specific wheel loading intolerant Engineer's vehicles until rectified and rectify within 24 hours or TANC. (3) If 2 metre twist is over 30 mm for non-defined areas^ impose 10 mph speed restriction and correct within 24 hours. (4) Any faults no greater than 25 mm for non-defined areas^ reported prior to 31 March 2023 can be eligible to be treated, subject to risk assessment, as a registered condition and managed by the Registered condition process until 31 May 2024. (5) In Night Tube areas emergency access may be required.			
	The defined areas^: (1) Bakerloo Line (2) Central Line and Waterloo & City Line (3) District Line – East Putney to Wimbledon, Acton Town to Ealing Broadway (4) Piccadilly Line (5) Metropolitan Line – Rayners Lane to Uxbridge ^Areas where 24 Tube Stock will run plus East Putney to Wimbledon			

2.5 Twist 10 metre base (cross level variation)

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
2.5.1 10 metre twist, ballasted track The maximum permitted values of twist on a 10 metre base. Voids should be measured where possible or estimated and included in the twist calculation. See 3.3 Table 1.5 for method of measurement.	SS	40 (1 in 250)	Inspect within 24 hours, rectify within a further 72 hours	(1)
	ML	33 (1 in 300)	Inspect and rectify within 8 weeks	
	MT	30 (1 in 333)	Plan maintenance if required	
	(1) If 10 metre twist is over 50 mm impose 10 mph speed restriction and correct within 24 hours.			

2.5.2 10 metre twist, concrete track The maximum permitted values of the twist on a 10 metre base. Voids should be measured where possible or estimated and included in the twist calculation. See 3.3 Table 1.5 for method of measurement.	SS	40 (1 in 250)	Inspect within 24 hours, rectify within a further 72 hours	(1)
	ML	37 (1 in 270)	Inspect and rectify within 8 weeks	
	MT	35 (1 in 286)	Plan maintenance if required	
	(1) If 10 metre twist is over 50 mm impose 10 mph speed restriction and correct within 24 hours.			

3 Gauge

3.1 Running rail – gauge, plain line (see Table 13.1 for junctionwork)

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
3.1.1 Running rail – nominal static gauge (1435 or 1432) The maximum and minimum permitted running rail nominal gauge 1435 or 1432 permitted on plain line track. The Nominal gauge for running lines and sidings, without gauge widening is 1435mm. A 1432mm nominal gauge applies for legacy Tube (Bull head and Flatbottom) and Open/Subsurface Bullhead track forms with radius >399m. For details on gauge widening see S1157 and table 3.1.2 for limits on gauge widening below. The gauge is measured at points 14mm below the top surface of the running rails.	SS	Max 1465mm	Immediately Stop traffic until rectified	(5)
	SS	Max 1457mm Min 1420mm	Correct within 1 week	All
	ML	Max 1452mm Min 1422mm	Monitor and correct within 6 months	All
	MT	Max 1441mm Min 1424mm	Monitor gauge	All
Notes: (1) When rectifying always check what correct design gauge should be. (2) 5mm allowance for deflection under loading has been applied to permitted values. (3) Any signs of movement of chair/baseplate shuffle should be considered and if measurable added to the static measurement and compare to maximum values above. (4) Any lipping or irregularities that prevent the track measurement being taken accurately should be considered and added to the measured gauge (5) SS dynamic gauge stop traffic limit is defined in 3.4 Table 1.7.				

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
3.1.2 Running rail – Designed gauge widened The maximum permitted deviations from the designed widened gauge. For details on gauge widening see S1157. The gauge is measured at points 14mm below the running surface of the rails. Track measuring gauges normally allow for this, but due allowance must be made for any irregularities e.g. lipping of the running face which would affect the measurement.	SS	Max 1465mm	Immediately Stop traffic until rectified	(5)
	SS	-15, +22	Correct within 1 week	(1) (2) (3) (6)
	ML	-10, +17	Monitor and correct within 6 months	(2)(7)
	MT	-8, +6	Monitor gauge	(3)(7)
Notes: (1) When rectifying always check what correct design gauge should be. (2) 5mm allowance for deflection under loading has been applied to permitted values. (3) Any signs of movement of chair/baseplate shuffle should be considered and if measurable added to the static measurement and compare to maximum values above. (4) Any lipping or irregularities that prevent the track measurement being taken accurately should be considered and added to the measured gauge. (5) SS dynamic gauge stop traffic limit is defined in 3.4 Table 1.7. (6) If designed gauge widened to 1441mm or above the upper limits must be reduced to limit gauge to 1464 mm for SS (7) If designed gauge widened to 1441mm or above and 1463 for ML and 1462 for MT.				

3.2 Running rail – variation in gauge					
	Maximum permitted value for track category			Minimum action	Notes
	Standard	A - C	D		
Maximum permitted variation in gauge over 1m.	SS	5	5	Check and rectify within 2 weeks	
	ML	2	3	Check and rectify within 4 weeks	



4 Rail condition

4.1 Running rail - side wear as measured with the head wear and side wear gauge

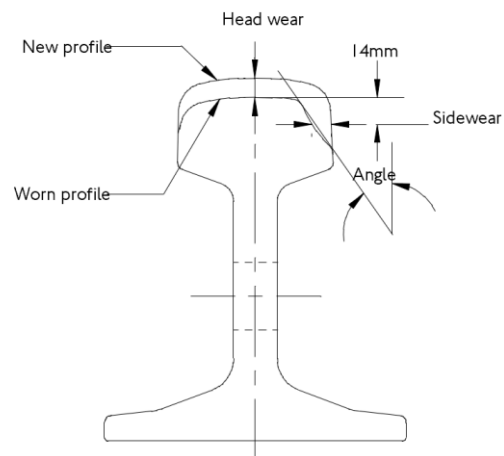
	Standard	Maximum permitted value - all categories										Minimum action	Notes					
		≤1	≤2	≤3	≤4	≤6	≤8	≤10	≤12	≤14	≤16			≤18	≤19			
4.1.1 Running rail - side wear on track used by LU stock only and which is outside fishplate limits Maximum permitted side wear as measured 14mm below the running surface of the rail head. The permitted sidewear is a function of the headwear with reference to the profile of a new rail. Applies to track used by LU stock only which is outside of ±1.5 metres of the centreline of a rail joint.	Headwear mm																	
	SS	11	10	9.5	9	8	7	6	5	3	2	1	0			Replace/turn or transpose rail within 1 week	(1)	
	ML	9	8	8	7	6	5	4	3	2	1	0	0			Plan replacement depending on rate of wear and reassess at a minimum of 12 months	(1)	
	MT	7	6	6	5	4	3	2	2	1	0	0	0			Monitor to determine rate of wear	(1)	

(1) Transposed rails relocated as high rails in curves are not permitted with field side sidewear, see S1157 for restrictions on turning or transposing rail.

Rate of change of sidewear. Maximum permitted decrease of side wear over a distance of 3 metres	SS	6mm	Impose a 10mph speed restriction and grind to provide longer transitions within 1 week
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Rate of change of sidewear. Maximum permitted decrease of side wear over a distance of 1.5 metres	SS	3mm	Impose a 10mph speed restriction and grind to provide longer transitions within 1 week
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Running rail - side wear diagram



	Standard	Maximum permitted value - all categories										Minimum action	Notes
		≤ 1	≤ 2	≤ 3	≤ 4	≤ 6	≤ 8	≤ 10	≤ 11	> 11			
4.1.2 Running rail - side wear at fishplates or on track used by TOC stock Maximum permitted side wear as measured 14mm below the running surface of the rail head. The permitted side wear is a function of the headwear with reference to the profile of a new rail. Applies within fishplate limits i.e. ±1.5 metres of the centreline of the joint, or on track used by TOC stock.	Headwear mm												
	SS	11	8	7	6	5	4	3	1	0	Replace/turn or transpose rail within 1 week	(1) (2)	
	ML	8	6	5	4	3	2	1	0	0	Plan replacement depending on rate of wear and reassess at a minimum of 12months	(1)	
	MT	6	4	3	2	1.5	1	0	0	0	Monitor to determine rate of wear	(1)	
(1) Transposed rails relocated as high rails in curves are not permitted with field side sidewear, see S1157 for restrictions on turning or transposing rail.													
Rate of change of sidewear. Maximum permitted decrease of side wear over a distance of 3 metres	SS	6mm (over a distance of 1.5 metres the maximum permitted decrease of side wear shall be 3mm)										Impose a 10mph speed restriction and grind to provide longer transitions within 1 week	
Rate of change of sidewear. Maximum permitted decrease of side wear over a distance of 1.5 metres	SS	3mm										Impose a 10mph speed restriction and grind to provide longer transitions within 1 week	

4.2 Running rail – Stock Rails (at switch tips) – Side wear as measured with ‘go/ no-go

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
Maximum permitted side wear on running edge. Measured with standard side cut ‘go/no-go’ gauge. Limiting values in mm of clearance between the ‘go/no-go’ gauge and web of rail. Note: currently this gauge should only be used to measure stock rail wear at switch tips; see Handbook 4 for method of use.	SS	0	Replace/turn or transpose rail within 1 week	(1)
	(1) See S1157 for restrictions on turning or transposing rail.			
	ML	3	Plan replacement depending on rate of wear and reassess at a minimum of 12months	
	MT	5	Monitor to determine rate of wear	

4.3 Running rail – chair gall

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
Maximum permitted depth of chair gall on the underside of the rail.	SS	3	Replace rail within 4 weeks	(1)
	ML	2	Plan to replace within 6 months depending on rate of development	
	MT	1	Monitor every 6 months and plan replacement	
	(1) Impose a 20mph speed restriction if the gall is extensive >5.			



4.4 Running rail – headwear as measured with the headwear and sidewear gauge

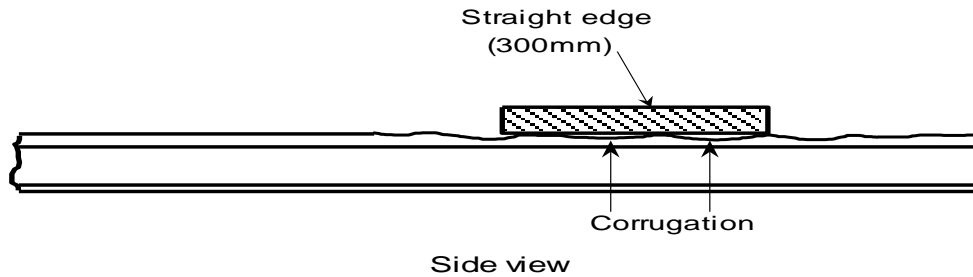
	Standard	Maximum permitted value - all categories											Minimum action	Notes	
4.4.1 Running rail - headwear on track used by LU stock only and which is outside fishplate limits Maximum permitted head wear permitted (excluding rail gall) based on a nominal rail depth of 145mm for 95RBH rail and 159mm for 56E1 (BS113A) FB rail. The permitted headwear is a function of the sidewear (see also 3.3 Table 4.1.1). Applies to track used by LU stock only, which is outside of ±1.5 metres of the centre line of a rail joint.	Sidewear mm	0	≤1	≤2	≤3	≤4	≤5	≤6	≤7	≤8	≤9	≤10	≤11		
	SS	19	18	16	14	13	12	10	8	6	4	2	1	Replace within 4 weeks	
	ML	18	16	14	12	10	8	6	4	2	1	0	0	Plan to replace within 6 months depending on rate of wear	
	MT	16	14	12	8	6	4	3	1	0	0	0	0	Monitor every 6 months to establish rate of wear	

	Standard	Maximum permitted value - all categories											Minimum action	Notes	
4.4.2 Running rail - headwear at fishplates or on track used by TOC stock Maximum permitted head wear (excluding rail gall) based on a nominal rail depth of 145mm for 95RBH rail and 159mm for 56E1 (BS113A) FB rail. The permitted headwear is a function of the sidewear (see also 3.3 Table 4.1.2). Applies within fishplate limits i.e. ±1.5 metres of the centreline of the joint, or on track used by TOC stock.	Sidewear mm	≤0	≤1	≤2	≤3	≤4	≤5	≤6	≤7	≤8	≤10	≤11			
	SS	14	11	10.5	10	8	6	4	3	2	1.5	1	1	Replace within 4 weeks	
	ML	12	10	8	6	4	3	2	1.5	1	0	0	0	Plan to replace within 6 months depending on rate of wear	
	MT	10	8	4	3	2	1.5	1	0	0	0	0	0	Monitor every 6 months to establish rate of wear	

