MAINTENANCE OF

TRACK GAUGE

GUIDELINES

Produced by Civil Engineering Conference
For use by all railway civil engineering staff

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Maintenance of Track Gauge Guidelines

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Background

Track gauge is the distance between two running rails.

Correct gauge is important for three reasons:

1. Tight or wide gauge will adversely affect the ride of trains. On occasions tight gauge has been known to cause severe hunting resulting in emergency stops. Variations in gauge also trigger rough riding conditions especially in switches and crossings (S&C). Consequently the service to rail customers is affected with discomfort and delays.

2. Correct track gauge extends the life of track components and train wheelsets. This is because the forces involved are minimised.

3. Gauge defects are the most common cause of derailments.

Typically 26 running line derailments are attributed to track gauge per year in the UK. The number in sidings and loops is far higher. Consequently, of all track defects, gauge is the biggest single cause of derailments at a third of the total.

Railtrack contractors' aim is to eliminate the risk presented by gauge defects with the overall objective of further improving the safety and quality of Britain's railway network.

Fig.1. A gauge spread derailment

What is Track Gauge?

For most of the railways in England, Scotland and Wales the Standard Track Gauge is within the range 1432mm to 1435mm inclusive.

Since 1997 the Standard Gauge is 1435mm on new installations of concrete sleepered track. Track installed before then was designed to 1432mm or 1435mm.

This dimension is the distance between the Gauge Points of the running rails of a railway.

The gauge points are 14mm below the top of the rails on the 4-foot side.

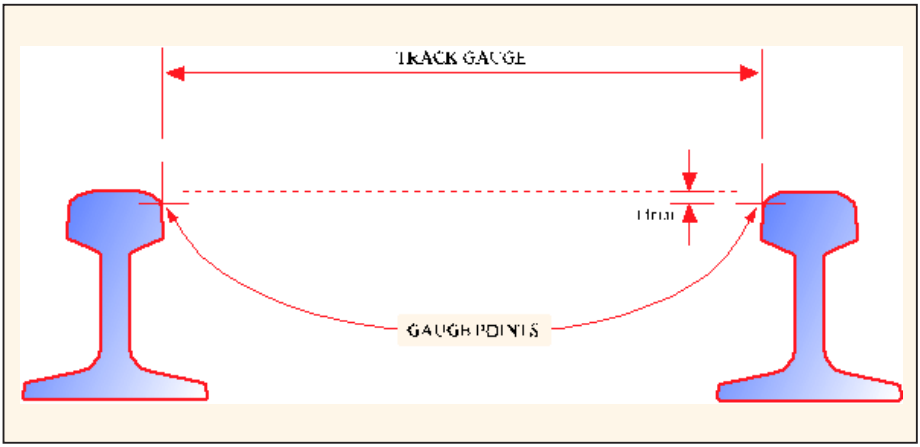


Fig.2. Where track gauge is measured

Static and Dynamic Gauge

Static Gauge is measured without the influence of trains.

Dynamic Gauge is measured when the track is subject to train loading. The forces applied to the track by trains tend to spread the running rails apart.

Gauge Maintenance Limits

Tight Gauge

Where this is less than 1426mm in plain line or in S&C tight gauge must be reported for correction.

Where linespeed is more than 100mph, gauge of less than 1429mm over a continuous distance exceeding 10 metres must be reported for correction.

Wide gauge

If static gauge exceeds 1455mm and there are visible symptoms of component defects then the dynamic gauge shall be measured. Steps must be taken to prevent further widening (eg tie bars).

If static gauge exceeds 1465mm then dynamic gauge must be measured and steps must be taken to prevent further widening (eg tie bars).

If dynamic gauge exceeds 1481mm then trains must be stopped immediately until repairs are carried out. This is an absolute safety limit for track gauge

The maintenance limits for wide gauge may be increased by any approved gauge widening. (See page 6)

Gauge Variation

Variation of the measured gauge over a distance of 3m must not exceed:

Speed (mph)	5-60	65-95	100-125
Variation	8	7	6

Moving Areas Within S&C

Throughout the moveable lengths of switches, switch diamonds and swing-nose crossings including 100mm in front of the switch toes track gauge must be maintained within the following ranges:

	Range (mm)
Vertical S&C	1430 to 1438
Inclined S&C	1433 to 1441

Gauge Widening

To ease the passage of trains at very sharp curves the standard track gauge may be intentionally widened. Gauge widening is typically applied on curves tighter than 200m radius as follows:

Curve radius	Gauge widening
200m-176m	3mm
175m-151m	6mm
150m-126m	10mm
125m-101m	13mm
100m or less	16mm

Check Rails

Where check rails are installed the distance between the check rail rubbing face and the opposite running rail is 1391mm (with tolerance of +1,-3mm). This dimension does not change where the standard track gauge may vary.

