7¼ Inch Gauge Society Limited

Permanent Way Maintenance

Gold Award Module

V1.2 Aug 2026

Introduction

This manual is intended to introduce Gold Award candidates into Permanent Way Maintenance, commonly known as Track Maintenance, as part of the 7¼" Society Proficiency Scheme Gold Award. Maintenance of all kinds is an important aspect of any railway, miniature or full size, and this module provides drivers, guards, maintenance teams and others knowledge of aspects that need to be checked in order to maintain a safe environment. Whilst this module may be considered for the benefit of maintenance teams only, the knowledge and safe practices are relevant to everyone involved and will help those who are interested but may not actively take part in running a miniature railway.

To use this manual to qualify for the Gold Award, you will need to have achieved the Silver Award first.

Thanks are due to Nick Bone for drafting this guide, and to the many other people, who helped develop these notes further.

Before we even think of embarking on maintaining a railway and its permanent way, it is important to consider other aspects and to ensure that other elements for safe practices are in place. Health and Safety rules and regulations, insurances, suitable tools, qualifications for safe handling of tools and equipment as appropriate, track design, materials and equipment. There are many things that need to be understood and things to be put in place.

As with any of the Gold Award modules, the content is designed to cover as many aspects as possible but there will always be differences depending on the miniature railway you are working on and society or club you are a member of. However, having a Gold Award should give you a head start and will show your society or club that you have achieved a certain level of knowledge, which will, in turn, enhance the society or club's standing.

For this manual we cover track safety, track formation, track components, loading gauge and track inspection. Please note that you will also need to be familiar with your local track's rules and regulations as well as those you may visit, as there may be differences. However, this module is designed to give you a good grounding.

Proficiency Scheme Co-Ordinator.

August 2026

Subjects Covered

This module is designed to support and enhance your understanding of permanent way or track maintenance on a miniature railway.

The areas covered in this module include:

- Track Safety
- Track Formation
- Track Components
- Permanent Way Inspections

Please be aware that there may be variations to those given in this module which would reflect the Club or Society's track design. This module should provide a base from which you can use and adapt your knowledge and experience to accommodate these.

Please note that this module should be read in conjunction with the Health and Safety Guidance document that can be found on the 7¼" Gauge Society website.

Track Safety

Safety is paramount at any location, whether it is for full size or miniature railways, and many of the aspects and features in this module will be shared with railway operating guidelines. That said, this module will concentrate on miniature railways and track safety.

This may sound obvious, but it is worth mentioning that the track on which a locomotive travels is fixed and this is where the name 'Permanent Way' originates. Permanent Way is the term used in full size railway operation. For those not familiar with this term, an easy way of remembering is that a locomotive cannot deviate from the rails and therefore the travel is limited to and determined by the track. Therefore, it is permanent and it is the way upon which a train travels between the start and finish point.

Workforce Protection

Clearly, common sense should play a part in any protection, but it is always wise to plan and act as if common sense didn't exist. Working on a track as part of track maintenance will need to be carefully planned, warnings and markers put out, and station operations and signallers made aware of timing and locations. There is nothing you can do, however, to prevent someone from getting hurt when they are determined to do so. All you can do is to endeavour to mitigate and reduce the chances of this happening. So, what can we do:

Block the Way

Now the track maintenance is planned, documented and logged, the track needs to be suitably marked showing where work will be carried out. The traditional methods of blocking the track are:

- Red flags
- Flashing red lamps
- Traffic cones

So, we have the methods, now we need to consider the positioning of these markers. These should be:

- In the path of an approaching train
- A certain distance in front of the work area which will be determined by the distance it takes for an approaching train to stop
- Any areas that may obscure the markers such as buildings, track curves, cuttings or vegetation. In these instances, the markers should be positioned in front of these obstructions using the same consideration for distance from the obscured point taking into account the stopping distance of the train

Track Formation

A survey of the terrain upon which the rails are laid needs to be made before any track is laid. Unstable or unprepared ground will only result in the rails moving and thereby could result in locomotives or carriages derailing.