4.5 Corrugations (long wavelength > 100 mm pitch)

	Maximum permitted value for track category			Minimum action	Notes
	Standard	A - C	D		
Maximum permitted depth of corrugation in mm measured using a feeler gauge and 300 mm straightedge or other suitable gauge.	ML	0.40	0.45	Check and rectify within 6 months	
	MT	0.35	0.40	Plan maintenance if required	

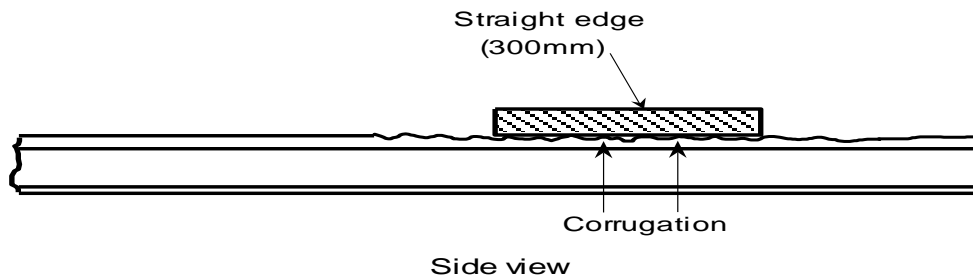
Rail corrugation



4.6 Corrugations (short wavelengths - 20 mm to 100 mm)

	Maximum permitted value for track category			Minimum action	Notes
	Standard	A - C	D		
Maximum permitted depth of corrugation in mm between 20 and 100 mm pitch, using a feeler or other suitable gauge to measure the gap between the rail head and a 300 mm long straightedge.	ML	0.08	0.15	Grind within 8 weeks	(1)
	(1) Damage and nuisance will occur				

Rail corrugation



5 Rail joints
(see also tables 2.1.3, 2.1.4, 2.1.5)

Bolted rail joints are a structural weakness in the rail. Poor or deteriorating joint profile will lead to increased loading on all track components at a joint. For this reason it is a general requirement to reduce the number of rail joints in the track whenever a suitable opportunity arises, and, where practicable, to eliminate them completely. Unless part of a formally reviewed and authorised design, it is not permitted to cut in additional permanent rail joints in conjunction with rail defect removal or other track work. Joints made temporarily to return track into operation must be removed and replaced with plain rail or a rail weld at an early opportunity.

Particular care and attention must be paid to defect assessment, mitigation, and prioritisation where one or more track twist faults is present in combination with poor track support conditions, especially around rail joints.

5.1 Assembly – all plated joints

	Condition to be rectified for track category			Minimum action	Notes
	Standard	A - C	D		
Incomplete assemblies, e.g. with defective or missing bolts. Maximum permitted number per 100-metre length of track (both rails).	SS	2	6	Rectify within 7 days	(1)
Note: All individual joints must meet the tolerances in 3.4 - Tables 5.2.1 & 5.2.2	(1) For insulated joints; any end posts split, damaged or broken shall be replaced or repaired using an approved process within 2 weeks. Information on an approved repair process can be found in APR item 2729				

5.2 Bolt assembly – all plated joints

	Condition to be rectified for track category		Minimum action	Notes
	Standard	A-C		
5.2.1 Bolt assembly – single joints. Category A- C Maximum permitted number of missing, broken, seized, defective or loose bolts in any <u>one</u> rail joint.	SS	2	If rail gap >50mm – Stop Traffic, rectify before resumption. If both within one rail end impose 10mph TSR (20mph with clamps)	(1) (2)
Note: Single joints for Cat A-C track must be assessed against Section 3.4 - Table 5.2.1. and in addition, when joints are present as a pair, all must meet the tolerances in Section 3.4 - Table 5.2.3.	SS	2	Tighten all bolts immediately if possible. Rectify all broken or missing bolts within 24 hours. Rectify all loose or seized bolts within 72 hours.	(1) (2)
	ML	1	Tighten all bolts immediately if possible. Rectify all broken or missing bolts within 7 days. Rectify all loose or seized bolts within 4 weeks.	(1) (2)



- (1) In Night Tube areas emergency access may be required
 (2) If a bolt cannot be installed in Cat A/B/C track, fit a rail clamp at the bolt position

	Condition to be rectified for track category		Minimum action	Notes
	Standard	D		
5.2.2 Bolt assembly – single joints – Category D Maximum permitted number of missing, broken, seized, defective or loose bolts in any <u>one</u> rail joint. Note: Single joints for Cat D track must be assessed against Section 3.4 - Table 5.2.1. and in addition, when joints are present as a pair, all must meet the tolerances in Section 3.4 - Table 5.2.3.	SS	2	If rail gap >50mm – Stop Traffic, rectify before resumption. If both within one rail end impose 10mph TSR (20mph with clamps)	(1)
	SS	2	Tighten all bolts immediately if possible. Rectify all broken or missing bolts within 48 hours. Rectify all loose or seized bolts within 72 hours.	(1)
	ML	1	Tighten all bolts immediately if possible. Rectify all broken or missing bolts within 7 days. Rectify all loose or seized bolts within 4 weeks.	(1)
(1) In Cat D track any bolt missing as a result of a misaligned hole counts towards the Maximum permitted values but as long as there is no more than one per joint it need not be rectified				

	Condition to be rectified for track category		Minimum action	Notes
	Standard	C		
5.2.3 Bolt assembly – pair of joints– Category A-C Maximum permitted number of missing, broken, seized, defective or loose bolts in any one <u>pair</u> of opposite (in the same bed) rail joints. Note: Single joints for Cat A-C track must be assessed against Section 3.4 - Table 5.2.1. and in addition, when joints are present as a pair, all must meet the tolerances in Section 3.4 - Table 5.2.3.	SS	2	Tighten all bolts immediately if possible. Rectify all broken or missing bolts within 24 hours. Rectify all loose or seized bolts within 72 hours.	(1) (2)
	ML	1	Tighten all bolts immediately if possible. Rectify all broken or missing bolts within 7 days. Rectify all loose or seized bolts within 4 weeks.	(1) (2)
(1) In Night Tube areas emergency access may be required (2) If a bolt cannot be installed in Cat A/B/C track, fit a rail clamp at the bolt position				

	Condition to be rectified for track category		Minimum action	Notes
	Standard	D		
5.2.4 Bolt assembly – pairs of joints – Category D Maximum permitted number of missing, broken, seized, defective or loose bolts in any one pair of opposite (in the same bed) rail joints.. Note: Single joints for Cat D track must be assessed against Section 3.4 - Table 5.2.1. and in addition, when joints are present as a pair, all must meet the tolerances in Section 3.4 - Table 5.2.3.	SS	2	Tighten all bolts immediately if possible. Rectify all broken or missing bolts within 48 hours. Rectify all loose or seized bolts within 72 hours.	(1)
	ML	1	Tighten all bolts immediately if possible. Rectify all broken or missing bolts within 7 days. Rectify all loose or seized bolts within 4 weeks	(1)

(1) In Cat D track any bolt missing as a result of a misaligned hole counts towards the Maximum permitted values but as long as there is no more than one per joint it need not be rectified

5.3 Bolt security – all plated joints

	Maximum permitted value for track category			Minimum action	Notes
	Standard	A - C	D		
Number of bolts not tightened in accordance with the engineering standards ((see 3.4 Tables 5.4.1 - 5.2.4, 5.5 and 5.6), cracked, bent or otherwise defective or the incorrect type installed: maximum permitted number per 100 metre length of track (both rails). See section 3.4 Tables 5.2.1 - 5.2.4	ML	4	8	Rectify within 2 weeks	
	MT	2	4	Rectify within 8 weeks in accordance with S1158.	

5.4 Bolt tightness

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
5.4.1 Bolt tightness - fishplated joints (non-insulated) Maximum permitted deviation in Nm from the required torque of 270Nm.	ML	±30	Rectify within one week in accordance with S1158.	
See note in 3.4 Tables 5.2.1 & 5.2.2				

5.4.2 Bolt tightness - tight joints Maximum permitted deviation in Nm from the required torque of 1300Nm.	ML	-0 +50	Rectify within one week.	
See note in 3.4 Tables 5.2.1 & 5.2.2				

5.4.3 Bolt tightness - insulated joints (all types) Maximum permitted deviation in Nm from the torque shown.	ML	-0 +50	Rectify within one week in accordance with S1158.	(1)
(1) Glued joints generally use multi-groove locking pins. Where bolts are used, they shall be torqued to 1020Nm. Bolts in Tenconi running rail joints shall be torqued to 1200Nm. Bolts in Tenconi 33C1 check rail joints shall be torqued to 520Nm. Bolts in Tenconi flat-bottom and bullhead check & runner rail joints shall be torqued to 950Nm, with the exception of the Orange runner joint which shall be torqued to 1200Nm.				

5.4.4 Bolt tightness - elsewhere Maximum permitted deviation in Nm from the required torques, which are shown below.	ML	± 30	Rectify within one week	
Black bolts for slide chairs, crossings, and switch blocks			475 Nm	(350 lb-ft)
High tensile steel fishbolts and steel transfer block bolts		25mm dia	880 Nm	(650 lb-ft)
		29mm dia	1020 Nm	(750 lb-ft)
High tensile steel slide chair or baseplate bolts		25mm dia	880 Nm	(650 lb-ft)
		29mm dia	1070 Nm	(790 lb-ft)

5.5 Fishplates - all plated joints

	Condition to be rectified for track category		Minimum action	Notes
	Standard	All categories		
Cracked or broken fishplates.	SS	Both fishplates in joint	Impose 10 mph speed restriction and replace both fishplates within 24 hours.	(1) (2)
	SS	One fishplate in joint	Replace both fishplates within 24 hours.	(2) (3)
(1) Stop traffic if gap is greater than 50mm. (2) In Night Tube areas emergency access may be required. (3) 72 hours for category D track				

5.6 Rail expansion gaps

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
5.6.1 Short rail gap - all plated joints The maximum permitted deviation from the calculated average gap (averaged over the total rail length) shall be: The required gap in short rail track shall be calculated as in the table below.	SS	The average gap shall not fall below that calculated using the table below	Regulate gaps before hot weather	(1) (2)
	ML	+6	Regulate gaps before end of hot weather period	
		+4	Regulate gaps before December.	
(1) A rapid rise in temperature can occur in February, therefore work should be carried out before this date. (2) See S1177 regarding lubrication, consecutive closed joints, sleeper squareness, joint condition, and consolidation				

Expansion allowance - sum of rail gaps mm

For 18.3m or 13.7m rails the total allowance shall be as shown. This assumes that the full length of each rail is free to expand and contract.

For 36.6m rails the total allowance shown shall be halved unless the rails are free to move over their full length (e.g. if fitted with Panlock or wood keys).

Track length (metres)	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400
-10°C	11	21	32	42	53	63	74	84	95	105	116	126	137	148	158	169	179	190	200	211
0°C	9	17	26	35	44	52	61	70	79	87	96	105	114	122	131	140	149	157	166	175
10°C	6	13	19	26	32	39	45	52	58	64	71	77	84	90	97	103	109	116	122	129
20°C	4	8	12	17	21	25	29	33	37	41	46	50	54	58	62	66	70	75	79	83
30°C	2	4	6	7	9	11	13	15	17	18	20	22	24	26	28	29	31	33	35	37

5.6.2 Long rail gap - plated joints The maximum permitted gap in plated joints in <ul style="list-style-type: none"> long welded rail long rails in areas of the network where thermal effects are insignificant (rail temperature range not more than 20C) 	SS	10	Replace with tight joint within 72 hours	(1)
	ML	7	Replace with tight joint within 2 weeks	(1)
	(1) Or weld the joint in accordance with the "previously-bolted joint" criteria in standard S1157, or replace it with a welded closure rail.			

5.7 Rail joint position

	Maximum permitted value for track category			Minimum action	Notes
	Standard	A - C	D		
5.7.1 Plated joints - sleeper distance					
The maximum permitted variance in position for joints normally located centrally between sleepers on straight track.	MT	± 100	± 100		
The maximum permitted variance in position for joints normally located centrally between sleepers on curved track.	MT	± 100	± 100		

5.7.2 Plated joints - stagger					
The maximum permitted longitudinal stagger of opposite fishplated rail joints on straight track.	MT	50	100		(1)
	(1) If staggered joints are unavoidable the minimum longitudinal stagger shall be as in S1157.				
The maximum permitted longitudinal stagger of opposite fishplated rail joints on curved track.	MT	100	100		(1)
	(1) If staggered joints are unavoidable the minimum longitudinal stagger shall be as in S1157.				