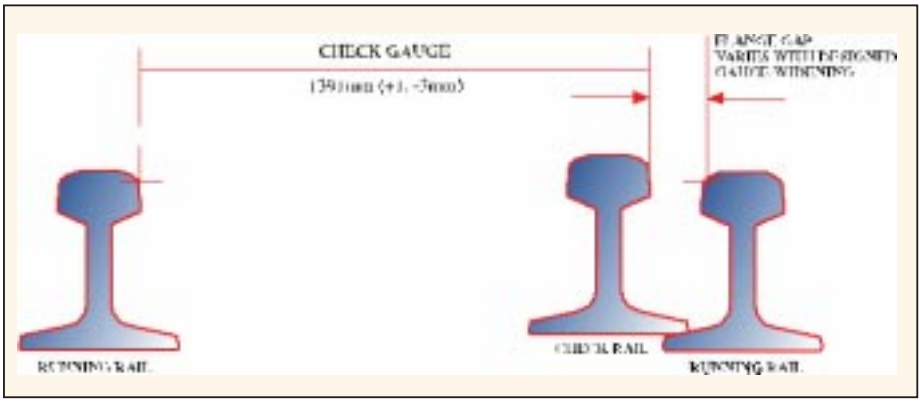


Fig.3. Check Rail Gauge

How is it Measured?

A variety of track gauges exists to measure track gauge. These instruments will give readings accurate to 1mm when used properly.

The gauges must sit properly on the rail head and must be square across the 4-foot. The squareness of the gauge can be judged by eye and will be the smallest reading.

When movement under traffic is suspected a dynamic gauge should be used. This will measure how much the static gauge is increased by passing trains.
It is fitted before a train passes over and readings are taken after. They record the maximum gauge reading which occurred as the train passed.

There is currently no approved dynamic gauge for use where the 4-foot is obstructed (eg in S&C, viaduct guard rails, level crossings and some designs of underbridge).

All track gauges must be insulated to prevent disruption to track circuits. Some incorporate other features such as a cross level or check rail gauge.

Track gauges should be regularly checked for accuracy in accordance with your local procedures.

Track gauges should not be confused with gauge setting bars. This is a tool comprising a rod with two stops which is used as a separator when setting two running rails to gauge.

Fig.4. Gauge-setting bar ***NOT*** *a track gauge*

Track Gauges

Abtus Ltd

Gauge and crosslevel with checkrail gauge

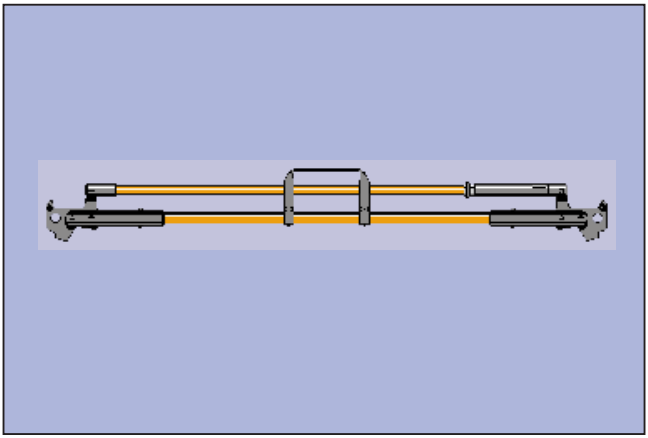
electronic version shown

Figure 5

Giesmar

S&C and plain line gauge with crosslevel

Figure 6



Abtus Ltd

Dynamic Gauge

Figure 7

Abtus Ltd

Sidewear gauge

Figure 8

Other gauges are available for fourth rail electrified track.

Track Recording

Track recording vehicles also measure dynamic gauge. Reported faults must be investigated, confirmed and corrected. Level 2 faults (L2s) should normally be corrected within 10 working days.