5.7.3 Welded joints - longitudinal positioning					
The minimum distance from the welded joint to an assembled chair or baseplate or pandrol housing.	MT	75	75		(1)
	(1) If due to the staging of deep tube track renewals or rerailing where FB rail and new baseplates only are installed, complying with this clause is not practicable a flash butt weld is permitted to be closer than this if:				
	a) the underside of the foot (FB) is fully ground flush to the rail profile, and is painted white with a brush on both sides of the weld. (to be clear of the weld fusion faces by approximately 75mm) to highlight the weld to Track inspection staff (S1157 3.8.2.3).				
	b) Where flash butt welds fall on FB baseplates or between pandrol housings on concrete sleepers and bearers, Rail pads are to be used.				

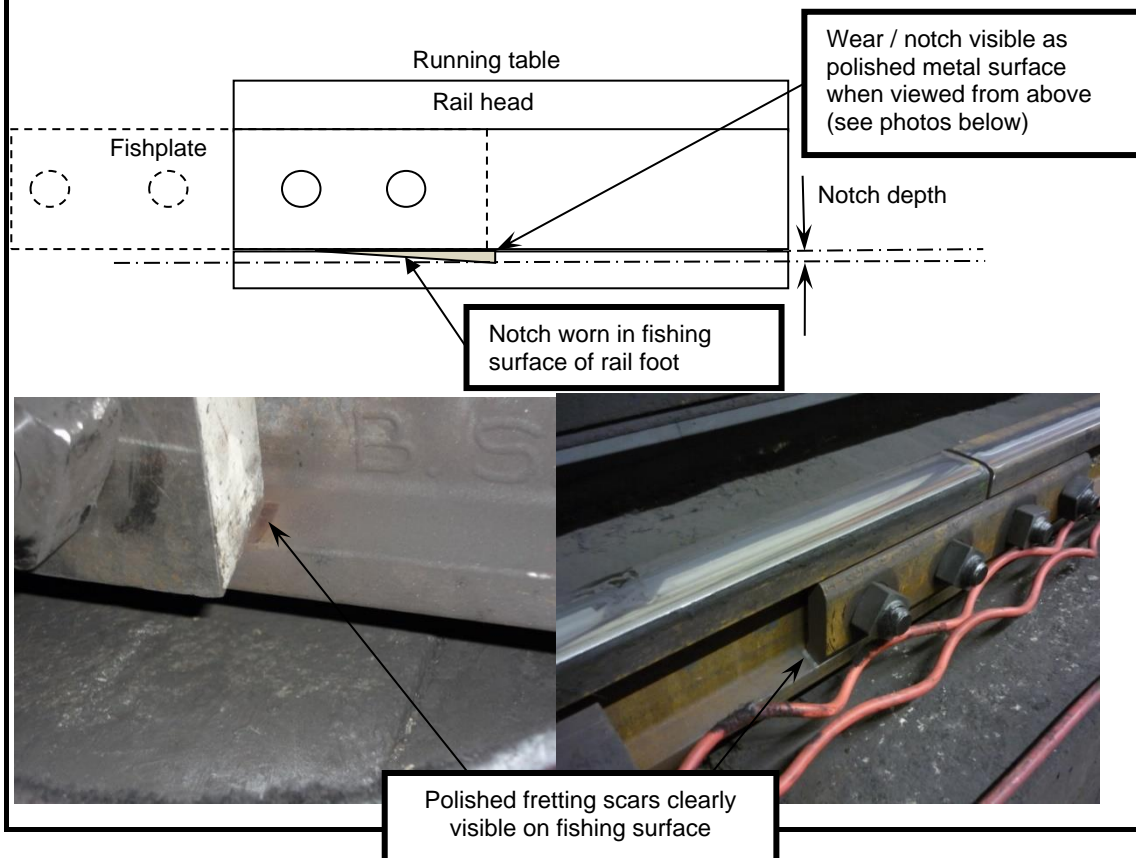
5.8 Rail foot wear at fishing surface (Fishplate Fretting): Rail Condition / Notch Depth

	Condition to be rectified for track category			Minimum action	Notes
	Standard	A - C	D		
Notch depth (mm) exceeds:	SS	1	-	Eliminate or replace joint, with replacement of affected rail(s), within 4 weeks. If fault is not corrected within this timescale, apply 20mph TSR to limit further fatigue damage.	(1) (2) (3)
	ML	0.5	-	Eliminate or replace joint, with replacement of affected rail(s), within 13 weeks.	
Evidence of wear-inducing movement (visible polished surface and/or notch with depth less than 0.5mm)	MT	<0.5	-	a) Record joint on defect register. b) Monitor notch depth during Measured Inspections (PM3 or equivalent). c) Investigate cause of wear (movement under traffic) and eliminate or limit. d) Where movement and wear cannot be limited, consider elimination or replacement of joint.	

Notes:

- (1) See diagram below for notch detail.
- (2) Measure notch depth with feeler gauge.
- (3) Any gap between the top of the fishplate and the upper fishing surface of the rail should also be measured with the feeler gauge. A gap here may be a precursor to notching of the lower fishing surface of the rail.

Diagram and illustrations of Rail Foot Wear at Fishing Surface (Fishplate Fretting)



6 Track fastenings

Particular care and attention must be paid to defect assessment, mitigation, and prioritisation where one or more track gauge faults is present in combination with rail fastenings that are missing or in poor condition.

6.1 Running rail support - baseplates and chairs

	Condition to be rectified for track category			Minimum action	Notes
	Standard	A - C	D		
Any isolated baseplates/chairs missing, non-supporting, defective, cracked or broken	SS	1	1	Missing or non-supporting - Rectify within 24 hours. Defective, cracked, or broken– Rectify within 13 weeks.	All
Maximum permitted number of baseplates/chairs missing, non-supporting, defective, cracked or broken in one rail in a group of 5 sleepers.	SS	4	4	Missing or non-supporting - Rectify within 24 hours. Defective, cracked, or broken– Rectify within 4 weeks.	All
	ML	3	3	Rectify within 8 weeks	All
Maximum permitted number of baseplates/chairs missing, non-supporting, defective, cracked or broken in one rail in consecutive sleepers	SS	3	3	Missing or non-supporting - Rectify within 24 hours. Defective, cracked, or broken– Rectify within 4 weeks.	All
Maximum permitted number of baseplates/chairs defective, cracked or broken adjacent to a joint	SS	1	1	Defective, cracked, or broken– Rectify within 4 weeks.	All
Maximum permitted number of baseplates/chairs missing, non-supporting, defective, cracked or broken per 100 metres of track.	SS	30	50	Missing or non-supporting - Rectify within 24 hours. Defective, cracked, or broken– Rectify within 4 weeks	All
	ML	15	25	Rectify within 8 weeks	All
	MT	7	15	Plan replacement	All

- (1) Defects include wear, e.g. fretting from clips on baseplate housings, and on chair jaws such that keys cannot be retained securely
- (2) In junctionwork the following conditions shall be rectified within 24 hours (In Night Tube areas emergency access may be required):
- a) any grouping of 3 within the A, B, C, X, Y, Z baseplate/chair positions or in the stock and switch layout
 - b) consecutive defective baseplates or chairs on one rail
 - c) any missing baseplates or chairs
 - d) if any of the conditions in Tables 13.4.5, 13.5.1 or 13.7.2 are also identified.
- (3) In the case of baseplates with four Pandrol housings, if the only defect relates to the housings the baseplate need not be replaced as long as two diagonally-disposed housings are fully effective



6.2 Pandrol housings (concrete sleeper)

	Condition to be rectified for track category			Minimum action	Notes
	Standard	A - C	D		
Maximum permitted number of sleepers in a group of 5 with missing or defective housings in one rail.	SS	4	4	Rectify within 4 weeks	(1) (2)
	ML	3	3	Rectify within 8 weeks	(1) (2)
Maximum permitted number of Pandrol housings defective, cracked or broken per 100 metres of track.	SS	40	60	Rectify within 4 weeks	(1) (2)
	ML	20	30	Rectify within 8 weeks	(1) (2)
	MT	10	15	Plan refurbishment.	(1) (2)
(1) Count 3 consecutive sleepers with missing or defective housings as an SS fault (2) Count missing or defective housings at a joint as an SS fault					

6.3 Chair screws, spikes, bushes

	Condition to be rectified for track category			Minimum action	Notes
	Standard	A - C	D		
Maximum permitted number of screwspikes/bushes or rail pads missing, defective, or not secure per 5 adjacent chairs or baseplates on one rail.	SS	8	10	Rectify within 1 week.	All
	ML	4	4	Rectify within 4 weeks.	All
Maximum permitted number of screwspikes/bushes or rail pads missing, defective, or not secure in consecutive sleepers on one rail.	SS	3	3	Rectify within 24 hours.	All
Maximum permitted number of screwspikes/bushes or rail pads missing, defective, or not secure adjacent to a joint	SS	1	1	Rectify within 1 week	All
Maximum permitted number of screwspikes/bushes or rail pads missing, defective, or not secure per 100 metres of track.	SS	60	80	Rectify within 4 weeks	All
	ML	30	40	Rectify within 8 weeks	All
	MT	15	20	Plan to rectify within 12 months	All
(1) The numbers shown are for the listed components together, not separately (2) In direct-fix assemblies, investigate defective baseplate securing screws for signs of cascade failure (3) In junctionwork the following conditions shall be treated as a SS fault and rectified within 24 hours (in Night Tube areas emergency access may be required): a) any missing, defective or insecure screwspikes, ferrules, bushes or rail pads within the A, B, C, X, Y, Z baseplate/chair positions or in the stock and switch layout b) more than 2 loose fixings on any one baseplate or chair c) if any of the conditions in Tables 13.4.5, 13.5.1 or 13.7.2 are also identified.					
Note: Certain additions are permitted to these quantities – see S1179 Table 6.3					

6.4 Keys, clips

	Condition to be rectified for track category			Minimum action	Notes
	Standard	A - C	D		
6.4.1 Keys (wood, steel or Panlock) - applies also to check rails					
Maximum permitted number of keys missing, defective, or not secure per 5 adjacent sleepers on one rail	SS	3	3	Rectify within 1 week	All
	ML	2	2	Rectify within 2 weeks	All
	MT	1	1	Rectify within 12 months	All
Maximum permitted number of keys missing, defective, or not secure in consecutive sleepers on one rail.	SS	3	3	Rectify within 1 week	All
Maximum permitted number of keys missing, defective, or not secure adjacent to a joint.	SS	1	1	Rectify within 1 week	All
Maximum permitted number of keys missing, defective, or not secure at a tripcock location	SS	1	1	Rectify within 24 hours	All
Maximum permitted number of keys missing, defective, or not secure per 100 metres of track.	SS	20	30	Rectify within 4 weeks	All
	ML	10	15	Rectify within 8 weeks	All
	MT	5	7	Plan to rectify within 12 months	
(1) If conditions in Tables 6.1, 6.2 or 6.3 are also identified, action within 24 hours (in Night Tube areas emergency access may be required) (2) In junctionwork the following conditions shall be rectified within 24 hours (in Night Tube areas emergency access may be required): a) any missing, defective keys within the A, B, C, X, Y, Z baseplate/chair positions or in the stock and switch layout b) if 25% of keys within the junctionwork unit are missing or loose c) if any of the conditions in Tables 13.4.5, 13.5.1 or 13.7.2 are also identified. (3) At the location of an axle counter, keys are to be inserted into the adjacent chairs from the beds outside the bed in which the axle counter is located, i.e. the keys must be driven towards the axle counter. (4) At a tripcock site only Panlock keys or wooden keys secured by nails at each end shall be used (wooden keys secured by nails are preferred).					

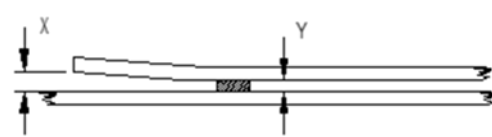
	Maximum permitted value for track category			Minimum action	Notes
	Standard	A - C	D		
6.4.2 Mixed keys					
Maximum permitted number of steel keys in a wood key site or vice versa per 100 metres of track section.	ML	8	16	Rectify within 8 weeks	
	MT	4	8	Plan to rectify within 12 months	

	Maximum permitted value for track category			Minimum action	Notes
	Standard	A - C	D		
6.4.3 Resilient flat-bottom clips, clip insulators					
Maximum permitted number of clips or insulators missing, defective, or not secure per 5 adjacent baseplates on one rail.	SS	4	5	Rectify within 1 week	All
	ML	2	3	Rectify within 2 weeks	All
	MT	1	2	Plan to rectify within 12 months	All
Maximum permitted number of clips or insulators missing, defective, or not secure in consecutive sleepers on one rail.	SS	3	3	Rectify within 24 hours	All
Maximum permitted number of clips or insulators missing, defective, or not secure adjacent to a joint.	SS	1	1	Rectify within 24 hours	All
Maximum permitted number of clips or insulators missing, defective, or not secure at a tripcock location	SS	1	1	Rectify within 24 hours	All
Maximum permitted number of clips or insulators missing, defective, or not secure per 100 metres of track.	SS	40	60	Rectify within 4 weeks	All
	ML	20	30	Rectify within 8 weeks	All
	MT	10	15	Plan to rectify within 12 months	All
<p>(1) If conditions in Tables 6.1, 6.2 or 6.3 are also identified, action within 24 hours (in Night Tube areas emergency access may be required)</p> <p>(2) In junctionwork the following conditions shall be rectified within 72 hours:</p> <ul style="list-style-type: none"> a) any missing or defective clips or insulators within the A, B, C, X, Y, Z baseplate/chair positions or in the stock and switch layout b) if 25% of clips or insulators within the junctionwork unit are missing or defective c) if any of the conditions in Tables 13.4.5, 13.5.1 or 13.7.2 are also identified. <p>(3) At the location of an axle counter, clips are to be inserted into the adjacent baseplates or housings from the beds outside the bed in which the axle counter is located, i.e. the clips must be driven towards the axle counter. This will require the use of one right-handed and one left-handed clip in the baseplates or housings. This requirement is not applicable to FE clips, as these are driven perpendicular to the rail.</p> <p>(4) in the case of baseplates with four Pandrol housings, the normal number of clips is two</p>					

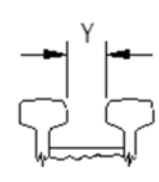
7 Check rail

7.1 Check rail flangeway, plain line (see Table 13.6.2 for junctionwork)

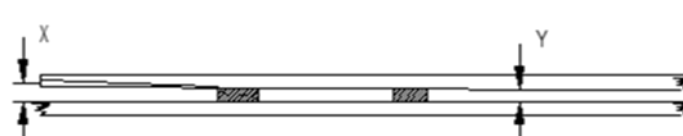
	Maximum permitted value for track category			Minimum action	Notes
	Standard	All categories			
		X value	Y value		
Maximum permitted deviation of the flangeway gap from the nominal dimensions shown in the drawings opposite. "X" is the flare opening. "Y" is the parallel flangeway.	SS	-0	-4, +6	Rectify within 72 hours	(1)
	ML	-0, +5	-3, +5	Rectify within 4 weeks	



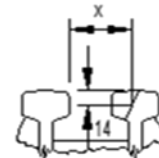
BH standard check rail end



End view



FB and 33C1 standard check rail end



End view

Location of check rail	X value		Y value
	BH	FB, 33C1	
Checked curves less than 200m radius	89mm minimum	75mm minimum	(2)
Cover checks e.g. trip cock tester	89mm minimum	75mm minimum	(3)

(1) No upward Maximum permitted X value applies for SS.
 (2) For nominal value, subtract 1388mm from track gauge shown in S1157 Table 3a for radius concerned.
 (3) For nominal value, subtract 1391mm from track gauge shown in S1157 Table 3a for radius concerned.

7.2 Check rail height, plain line (see Table 13.6.1 for junctionwork)

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
Maximum permitted height of the top surface of the check rail above the adjacent running rail head. (Except where the item for Junctionwork check rails applies for the safe passage of a negative shoe - see 3.3 Table 13.6.1).	SS	-0 +30	Rectify within 72 hours	
	ML	-0 +25	Rectify within 4 weeks	

7.3 Check rail - joint assembly

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
Maximum permitted number of missing or defective bolts per joint.	SS	1	Rectify within 72 hours	

7.4 Check rail - bolt security - plated joints

	Condition to be rectified for track category		Minimum action	Notes
	Standard	All categories		
Maximum permitted number of bolts per joint not tightened in accordance with the Engineer's nominal specified torque of 270Nm (or other relevant specified torque). Note: For Tenconi insulated joints on 33C1 check rail the specified bolt torque is 520Nm.	SS	2	Rectify within 72 hours	
	ML	1	Rectify within 1 week	

7.5 Check rail - Check block assembly - bullhead rail

	Condition to be rectified for track category		Minimum action	Notes
	Standard	All categories		
Incomplete assembly, missing or broken bolts.	SS	1	Rectify within 24 hours	(1) (2)
Loose or seized assembly or bolts	SS	1	Tighten immediately and retorque within 72 hours	(2)
(1) In Night Tube areas emergency access may be required (2) Non-compliant cover-check bolt security at the 'running-on' or 'running-off' ends - 48 hours.				

7.6a Check rails – bolt or clamp security – flat bottom running rail

	Condition to be rectified for track category			Minimum action	Notes
	Standard	A - C	D		
Maximum permitted number of: <ul style="list-style-type: none"> bolts in association with blocks; clamps in association with 33C1 check rail; per 100 metres of track, not tightened in accordance with the engineer's instructions, loose or seized.	SS	4	8	Tighten immediately. Retorque within 72 hours	(1), (2)
	ML	2	4	Rectify within 4 weeks	(1), (2)
	MT	1	2	Rectify within 8 weeks	(1), (2)
(1) Any incidence of loose bolts or clamps at adjacent sleepers shall be treated as SS (2) If bolts or clamps are broken or missing, or loose in end support, rectify within 48 hours					

7.6b Check rails– retaining bolt security – flat bottom running rail (plain line)

	Condition to be rectified for track category			Minimum action	Notes
	Standard	A - C	D		
Maximum permitted number of: <ul style="list-style-type: none"> bolts in association with 33C1 check rail per 100 metres of track, not tightened in accordance with the engineer's instructions	SS	6	12	Tighten immediately. Retorque within 72 hours	(1), (2)
	ML	3	6	Rectify within 4 weeks	(1), (2)
	MT	2	3	Rectify within 8 weeks	(1), (2)
(1) Any incidence of loose bolts at adjacent sleepers shall be treated as SS (2) If bolts are broken or missing, or bolts loose in end support, rectify within 48 hours					

7.6c Check rails (33C1 or other) – bolt security – flat bottom cover checks including junctionwork

	Condition to be rectified for track category		Minimum action	Notes
	Standard	All categories		
Maximum permitted number of: <ul style="list-style-type: none"> bolts in association with blocks; clamps in association with 33C1 check rail; in one cover check rail, not tightened in accordance with the engineer's instructions	SS	2	Rectify within 72 hours	(1), (2)
	ML	1	Rectify within 1 week	(1), (2)
(1) Any incidence of loose bolts at adjacent bearers shall be treated as SS (2) If bolts loose in end support, rectify within 48 hours				

8 Adjustment/expansion switches

8.1 Adjustment/expansion switches - assembly

	Condition to be rectified for track category			Minimum action	Notes
	Standard	A - C	D		
8.1.1 Adjustment switches - assembly Number of defective/missing/loose clamp assemblies or stock rail to chair bolted assemblies.	SS	2	N/A	Rectify within 72 hours	

8.1.2 Expansion switches – assembly (NR scarf type) Number of defect/missing/loose clamp assemblies.	SS	1	N/A	Rectify within 72 hours	
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8.2 Adjustment/expansion switches - bolt security

	Condition to be rectified for track category			Minimum action	Notes
	Standard	A - C	D		
Number of clamp assembly bolts per assembly, not tightened in accordance with the engineer's instructions. See 3.3 Table 5.4.	SS	2	N/A	Rectify within 72 hours	
	ML	1	N/A	Rectify within 8 weeks	

8.3 Adjustment switch to stock rail fit

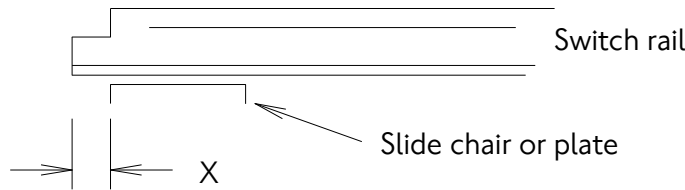
	Condition to be rectified for track category			Minimum action	Notes
	Standard	A - C	D		
Gap between the stock rail and the switch rails measured at the tip.	SS	6	N/A	Rectify within 72 hours	
	ML	4	N/A	Rectify within 8 weeks	
	MT	3	N/A	Plan to rectify	

8.4 Adjustment switch tip (LU switch rail type) - longitudinal position

	Maximum permitted value for track category			Minimum action	Notes
	Standard	A - C	D		

8.4.1 Switch tip overhang Maximum permitted overhang (dimension X) of switch tip beyond the end of slide chair or plate.	Maximum permitted overhang bullhead rail				
	ML	115	N/A	Rectify within 8 weeks	
	Maximum permitted overhang flat bottom rail				
	ML	127	NA	Rectify within 8 weeks	

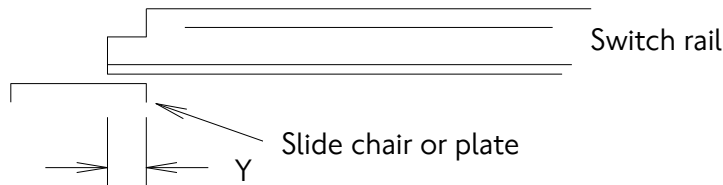
◆ Adjustment switch (LU switch rail type)



Note Design position (dimension Z)		Rail temp (°C)	Dimension Z
		-9 to -4	18
		-4 to zero	15
		zero to 4	13
		4 to 9	10
		9 to 13	8
		13 to 17	5
		17 to 22	3
		22 to 27	nil

8.4.2 Switch tip overlap	SS	30	NA	Rectify within 24 hours	(1)(2)
Minimum overlap (dimension Y) of switch tip with slide chair or plate.	SS	60	NA	Rectify within 48 hours	(2)
	ML	65	NA	Monitor situation. Rectify if necessary	
	(1) When rail temperature is liable to fall below 20C, apply 20mph speed restriction. (2) In Night Tube areas emergency access may be required.				

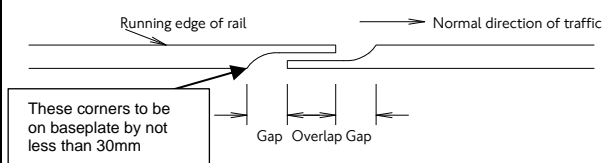
Adjustment switch (LU switch rail type)



8.5 Expansion switch gaps and overlaps (Network Rail scarf type)

	Maximum permitted value for track category					Minimum action	Notes	
	Stand-ard	All categories						
Network Rail scarf joint type Maximum and minimum dimensions Overlaps and Gaps, as shown in diagram below.		Rail temp (°C)	Overlap		Gap			
			Max	Min	Max	Min		
	SS	All temperatures	700	-	-	60	Post watchman. Rectify within 48 hrs. If gap closes completely apply 20mph TSR.	(1)(6)
	ML	-9 to -4	654	630	130	106	Excess overlap: rectify prior to hot weather. Excess gap: rectify prior to cold weather	(1) (2) (3) (4)
		-4 to 0	657	633	127	103		
		0 to 4	659	635	125	101		
		4 to 9	662	638	122	98		
		9 to 13	664	640	120	96		
		13 to 17	667	643	117	93		
		17 to 22	669	645	115	91		
	MT	-9 to -4	651	633	127	109	Monitor site conditions	(3)
		-4 to 0	654	636	124	106		
		0 to 4	656	638	122	104		
		4 to 9	659	641	119	101		
		9 to 13	661	643	117	99		
13 to 17		664	646	114	96			
Network Rail scarf joint type Minimum actions for length of full rail section on baseplate	SS	No part of full rail section supported on baseplate				Investigate cause. Adjust rails or bearer spacing to provide full support, within 7 days	(5)	
	ML	30mm or less				Adjust rails or bearer spacing to provide increased support, within 13 weeks	(5)	
	(1) If end of the expansion switch rail is 60mm or less within the clamp plate, treat as SS. (2) In the event of unexpected high rail temp prior to the hot weather period, i.e. if rail temperature exceeds 35°C, post watchman. (3) Restress if necessary. (4) Excess overlap = insufficient gap; excess gap = insufficient overlap. (5) The spacing between the two bearers supporting the machined rails should be 700mm. (6) In Night Tube areas emergency access may be required.							