Remember that the static gauge measured by hand at L2 sites will be less than the dynamic gauge reported by the track recording vehicle. It is important to be observant for symptoms of further spread under traffic.

Smaller recording devices, such as the Geismar or Autograph measuring trolleys are also available. These provide a continuous measurement of static gauge along a piece of track. They will store the information on paper traces or in electronic format.

Fig.9. A track recording trolley

High Risk Areas for Gauge Defects

Certain locations are more prone to gauge problems than others. The following factors increase the derailment risk:

- Curves especially without checkrails. On curves the lateral forces from rolling stock tend to spread the rails. This makes the rail, fastenings and sleepers work harder, and fail more quickly, than on straight track.
- Longitudinal timbers (waybeams) or other non-ballasted track. Unusual rail support arrangements such as these require special attention because gauge defects might not be obvious at first.
- S&C particularly on the turnout route and at switches where the absence of cant will make the problem worse.
- Fastenings and sleepers not visible at level crossings or where excess ballast obscures them. This is because many of the symptoms of gauge defects are visible in the area of the fastenings. Excess ballast should be removed quickly.

Figure 10 Excess ballast must be removed quickly to allow inspection

Figure 11 Longitudinal timbers require detailed attention

Figure 12 Leaning chairscrews in this S&C indicate gauge spread

Symptoms of Track Gauge Faults

Most gauge faults can be detected during routine track inspection.

When the following symptoms are observed the gauge must be measured. Some should be observed under traffic.

Each symptom may not be serious by itself but when added to others the effect can be a gauge defect.

Symptom	Solution
Rail	
Sidewear will widen gauge	• turn rails • transpose rails • rerail
Lipping can cause tight gauge	• turn rails • transpose rails • remove lipping by grinding rerail
Foot Wear or Gall will widen gauge	• reposition sleepers • replace insulators* • repad • rerail
Unusual wear pattern on head may indicate rail movement or rotation	• check for cause
Impact/Wear on splay of check rails may indicate wide gauge	• check for cause
Fastening systems	
Insulators - missing or damaged can allow the rail to move and tilt	• replace insulators (check the type**)
Ferrules - missing or damaged can allow the rail to move and tilt	• referrule (check the type**)
Pads - missing or worn can allow the rail to move and tilt	• repad (check the type**)
Baseplate or Chair - wear or damage	• replace baseplate

Chair Screws, spikes or through bolts - bent, leaning, missing or broken.	• install screw sleeves or coils • replace sleepers • install spike inserts • plain vertical baseplates can be turned
Fastenings or Keys - loose or missing	• replace fastenings (check that they are the correct type) • panlock keys • check housing or baseplate
Sleepers and Bearers	
Timber sleepers - split	• band sleepers • use maintenance sleeves (eg Vortok coils or Hilti plugs) • replace sleepers
Timber sleepers - rot	• use maintenance sleeves (eg Vortok coils or Hilti plugs) • replace sleepers
Timber sleepers - indentation or shuffle	• pull S&C timbers through • turn sleepers over • replace sleepers
Concrete sleepers - damaged or worn	• refurbishment procedures are possible for some concrete sleepers*** • use maintenance pad to compensate for rail seat wear • replace sleepers
Concrete sleepers - loose or damaged housings	• refurbishment procedures are possible for some concrete sleepers • replace sleepers
Sleepers out of square - will cause tight gauge	• square sleepers
Steel sleepers - damage or severe corrosion	• replace sleepers

* The GRN (glass reinforced nylon) type insulators are designed to compensate for rail side gall when used with the MV baseplate.

** The Track Maintenance Handbook contains a table showing which type of fittings match the various types of baseplates, concrete sleepers and steel sleepers.

*** Generally sleeper repair techniques will require approval by the infrastructure owner.

Preventative Measures

At locations where gauge problems are expected certain measures can be taken to prevent them:

- Gauge Stops are small blocks screwed to the sleeper. They butt up to the side of baseplates or chairs and provide additional resistance to gauge spreading forces. They may be applied to high rail baseplates or chairs where high speed traffic runs, or low rail baseplates or chairs if low speed traffic runs.
- Gauge widening on very sharp curves (see page 8)
- Extra sleepers
- Use similar sleeper types when replacing them
- Install more resilient ferrules, nylon rather than the normal polypropylene.
- Install upgraded pads and insulators, use thicker or stiffer components
- Preserve timber bearers and sleepers against fungal decay using copper borate plugs.
- Introduce lubrication where sidewear is a problem
- Adjustable check rail arrangements (eg. UIC 33 adjustable check rails or the Vortok adjustable check rail spacer block)

Figure 13 Tie bars must be checked on each track inspection

Gauge Tie Bars

Gauge tie bars may be used as a temporary measure to prevent further widening. Gauge should be corrected to a value less than 1465mm which is representative of the location.