Expansion switch (NR scarf joint type)



Rail temp (°C)	Overlap	Gap
-9 to -4	642	118
-4 to 0	645	115
0 to 4	647	113
4 to 9	650	110
9 to 13	652	108
13 to 17	655	105
17 to 22	657	103
22 to 27	660	100

9 Sleepers (to be read as including pitblocks where appropriate)

9.1 Sleeper spacing, plain line (see Table 13.7.1 for junctionwork)

	Maximum permitted value for track category			Minimum action	Notes
	Standard	A - C	D		
Maximum permitted variation from the nominal sleeper spacings shown below.	ML	±100	±150	Inspect and rectify within 8 weeks.	(1)
	MT	±75	±100	Assess risk and plan to rectify if required.	(1)

(1) Reduce each variation by 50mm at 4-hole plated joints. See Note (e) below regarding 6-hole insulated joints.

Track type	Sleeper spacing (mm)						Diagram
	A	B	C	D	E	F	
1. Tube track							
a) Tunnels constructed with 20" Cast Iron segment width	666 +10 - 0	530 +20 - 30	915	1016	333 +10 - 0	Seg joint +/-10	
b) Tunnels constructed with 18" Concrete segment width	666 +10 - 0	530 +20 - 30	915	915	-	-	
2. Open/sub surface track							
a) Short rails	666	660	678	787	-	-	
b) Long rails	666	730	770	770	-	-	
c) CWR	610	610	610	610	-	-	
	See also Note e						

Notes:

- Welded joints are treated as continuous rail.
- Sleeper numbering refers to the installation of 18.288m (60ft) rail length. *Sleeper numbers 10 & 11 will be in adjacent tunnel segments. The sleeper centre spacing dimension will be 508mm.
- Dimensions E and F are measured from the centre of the end post.
- Dimensions applicable to Bull Head and Flat Bottom rail.
- Where six-hole insulated rail joints are used dimension A shall be maintained at:
 - 754 ±5 mm for wood sleepers with Pan 11 baseplates;
 - 630 ±5 mm for concrete sleepers with Pandrol PR or e clips;
 - 610 ±25 mm for concrete sleepers with Pandrol Fastclip.
- In Tube sections the ML and MT Maximum permitted values on sleeper spacings "C" and "D" relate to the values shown, or to any reduced values achieved where spacings have been adjusted in accordance with Table 9.1 in S1179 section 3.3 (sleeper spacings "C" and "D" shall be reduced to not greater than 750mm where track radius is below 400m, and not greater than 550mm where radius is less than 200m)
- When carrying out maintenance activities the sleeper spacing shall be set as per the original design. The design sleeper spacing is to be determined by averaging the sleeper spacing over 11 sleepers (10 beds).
- At the location of an axle counter, the sleeper spacing may be increased to provide space in the ballast bed for the axle counter, up to a maximum spacing of 762mm.

Note regarding direct-fix configuration:

Where direct fix is used rather than sleepers, the rail support spacing shall be selected within the range 500mm to 800mm. The selected spacing shall allow adequate clearance between baseplate anchor bolts and cast-iron tunnel segment flanges and shall be appropriate for six-hole insulated joints if used.

Taken over 100m cells the support spacing shall be generally uniform and subject to the Maximum permitted values shown above. Where site configuration means that variations in sleeper spacing are required, they shall be suitably transitioned to avoid sudden variations in track stiffness.

9.2 Sleeper squareness

	Maximum permitted value for track category			Minimum action	Notes
	Standard	A - C	D		
Maximum permitted deviation of sleeper from square to the running edges of the rail. Measured across the four-foot and not cumulative with Table 9.1.	ML	±75	±75	Inspect and rectify within 8 weeks	(1)
	MT	±40	±50	Assess risk and plan to rectify if required.	
(1) Determine reason for out of squareness.					

9.3 Sleepers – condition, plain line (see Table 13.7 for bearers in junctionwork)

	Maximum permitted value for track category			Minimum action	Notes
	Standard	A - C	D		
9.3.1 Chair or baseplate indentation	SS	10	10	Rectify within 12 weeks	(1)
Maximum permitted depth of indentation of the chair or baseplate into the top surface of an individual sleeper.	ML	6	6	Rectify within 52 weeks	(1)
	MT	3	4	Monitor	
	(1) If chair/baseplate shuffle >5mm is present, replace sleeper. Otherwise packing may be used.				

9.3.2 Redundant screwspike holes	ML	4	4	Rectify holes within 6 months.	(1) (2)
Maximum permitted number of redundant chair screw holes in an individual sleeper which have not been satisfactorily plugged.	(1) Not immediately safety critical but can lead to rapid deterioration. (2) Screwspikes used for lateral restraint to temporarily store rails must be removed when no longer required and the holes plugged.				

9.3.3 Condition of timber sleepers	SS	4	4	Rectify within 2 weeks	
Maximum permitted number of ineffective sleepers in a group of 5.	ML	3	3	Rectify within 8 weeks	
	SS	3	3	Rectify within 2 weeks	
Maximum permitted number of ineffective sleepers in consecutive sleepers.	SS	3	3	Rectify within 2 weeks.	
Maximum permitted number of ineffective sleepers per 100 metres of track. See also S1158 for other condition requirements.	SS	20	45	Rectify within 2 weeks.	
	ML	10	20	Rectify within 8 weeks.	
	MT	5	10	Plan sleeper renewal.	
Note: An ineffective sleeper is defined as either not capable of providing adequate vertical support to the baseplate or rail, or not capable of adequately holding the rails to gauge.					

9.3.4 Condition of concrete sleepers	SS	4	4	Rectify within 2 weeks	
Maximum permitted number of ineffective sleepers in a group of 5.	ML	3	3	Rectify within 8 weeks	
	SS	3	3	Rectify within 2 weeks	
Maximum permitted number of ineffective sleepers in consecutive sleepers.	SS	3	3	Rectify within 2 weeks.	
Maximum permitted number of ineffective sleepers per 100 metres of track.	SS	20	50	Rectify within 2 weeks.	
	ML	10	30	Rectify within 8 weeks.	
	MT	5	15	Plan sleeper renewal.	
Note: An ineffective sleeper is defined as either not capable of providing adequate vertical support to the baseplate or rail, or not capable of adequately holding the rails to gauge.					

10 Ballast

10.1 Ballast level

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
Maximum permitted deviation for individual beds of the top of the ballast or ash bed between sleepers from the upper surface of the sleeper, except where track equipment requires extra clearance.	SS	-100	Rectify within 2 weeks	(1)
	ML	-75	Rectify within 8 weeks	(2)
	MT	-50	Plan to add ballast	(2)
(1) This must be done and consolidated within 24 hours in hot weather on open track. (2) Extra ballast should be added before March.				
Maximum permitted number of consecutive beds with low ballast (75mm from the upper surface of the sleeper).	SS	5	Rectify within 2 weeks	(3)
	ML	2	Rectify within 8 weeks	(2)
(3) This must be done within 24 hours in hot weather.				
Where equipment or materials such as cables are laid along the track, tripping hazards shall be assessed, and the limits shown above adjusted as necessary to maintain risks ALARP.				

10.2 Ballast shoulder profile

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
Maximum permitted deviation of the width or height of the ballast shoulder from that shown in the figure opposite	SS	-150	Rectify within 4 weeks	(1)
	ML	-100	Rectify within 8 weeks	(1) (2)
	MT	- 50	Plan ballast profiling.	
(1) Add ballast within 1 week if hot weather predicted. (2) If height and width of shoulder are out of ML Maximum permitted value then SS.				
The figure is based on the requirements of track standard S1157.				

11 Concreted track

11.1 Concrete level

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
Maximum permitted deviation of top of concrete level from upper surface of the centre of the sleeper, except where track equipment requires extra clearance.	SS	±20	Rectify within 4 weeks	
	MT	±10	Plan refurbishment.	

11.2 Shingle level

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
Maximum permitted deviation of the top of the shingle level from the upper surface of the sleeper, except where track equipment requires extra clearance.	SS	+15 - 50	Rectify within 4 weeks	
	ML	+15 -30	Rectify within 8 weeks	
	MT	+15 -25	Plan releveling	

11.3 Rendering

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
Minimum height of rendering above the top surface of the positive conductor rail, unless otherwise authorised by the Profession Head of Permanent Way Engineering or their delegate.	SS	25	Rectify within 4 weeks	(1)
	(1) The minimum clearance between any exposed conductor rail (including any metalwork connected thereto) and any material with the potential to conduct electricity shall be 75mm. Rendering is NOT considered to be a material with the potential to conduct electricity.			

12 Lubrication

12.1 Rail lubricators - fixing

	Condition to be rectified for track category		Minimum action	Notes
	Standard	All categories		
Maximum permitted number of defective fixings to sleepers or rails.	SS	Defective/missing/loose fixings, unit insecure	Rectify within 72 hours	(1)
	ML	Missing/loose fixings, unit secure	Inspect daily and rectify within 8 weeks	(1)
(1) Fixings to concrete sleepers are not required as long as the reservoir is securely located in the ballast or infill concrete and cannot rotate.				

12.2 Rail lubricators - effectiveness

	Condition to be rectified for track category		Minimum action	Notes
	Standard	All categories		
Lubricator not working effectively.	SS	No grease/oil being supplied to the rail running face	Apply grease manually until rectified. Rectify within 1 week	(1)
	SS	Too much grease/oil being supplied to rail head.	Adjust lubricator or disconnect within 24 hours	(2)
	SS	Too much grease/oil being supplied to other track areas	Adjust lubricator or disconnect within 72 hours	
	ML	Grease/oil only partly covering distance required	Apply grease manually until rectified. Rectify within 8 weeks	(3)
(1) Rail running face dry with no trace of fresh grease/oil (2) Grease covering head of rail. In Night Tube areas emergency access may be required. (3) Grease being spread less than 100 metres from lubricator				



13 Junctionwork

Note: The Maximum permitted values shown in this section are only those applicable to junctionwork which are additional to, or different from, those listed in other sections of this standard. If a Maximum permitted value for a particular track feature is not shown in this section reference should be made to the relevant items elsewhere in this standard.

13.1 Junctionwork - rails/rail geometry

	Maximum permitted value for track category		Minimum action	Notes								
	Standard	All categories										
13.1.1 Running rails - track gauge Maximum permitted deviation from nominal running rail gauge within crossing units, check lengths, and from switch fronts to heel blocks.	SS	±6	Inspect and rectify within 4 weeks									
	ML	±5	Inspect and rectify within 8 weeks									
	MT	±4	Plan to rectify within 12 months									
	<table border="1"> <thead> <tr> <th colspan="3">Nominal rail gauge in junctionwork</th> </tr> <tr> <th>Type of junctionwork</th> <th>BH</th> <th>FB (vertical)</th> </tr> </thead> <tbody> <tr> <td></td> <td>1435</td> <td>1432</td> </tr> </tbody> </table> <p>Gauge-widening may be applied, in which case the MT, ML and SS limits apply to the design gauge. Straight-cut BH switches have a design gauge of 1444mm at the toes, running out to 1435mm at the end of the switch planning.</p>				Nominal rail gauge in junctionwork			Type of junctionwork	BH	FB (vertical)		1435
Nominal rail gauge in junctionwork												
Type of junctionwork	BH	FB (vertical)										
	1435	1432										

13.1.2 Junctionwork - running rails/lead rails - relative rail heights Maximum permitted level of the top surface of a running rail over which a negative shoe may pass, relative to the plane of the top surfaces of the rails on which the train is travelling.	SS	±10	Rectify within 4 weeks	
	ML	±8	Rectify within 8 weeks	

13.2 Switches or points

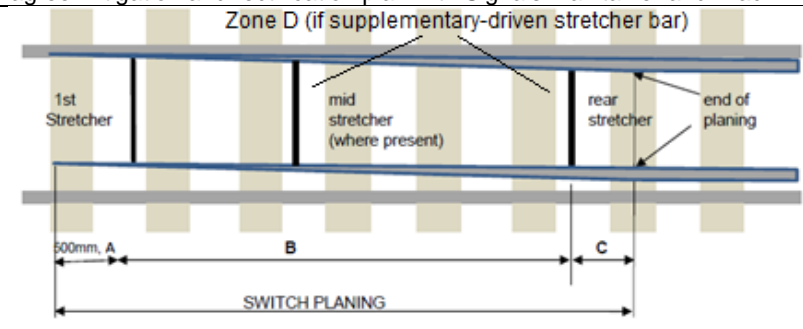
Refer also to S1158 for other items on switch maintenance

	Condition to be rectified for track category		Minimum action	Notes
	Standard	All categories		
13.2.1 Switch assembly Incomplete switch assembly, missing or defective bolts or fixings.	SS	Any parts missing or loose	Rectify within 72 hours	(1)
	ML	Any loose bolts	Rectify within 1 week	(1)
(1) If condition introduces a safety or service risk action in 24 hours; in Night Tube areas emergency access may be required				

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
13.2.2a Rail fit - all point mechanisms except Unistar				
Residual switch opening (RSO) between closed switch rail and stock rail, <u>above</u> which the minimum action applies (note that installation as shown in S1179 may be <u>up to</u> these values for Zones A and C)				
Measured over a distance of 500mm from the switch tip. Zone A in diagram below	SS	>1.5	Plan rectification within 96 hours, Rectify within 6 weeks.	(1) (5)
	ML	>0.5	Monitor and plan rectification if required	(1)
Measured 500mm from the switch tip up to the rear stretcher bar within the planed switch length for points without supplementary drives. Zone B in diagram below.	SS	>3.0	Rectify within 6 weeks	(2) (3)
Measured from the rear stretcher bar up to the end of planing where the distance is within one bed. Zone C in diagram below.	SS	>4.0		(2) (4)
Measured 50mm each side of a supplementary-driven stretcher bar . Zone D in diagram below.	SS	<1.0 >3.0	Plan rectification within 96 hours, Rectify within 6 weeks.	(3) (5)

Notes:

- In hand operated points (without signalling detection) within depots and in loose or sprung points in A - C: SS = 3mm and ML=1.5mm.
- Where Snipe Cut exists, the residual switch opening over the length of the closed switch shall apply up to the new end of planing/start of the snipe cut (which may occur before the rear stretcher).
- Where a supplementary drive is present the RSO at the driven stretcher bar (within 50mm of the centreline of the stretcher bar – Zone D) is to be minimum 1.0mm to eliminate overdrive.
- Where the distance is greater than one bed (750mm) the maximum permitted is 6.0mm.
- For Zone A and D agree mitigation and rectification plan with Signals maintainer and Track Maintenance Engineering.



Notes to diagram

- Length of Zone C varies: it is less than one bed (760mm) in all FB and in BH A and B switches, and is more than 760mm in BH C to F switches without supplementary drives.
- Zone D extends 50mm each side of a supplementary-driven stretcher bar and is to be used in addition to other Zones when supplementary drives are present.

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
13.2.2b Rail fit – Unistar point mechanisms only				
Residual switch opening (RSO) between closed switch rail and stock rail, <u>above</u> which the minimum action applies (note that installation as shown in S1179 may be <u>up to</u> these values for Zones A and C)				
Measured over a distance of 500mm from the switch tip. Zone A in diagram below.	SS	>1.5	Plan rectification within 96 hours, Rectify within 6 weeks.	(2)
	ML	>0.5	Monitor and plan rectification if required	
Measured 500mm from the switch tip up to the centreline of the last bearer within the planing length. Zone B in diagram below.	SS	>3.0	Rectify within 6 weeks.	
Measured from the centreline of the last bearer within the planing length up to the end of planing. Zone C in diagram below.	SS	>13.0		
Measured 50mm each side of a supplementary Unistar point machine. Zone D in diagram below.	SS	<1.0 >3.0	Plan rectification within 96 hours, Rectify within 6 weeks.	(1) (2)
Notes: <ol style="list-style-type: none"> Where a supplementary Unistar point machine is present the RSO at the driven position (within 50mm of the centreline of the point machine – Zone D) is to be minimum 1.0mm to eliminate overdrive. For Zone A and D within 96 hours of identification agree mitigation and rectification plan with Signals maintainer and Track Maintenance Engineering. 				
Notes to diagram <ul style="list-style-type: none"> Zone D extends 50mm each side of a supplementary Unistar point machine and is to be used in addition to other Zones when supplementary Unistar point machines are present. 				

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
13.2.3a Switch opening: powered points Minimum and maximum switch toe openings (at switch tip)	SS	Minimum opening 95mm	Contact fault reporting centre for emergency signal staff attendance	(1) (2)
		Maximum opening: see Note (3)	See Note (3)	(3)
	ML	Minimum opening 100mm	Assess and report openings below 100mm to FRC, requesting signal staff assistance as necessary for resetting of the switch opening	(1) (2)
		Maximum opening: see Note (3)	See Note (3)	(3)
<p>(1) Any gauge widening present beyond 1435mm shall be added to the minimum switch toe opening limits.</p> <p>(2) The switches shall be secured out of use if site conditions indicate that the opening could reduce further before rectification is carried out.</p> <p>(3) The opening shall permit effective vertical support to the switch rail by the slide chairs, baseplates or rollers at all times. If such support is found to be absent the Fault Reporting Centre shall be contacted immediately.</p>				
13.2.3b Switch opening: hand-worked points Minimum and maximum switch toe openings (at switch tip)	SS	Minimum opening 85mm	Rectify within 7 days	(1) (2)
		Maximum opening: see Note (3)	See Note (3)	(3)
	<p>(1) Any gauge widening present beyond 1435mm shall be added to the minimum switch toe opening limits.</p> <p>(2) The switches shall be secured out of use if site conditions indicate that the opening could reduce further before rectification is carried out.</p> <p>(3) The opening shall permit effective vertical support to the switch rail by the slide chairs, baseplates or rollers at all times. If such support is found to be absent the Fault Reporting Centre shall be contacted immediately.</p>			

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
13.2.4 Switch flangeway gap Minimum measured flangeway gap between switch rail and stock rail over the length of an open switch to avoid contact with the back of the wheel and the switch rail.	SS	<47	Rectify within 7 days	(1),(2),(3)
	ML	<50	Rectify within 2 weeks	(1),(2)
	<p>(1) These values apply when the track gauge is correct (1432mm FB or 1435mm BH). If the actual track gauge is wide the flangeway must be increased by the same amount in order to avoid wheel contact on the back of the open switch rail.</p> <p>(2) Any evidence of back wheel contact must be treated as a matter of concern and, as a minimum measurements must be taken at those positions and the start and finish of the contact from the switch tip, and must be captured and recorded as well as the length of contact. Stretcher bars and fastenings must be inspected for signs of fatigue or stress failure.</p> <p>(3) Any flangeway gap measured below standard tolerances and unable fix within minimum action timescales must be managed as per PR0132 (Management of non-compliant flangeway faults), and clause 3.2.5.4.</p>			

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
13.2.5 Switch tip - longitudinal position	SS	± 6	Rectify within 4 weeks	(1)
Maximum permitted deviation from the design position	ML	± 5	Rectify within 8 weeks	(2)

- (1) A value of ±25 is permitted for hand-operated points in Cat D track, except for straight-cut (joggled) points where the deviation forwards (away from the switch heel) is limited to 6: see Figures below. The Maximum permitted values in Table 13.2.6 are not affected by this relaxation.
- (2) A value of ±20 is permitted for hand-operated points in Cat D track, except for straight-cut (joggled) points where the deviation forwards (away from the switch heel) is limited to 25: see Figures below. The Maximum permitted values in Table 13.2.6 are not affected by this relaxation.

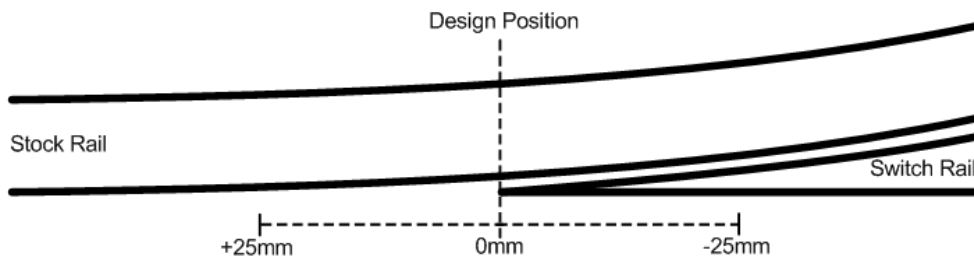


Figure 1 – Cat D track Hand operated points with chamfered or undercut switches SS Maximum permitted value for deviation from the design position. ML Maximum permitted values are +20mm and -20mm.

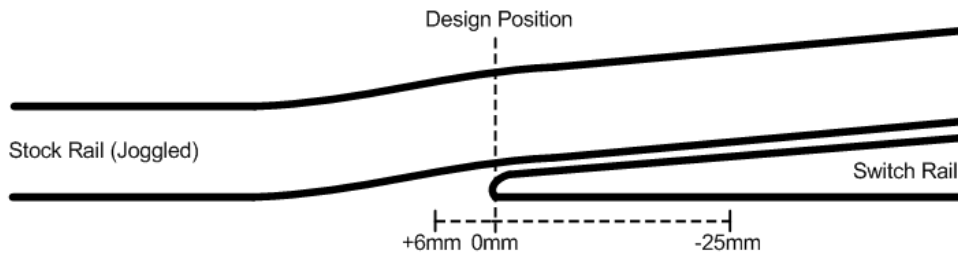


Figure 2 – Cat D track Hand operated points with straight cut (joggled) switches SS Maximum permitted value for deviation from the design position. ML Maximum permitted values are +5mm and -20mm.

13.2.6 Switch tip - squareness	SS	12	Rectify within 4 weeks	(1)
Maximum permitted out of squareness ("lead") of a set of points across the 4-foot.	ML	10	Rectify within 8 weeks	(1)
(1) Out-of-squareness must be contained within the limits for longitudinal position as set out in 3.3 Table 13.2.5.				

13.2.7 Switch and stock rail wear	
Refer to S1176 for details of switch and stock rail wear	

13.3 Switch diamonds				
	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
13.3.1 Switch rail position (95RBH, original design - has a single SDN slide chair supporting the wing rail and the two switch rail toes). Maximum permitted deviation from design toe-to-toe dimension of 102mm.	SS	± 6	Rectify within 4 weeks	(1)
	ML	± 5	Rectify within 8 weeks	(1)
	(1) Each switch rail toe to be not greater than 51 ± 3mm from centre line of wing rail bend.			
13.3.2 Switch rail position (95RBH, current design - has one PJ1 slide chair per switch rail toe). Maximum permitted deviation from design toe-to-toe dimension of 230mm.	SS	± 12	Rectify within 4 weeks	(1)
	ML	± 10	Rectify within 8 weeks	(1)
	(1) Each switch rail toe to be not greater than 115 ± 6mm from centre line of wing rail bend.			
13.3.3 Switch rail position (56E1, vertical design) Maximum permitted deviation from design toe-to-toe dimension of 230mm.	SS	± 10	Rectify within 4 weeks	(1)
	ML	± 8	Rectify within 8 weeks	(1)
	(1) Each switch rail toe to be not greater than 115 ± 5mm from centre line of wing rail bend.			

13.4 Switch fittings/assemblies

	Condition to be rectified for track category		Minimum action	Notes
	Standard	All categories		
13.4.1 Soleplate assembly Incomplete soleplate assembly, defective or missing insulation, bolts or fixings.	SS	Any parts missing or defective	Rectify within 72 hours	
	ML	Any parts loose	Rectify within 1 week	
Gauge stops: to be present: any gap between stop and baseplate exceeding 2mm to be treated as an ML fault.				