On track-circuited routes they must be of the insulated type. Care must be taken to prevent other materials (including wet ballast) from bridging the insulation. The bars should be installed with the insulation on the same side.

The correct type must be used for bullhead or flat-bottomed rail.

At least three should be fitted at any location in plain line. This spreads the load and prevents the gauge fault spreading along the track.

They should be inspected on each track inspection to ensure:

- that they are square and tight
- that the locknuts are done up tightly against the turnbuckle
- that the insulation assembly is complete and its bolts tightened
- the hooks on the rail feet are not straightening out or cracking on the inside of the hook.

Where tie bars are installed in track circuited S&C they must be insulated from other rails by use of the Vortok clip on insulator or similar.

Where temporary tie bars are fitted a permanent solution should normally be carried out within six months.

A register must be maintained to record the installation of tie bars.

Maintenance of Gauge in S&C

Detailed attention to gauge in S&C is required in each route that trains can take.

As a minimum gauge should be measured at:

- the tips of switches
- all switch drives
- the fixed heel blocks on both routes
- the flangeways of the wing and check rails of crossings

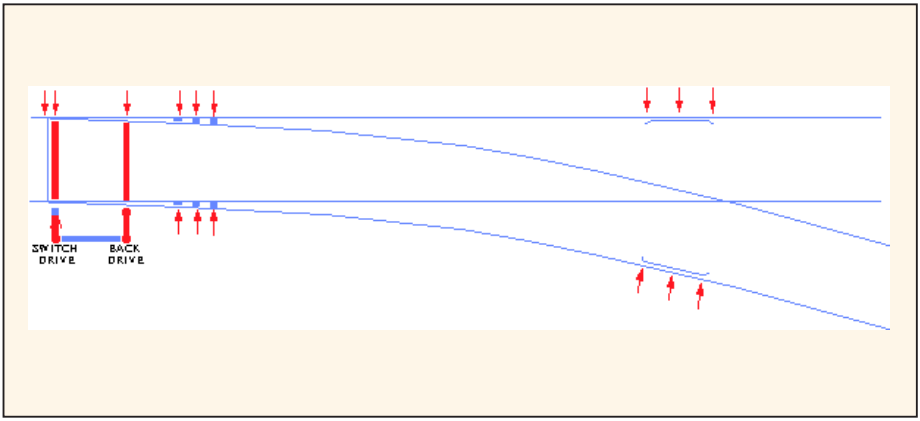


Figure 14 These are the minimum locations for gauge checks in S&C during routine inspection

At switches soleplates should be checked for wear at the gauge stops. Crossings and check rails should be examined for uneven wear or damage resulting from incorrect check rail gauge. Excessive wear or damage on the splay of the check rails is a clear indication of gauge problems

At any S&C unit the components should be all either inclined or vertical. They should never be mixed.

Stock rails may be adjusted for gauge using web liner packings.

When correcting gauge in S&C, flangeway clearances must also be checked and adjusted as necessary.

There are processes available which use epoxy resin to extend the service life of timbers by making up indentation and improving the hold of chair screws.

Construction Tolerances

Where track is relaid gauge must achieve the following tolerances:

	up to 20mph	25 to 40mph	45 to 60mph	65 to 95mph	100 to 125mph
Gauge permissible variation from design in					
plain line	+12,-4	+9,-4	+9,-4	+6,-3	+4,-3
S&C	+6,-3	+5,-3	+5,-3	+3,-3	+3,-3
permissible change over 3m	6	5	5	4	3

These values should be used when checking sites after relaying work is done.

Appendix A

References

Further reading may be found in the following publications

1. Railtrack
   Track Construction Standards
   Railtrack Line Specification, RT/CE/S/102

2. Railtrack
   Track Maintenance Requirements
   Railtrack Line Specification, RT/CE/S/104

3. Civil Engineers Conference CEC/C/0005
   Track Maintenance Handbook

4. Permanent Way Institution
   British Railway Track
   6th Edition 1993

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