13.4.2 Protective cover over signal equipment Height of the top surface of the protective cover above the plane of the top surfaces of the running rails, not to exceed.	In areas where there cannot be a free hanging shoe the following applies;-			
	SS	25	Rectify within 72 hours	(1) (2) (3)
	ML	15	Rectify within 4 weeks	
	In areas where there can be a free hanging shoe the following applies;			
	SS	10	Rectify within 72 hours	(3) (4)
	ML	8	Rectify within 4 weeks	(4)
	(1) Reference must be made to the low level gauging Diagram F1 before installing any equipment in the track. (2) The point motor casing can be 38mm above rail. (3) If condition is caused by asset or fastening problems emergency access may be required in Night Tube areas. (4) Reference must be made to the low level gauging Diagram F1 before installing any equipment in the track.			

13.4.3 Locked wheel ramp assembly (where installed) Incomplete locked wheel ramp assembly, missing or defective bolts or fixings.	SS	Any parts missing or defective.	Remove assembly within 72 hours	
	ML	Any loose bolts.	Remove assembly within 1 week	
The height of the top of the locked wheel ramp below the crown of the rail head shall be between 38 and 41mm. The securing bolts of the locked wheel ramp shall be tightened to 900Nm.				

	Condition to be rectified for track category		Minimum action	Notes
	Standard	All categories		
13.4.4a Stretcher bar assembly Incomplete stretcher bar assembly, defective or missing insulation, bolts or fixings	SS	Stretcher bar, bracket, insulation, or multiple fixings broken, missing, detached or seriously damaged. Minimum gap between the top of the stretcher bar and the underside of the foot of the stock rail shall be 3mm.	Assess safety of continued operation and restrict traffic if necessary. In any event rectify within 24 hours. If time does not allow full replacement, fit emergency stretcher bar.	(1) (2) (3)
	ML	Slight damage or single loose fixing but bar and bracket fit for service.	Rectify within 1 week.	(1)
(1) When replacing any broken, damaged or defective stretcher bars and/or brackets the complete assembly must be replaced as a unit including stretcher bar, brackets and fixings. (2) In Night Tube areas emergency access may be required. (3) Emergency stretcher bars must be replaced within 72 hours				
13.4.4b Stretcher bar assembly Omitted Omitted 3 rd Stretcher bar assembly	ML	Omitted 3 rd stretcher bar assembly	Raise work order and monitor	(1)
	(1) 3 rd Stretcher bar assembly is in some configurations are not installed due to repeated failure/tight flangeway. Advice should be sought from the Professional Head of Permanent Way Engineering, or relevant delegated authority, before omitting a stretcher bar or installing an omitted stretcher bar.			
13.4.5 Switch anchors, stress transfer blocks, ball & claw configurations Missing, defective or loose parts.	SS	Any parts missing, defective or loose	Rectify within 1 week	(1)
	(1) A ball & claw is not an anchor, but the corrective actions required are the same			
13.4.6 Ball & claw configurations Set-up	ML	Any contact between ball and claw between -7C and 54C	Rectify within 8 weeks	
	Refer to table 13.2.5 for maximum permitted deviation from switch toe position.			
13.4.7 Slide baseplate/ chair lubrication Slide surfaces inadequately lubricated.	SS	Plates dry with no trace of lubricant	Clean and lubricate within 72 hours	(1)(2)
	ML	Chairs with residual dirty lubricant	Clean and lubricate within 1 week	(1)
(1) Moly-coated, phosphor-bronze and equivalent slide surfaces shall be cleaned and lubricated with a lubricant approved for the purpose. (2) If affecting service, emergency access will be required in Night Tube areas				

13.5 Crossings

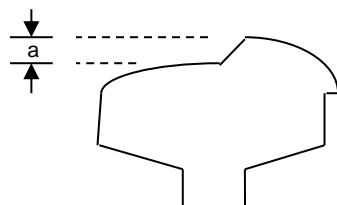
	Condition to be rectified for track category		Minimum action	Notes
	Standard	All categories		
13.5.1 Crossing assembly (common and obtuse crossings) Incomplete crossing assembly, defective or missing bolts, or blocks incorrectly seated against web of rail.	SS	Any parts missing, defective or loose, or blocks incorrectly seated	Assess safety of continued operation and restrict traffic if necessary. In any event rectify within 1 week	

	Maximum permitted value for track category			Minimum action	Notes
	Standard	A - C	D		
13.5.2 Crossing wear (nose and wing rail) Maximum permitted wear	SS	15	15	Replace within 2 weeks	(1)
	ML	9	12	Repair within 6 weeks	(2), (3)
	MT	5	9	Plan repair to prevent breach of ML Maximum permitted value	(3)
Uneven rail head wear in junctionwork. It is necessary to limit fatigue damage caused by grossly uneven wear across the rail head which can develop in wing rails and stock rails. Uneven wear across the rail head must be controlled.	SS	6		If uneven wear not corrected within 6 weeks, restrict speed over crossing to 20mph to limit further fatigue damage	
	ML	6		Remove uneven wear by either grinding away lipping and plastic flow to re-establish profile, or by weld repair	(3)
	MT	3		Monitor differential wear through PM4 inspections (or equivalent)	(3)

Notes:

- (1) If crossing is not changed within 2 weeks, restrict speed to 20mph to minimise further fatigue damage.
- (2) Where wear is allowed to exceed 12mm, assess crossing condition and where components are worn, broken or loose consider replacement. If decision to repair is taken, prioritise and complete within 3 weeks. If repair is not completed within this timescale, treat as SS.
- (3) Monitor wear using PM4 inspection results.

Diagram showing uneven rail head wear



Section through worn wing or stock rail head
 Size of uneven wear = a mm

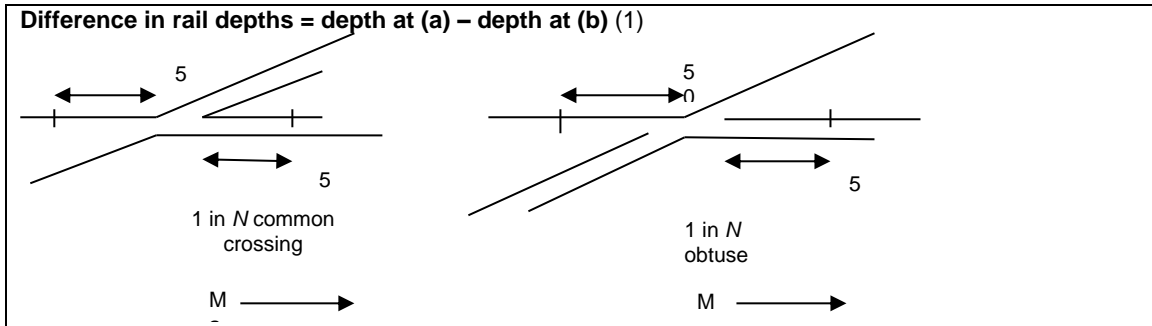
Other requirements:

- a) If previously ultrasonically untestable, the rails shall be tested within 24 hours after remedial work.
- b) All surrounding bearers shall be secured by lifting and packing.
- c) Where baseplate or chair shuffle is present, efforts shall be made to stop the dynamic movement by renewing fastenings and screws or by fitting gauge stops to the timber/bearers.
- d) Care shall be taken to ensure the correct wheel/rail interface between the crossing nose and its associated wing rails is established.

e) Rail depths within crossings

For fabricated and semi-welded crossings it is necessary to limit fatigue damage caused by dissimilar rail depths between the load-carrying rails either side of a flangeway gap. Dissimilar rail depths must be controlled within the limits set out in the table below.

Method of measurement



Standard	Track Cat A, B, C	Minimum action
SS	6	If crossing not replaced within 12 weeks, restrict speed over crossing to 20mph to limit further fatigue damage
ML	6	Replace crossing with new unit within 12 weeks
MT	3	Monitor differential wear through PM4 inspections (or equivalent)

Note: (1) Where crossing is at a route divergence, compare (a) and (b) along both routes.

f) Replacement of broken, worn or defective rails in crossings

Replace worn or defective common or obtuse crossings as a single unit. Where in an emergency it is necessary to replace a wing rail or nose in isolation, this is permitted subject to either

- i. then complying with the requirements and timescales applicable to dissimilar wear given in (f) above, or
- ii. making the replacement wing or nose from rail equal in depth to that of the adjacent nose or wing.

	Condition to be rectified for track category		Minimum action	Notes
	Standard	All categories		
13.5.3 Crossing - multi groove locking pins Missing, defective or loose multi-groove locking pins in semi-welded crossings.	SS	Any parts missing or loose	Rectify within 1 week	

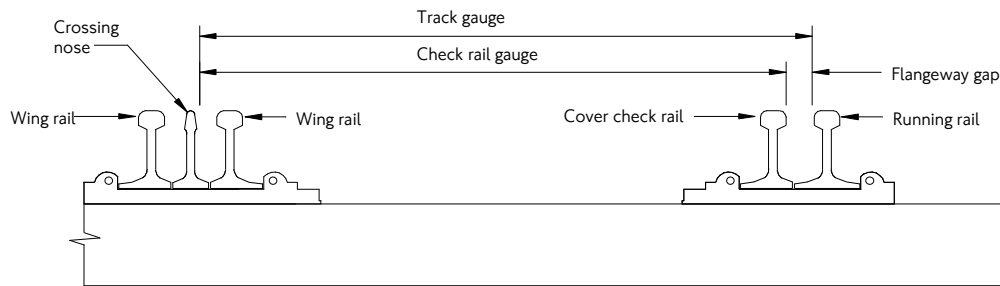
	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
13.5.4 Voids between crossing and bearer Maximum permitted void between the underside of a crossing unit and the supporting bearer, at the X, Y, Z, A, B and C positions (or equivalent in FB crossings).	SS	5	Rectify within 2 weeks	
	ML	3	Rectify within 4 weeks	(1)
	MT	1	Monitor	
	(1) On FB crossings rail pads must be installed. Any pads missing are to be treated as an ML fault			

13.6 Check rails

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
13.6.1 Check rails - relative heights Maximum permitted height of the top surface of a check rail over which a negative shoe may pass, above the top surface of its adjacent running rail.	SS	+2 -7	Rectify within 72 hours	

	Maximum permitted value for track category		Minimum action	Notes	
	Standard	All categories			
13.6.2 Flangeway gaps (common and obtuse crossings) Maximum permitted deviation from the nominal flangeway gap shown below (this applies to flangeway gaps within common crossings as well as at cover checks).	SS	-4+6	Rectify within 72 hours		
	ML	-3+5	Rectify within 4 weeks		
Maximum permitted deviation from the nominal check rail gauge shown below.	SS	-6+4	Rectify within 72 hours		
	ML	-5+3	Rectify within 4 weeks		
Type of junctionwork	Track curve radius (m)	Nominal track gauge (mm)	Nominal flange-way gap (mm)	Nominal check rail gauge (mm)	
95 RBH	≥ 200m	1435	44	1391	(1)
	< 200m	1438	47	1391	
56E1 Vertical design	≥ 200m	1432	41	1391	(1)
	< 200m	1435	44	1391	

(1) Gauge widening is not applied in all cases <200m radius.



The relationship between track gauge, cover check rail gauge and flangeways at the nose of a common crossing

13.7 Junctionwork – bearers

	Maximum permitted value for track category			Minimum action	Notes	
	Standard	A - C	D			
13.7.1 Bearer spacing Maximum permitted variation from design position as shown in the design drawings or standard drawings. Note: Nominal bearer spacings are shown in table opposite.	ML	±75	±75	Inspect and rectify within 8 weeks		
	MT	±50	±50	Plan to rectify within 6 months		
	Bearer spacing (mm)		FB	BH	Fishplated joint	
	Minimum		500	305	610	
	Preferred		710	762	635	
	Maximum (exceptionally)		800 900	840 -	660 -	
NB: To accommodate a Clamplock cylinder, the first bearer bed behind the toe of the switches shall be widened to 737mm.						

13.7.2 Bearer – condition Maximum permitted number of ineffective bearers within P&C unit. For concrete bearer also read “concrete block as used in some concreted P&C layouts”.	SS	3	5	Rectify within 2 weeks	(1), (2)
	(1) Ineffective bearer is defined as rotten or broken, providing inadequate vertical or lateral restraint to baseplate or rail. In the case of concrete bearers: a) spalling less than 10mm deep x 10mm wide is acceptable; b) spalling up to 25mm deep x 25mm wide x 300mm long can be repaired; c) larger areas or cracking leading to loose sections require individual bearer to be changed within 6 months, unless other bearers are also ineffective, in which case the above timescale applies. Replacement with modular bearers is to be considered. (2) Count 2 consecutive ineffective bearers and any bearers supporting point equipment of within 1m of the crossing nose as an SS fault.				

13.7.3 Timber bearer – chair or baseplate indentation Maximum permitted depth of indentation of the chair or base plate into the top surface of the timber.	SS	8	12	Rectify within 4 weeks	
	ML	5	6	Rectify within 8 weeks	
	MT	3	4	Rectify within 12 months	

13.7.4 Timber & composite bearer – redundant chair screw holes Maximum permitted number of redundant chair screw holes in a timber which have not been satisfactorily plugged.	ML	4	4	Rectify within 3 months	

14 General

	Maximum permitted value for track category		Minimum action	Notes
	Standard	All categories		
14.1 Ditches and drains Freedom of flow Silted catchpit or blocked water way.	SS	Blocked causing track flooding	Rectify within 1 week	
	ML	Full and not Flowing	Rectify within 4 weeks	
	MT	Flowing but restricted	Rectify within 6 months	

14.2 Catchpit covers Maximum permitted number of missing, defective, incorrectly seated catchpit covers or any other dangerous condition.	SS	1 Missing or unsafe covers	Rectify or make safe within 24 hours	(1)
	ML	1 Cracked or defective covers	Rectify within 8 weeks	
	(1) In Night Tube areas emergency access may be required			

14.3 Boundary markers Maximum permitted number of missing, defective, incorrectly seated catchpit covers or any other dangerous condition.	SS	1 Missing	Replace within 72 hours	(1)
	ML	1 Loose , damaged or Illegible	Rectify within 4 weeks	
	(1) Initial replacement may be made with a temporary marker, which shall be replaced with a permanent marker within 4 weeks.			

14.4 Speed Restriction Signs and other signs critical to the safe operation of the network	SS	Missing or Illegible	Replace within 24 hours	
	ML	Loose or damaged	Rectify within 4 weeks	

14.5 RFID Track Remote Monitoring Datum (ATMS RFID Tag)	SS	RFID Datum is defective or missing at boundary or two or more consecutive datums are defective or missing	Rectify within 28 days.	
	ML	RFID Datum is loose, damaged or missing	Rectify within 12 weeks	

14.6 Track Signage General	SS	Track Signage missing, defective or Illegible	Rectify within 28 days.	
	ML	Track Signage loose or damaged	Rectify within 12 weeks	

15 Train arrestors

Note: These requirements apply to the inspection and maintenance of all forms of train arrestor on A - C and in depots and sidings. For the purposes of this standard, the term "train arrestor" includes rail-built, concrete block, hydraulic, friction, drag and sand-drag types.

If any conditions identified during an inspection are believed to present an immediate safety risk to the train arrestor system, rectification works must be carried out within 36 hours and consideration must be given to the implementation of additional mitigations, such as speed restrictions or removing the road from service.

15.1 Arrestor and rail condition

	Condition to be rectified for track category		Minimum action	Notes
	Standard	All categories		
Corrosion of train arrestor or running rail	SS	Severe corrosion/damage of rail or any components	Within 1 week of corrosion being identified request Engineering to undertake an assessment of the site and issue report/findings with rectification timescale	(1) (2)

(1) Length of running rails to be inspected extends from the first rail joint in front of the arrestor to the face of the arrestor, or to the rail end behind the arrestor, (provided the rail ends are not incorporated within the arrestor structure).

(2) A copy of the report must be submitted to the Lead Maintenance Assurance Engineer

15.2 Arrestor fastenings

	Condition to be rectified for track category		Minimum action	Notes
	Standard	All categories		
Missing, loose or defective bolts or fastenings which secure the structure of the arrestor, or which secure the train arrestor to the running rails or friction shoes.	SS	Any loose, missing or defective bolts or fastenings which secure the structure of the train arrestor or secure the train arrestor to the running rails	Rectify within 4 weeks	(1)

(1) If there is an immediate safety concern which will compromise the performance of the train arrestor, rectify within 36 hours and consider the interim implementation of additional mitigations, such as speed restrictions or removing the road from service.

15.3 Arrestor light

	Condition to be rectified for track category		Minimum action	Notes
	Standard	All categories		
Effectiveness of arrestor red light.	SS	Any defective, missing or ineffective red light which is part of the arrestor configuration	Report to Fault Report Centre as a Signals fault	(1)
(1) Where no red light is provided or the red light is covered, the arrestor must have a functional reflective sign. In the event this is not provided, this shall be rectified in accordance with Clause 14.4.				

15.4 Storage of material

	Condition to be rectified for track category		Minimum action	Notes
	Standard	All categories		
15.4.1 Stored material in front of arrestor	SS	Any material stored in front of the train arrestor (with the exception of stored rail below the head of the running rail)	Regularise within 72 hours through the TANC process	(1)
(1) The removal period for the stored material shall be stated in the TANC				

15.4.2 Stored material or debris within friction/chipping drag arrestor movement zone	SS	Any material or debris within friction/chipping drag arrestor movement zone (with the exception of stored rail below the head of the running rail, provided it does not obstruct the path of the friction shoes)	Regularise within 72 hours through the TANC process	(1)
(1) The removal period for the stored material shall be stated in the TANC				

15.5 Sand profile

	Condition to be rectified for track category		Minimum action	Notes
	Standard	All categories		
Sand profile – sand drag (fixed arrestors)	SS	Insufficient sand for sand drag without a buffer beam present	Assess need for mitigations – Take road out of use, Implement further speed restrictions	

4 Responsibilities

- 4.1 The Professional Head of Permanent Way Engineering is responsible for the technical content of this standard and shall be responsible for auditing technical compliance with this standard with respect to the assurance of assets to which they are accountable.
- 4.2 Any concessions in relation to this standard shall be directed to the Professional Head of Permanent Way Engineering who has overall accountability for compliance with this standard. The Professional Head of Permanent Way Engineering may request support from the other technical authorities when reviewing concessions or queries arising from the application of this standard. For paragraph 3.4 Tables: 1.4, 1.5, 1b.4, 1b.5, 2.4 and 2.5 (2m twist and 10m twist criteria) the Professional Head of Vehicles must be consulted before granting any concession.
- 4.3 LU and LU Suppliers shall be responsible for compliance with the requirements of this standard.

5 Supporting information

5.1 Safety considerations

- 5.1.1 There are immediate safety implications if the track condition does not conform with the requirements of this standard.
- 5.1.2 The potential consequences of non-compliance with this standard include:
- a) loss of service, damage to track components and rolling stock, derailment, collision, injury or death;
 - b) overloading of components;
 - c) instability or misalignment in the track structure;
 - d) degradation of track support components;
 - e) damage to traction system and signalling equipment;
 - f) loss of ballast profile;
 - g) contamination of ballast;
 - h) localised or general settlement;
 - i) drainage problems leading to the possibility of flooding and disruption of the service;
 - j) environmental damage through reversion and degradation of components.
- 5.1.3 Particular attention is drawn to the run out between completed work and the existing track. Any sudden change in the geometry of the track can increase the risks identified in 5.1.2.

6 Person accountable for this document

Name	Job title
Andrew Brice	Professional Head of Permanent Way Engineering

7 Definitions

Term	Definition	Source
ATMS	Automated Track Monitoring System – an unattended track measurement system mounted on in-service passenger trains that measures, processes and transmits track geometry data to those responsible for the day-to-day maintenance of track.	Jargon Buster
Broken	Component structurally defective or in 2 or more parts.	Jargon Buster
Class I work	Track work which includes the installation and final adjustment of the entire track system either as a direct replacement for an existing track system or as a complete new build.	Jargon Buster
Class II work	Track which involves the planned replacement and/or adjustment of parts of the track system either individually or as assemblies.	Jargon Buster
Class III work	Track work which is unplanned and not considered to be Class I or Class II works, e.g. emergency repair. It shall include the unplanned replacement and or adjustment of parts of the track system either individually or as assemblies.	Jargon Buster
Class IV work	Track work (generally the run out) which is required as a direct consequence of the main stream work being carried out e.g. at the boundary of the main stream work where items outside of the work scope are affected as a consequence of the work.	Jargon Buster
Concreted track	Generic term for ballastless track designs where in-situ concrete is used to hold the sleepers or blocks in position.	Jargon Buster
Defective	Component/s present but not able to perform their required function, (structurally defective, stripped threads or severely corroded).	Jargon Buster
Loose	Bolt and nut are present and are wound up against the appropriate mating surfaces but are not correctly torqued.	Jargon Buster

Maintenance Limit (ML)	For a given track parameter, the Maximum permitted value or Condition to be rectified representing the level beyond which the parameter should not be allowed to deteriorate. Where measurement of a track parameter gives a reading at or beyond this value, corrective maintenance should be undertaken within the terms of this standard.	Jargon Buster
Maintenance Target (MT)	In the case of parameters which are record statistically over sections of the track, the value that should normally be achieved or bettered on not less than 90% of the length of the track. In the case of parameters such as chair gall or side wear, which are measured in the form of discrete occurrences, the values that should be achieved or bettered in all locations where normal conditions apply. The margin of tolerance allows for locations untypical of the track as a whole, where track characteristics impose particularly complex maintenance requirements, for example in junction work, or where track components are scheduled for renewal.	Jargon Buster
Missing	One component missing from the assembly.	Jargon Buster
Run out	The length of track over which the quality of achievement obtained shall be gradually run out to match the existing condition of the adjacent track. The run out shall take account of all design and configuration requirements and constraints.	Jargon Buster
Safety Standard (SS)	For a given track parameter, the Maximum permitted value or Condition to be rectified consistent with the safety of the track.	Jargon Buster
Seized	Bolt and nut are present but cannot be tightened to achieve the correct torque as they are seized.	Jargon Buster
Supplier	Supplier to London Underground; the primary organisation or individual that is selected to deliver a product, service, or facility to London Underground and contracting directly to London Underground. This includes Consultants, Contractors, and PFI Contractors and excludes organisations or individuals selected by and contracting directly to them.	Jargon Buster
Track system	All permanent way assets which support and guide trains and are within 2m of any running rail.	Jargon Buster

8 Abbreviations

Abbreviation	Meaning
ALARP	As Low As Reasonably Practicable
ATMS	Automated Track Monitoring System
SS	Safety standard
LU	London Underground
ML	Maintenance limit
MT	Maintenance target
NR	Network Rail
TOC	Train operating company
TRT	Track Recording Train
TRV	Track Recording Vehicle

9 References

Document no.	Title or URL
S1156	Gauging and Clearances
S1157	Track – Performance, design and configuration
S1158	Inspection and Maintenance
S1164	Conductor Rail – Dimensions and Tolerances
S1176	Inspection and repair to reduce the risk of derailment at switches
S1178	Rail Defect Management
S1179	
T0436	Weld repair of plain rails, switches and crossings

10 Document history

Issue no.	Date	Changes	Author
A1	October 2007	Standard 2-01302-240 reformatted and re-numbered to 1-159, no technical changes have been made to the content other than changing references to other Standards where their numbers have changed.	Quentin Phillips
A2	January 2011	Updated as per DRACCT 0085 - Incorporation of Written Notices - 00305, 00560, 00575, 00905 and 00942 - Clause 8.1.4 of E8404 incorporated as new clause 3.3.1	Quentin Phillips

A3	May 2013	Updated per DRACCT 01768 to incorporate thresholds and actions for use of ATMS. Incorporation of Written Notices 01038, 01059, 01093, 01114, 01125, 01139, 01165, 01194 and MR-WN-5077, and concessions CR06306, CR06862 and MR-CR-2731. Other minor changes and clarifications.	Quentin Phillips
A4	July 2015	Updated per DRACCT 03601 to incorporate Written Notices 01189, 01214, 01236, 01242, 01244, 01323, 01327 and 01339. Changes to some SS timescales (36 hrs mostly changed to 72 hrs or 24 hrs, the latter with a note that in Night Tube areas emergency access may be required).	Quentin Phillips
A5	March 2023	Title changed from 'Track – Dimensions and Tolerances'. Updated per CR-11069 to segregate requirements for Maintenance (this standard) and Completed Works (new standard S1179). Terminology amended to clarify requirements regarding Maximum permitted values and Conditions to be rectified. Written Notices 01364, 01372, 01422, 01456, 01547, 01556, 01557, 01611, 01675, 01656, 01660, 01667, 01675, 01707, and 01708 incorporated. Some criteria changed following peer review and Track Standards Workshop. Change No. CR-17459.	Mike Barlow & Susanne Smith