Ground Preparations

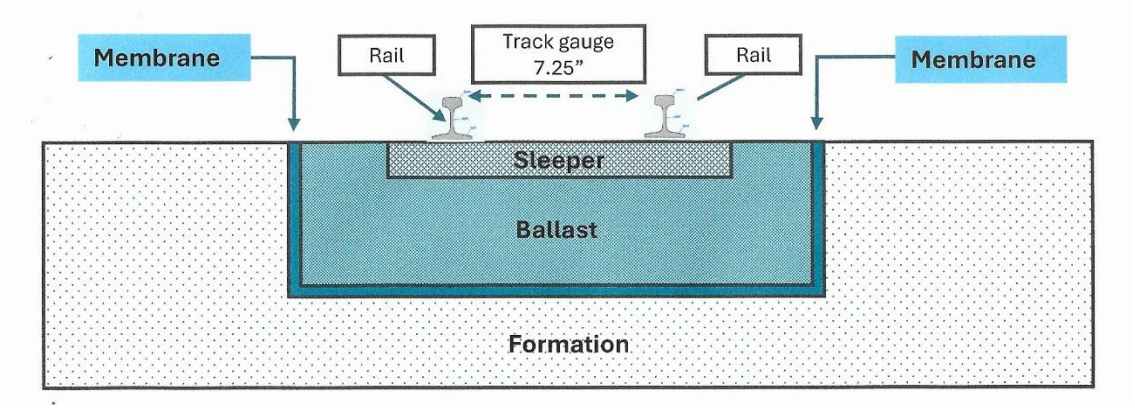
Good ground preparation can reduce the chance of the rails becoming unstable and therefore, after the initial survey, the topsoil will need to be removed up to a depth of 6" or 15 cm –to the formation level or subgrade in the USA. The depth may differ depending on the ground composition, but this initial depth should be a minimum.

It is important to note that rain can be a major contributor to track landslip and anything that is put into the preparation will need to allow rainwater to drain through. Therefore, a geotextile, permeable membrane will need to be laid on top of the prepared track bed. The membrane needs to also hold back soil and or clay from contaminating the ballast. If soil or clay mixes with the ballast, then it will destabilise the ballast which in turn destabilises the rails and can cause them to move.

> **Note**: if the ground conditions are prone to flooding or excessive pooling of water, additional measures need to be taken, such as adding drainage to help to prevent this from occurring.

Once the geotextile permeable membrane has been laid, crushed stone or granite is laid and compounded to provide a stable support for the railway sleepers. Granite is the preferred stone for ballast and is fairly readily available.

> **Note**: the ballast will need to be jagged in shape so that the stones will lock together and form a stable medium upon which the track can be laid. Smooth, round, or oval stones are unsuitable as they will move and not lock in place, thereby causing an immediate danger to any vehicle or person. The wrong shaped stones have been used on railways in the past and have contributed to rail derailments.



Embankment Construction

When constructing an embankment over 3' or 92 cm in height, it is important that the construction is built on the prepared ground (see above). In this instance, rubble is the best foundation for the embankment as it will lock it in position whilst allowing water drainage.

Interestingly, concrete laid on a rubble foundation can also be used to support the track. This is used in full size rail track construction and is especially useful where the railway track is on land that is prone to heavy flooding from streams and rivers.

Loading Gauge

The loading gauge in railways refers to the height and width of the railway vehicle together with clearances, whether this be the locomotive, coaches, rolling stock or a combination. Loading gauge is classified as the maximum allowed height and width for the train, coaches, rolling stock and cargo, to enable it to go through bridges, tunnels, platforms and other railway line or building restrictions.

Whilst much of this is the same for model or miniature railways, they need to also take into account additional height and width for passengers and locomotive drivers, who may be riding on a coach, driving truck, thereby increasing both the height and width of the train.

Note: Loading Gauge is different from Track Gauge. The Track Gauge is the space between the rails, and there are specifications to which miniature railways, as well as full size railways adhere to.

Track Components

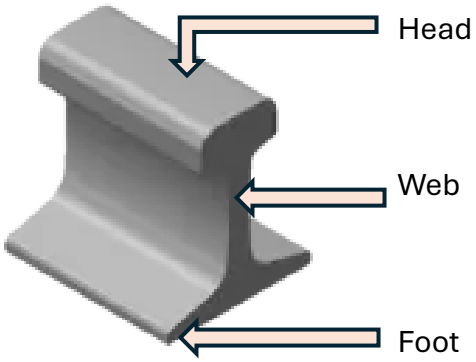
Rails

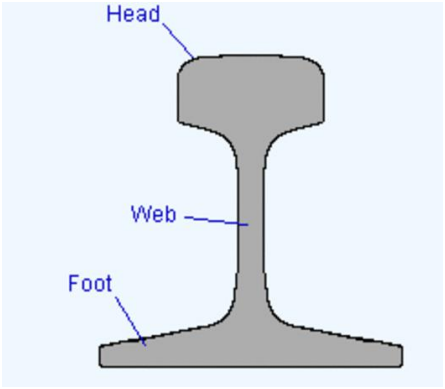
Rails are the fixed mechanism upon which a railway vehicle will travel. Rails can be manufactured from various materials but there are primarily three design options:

- **Steel bar**

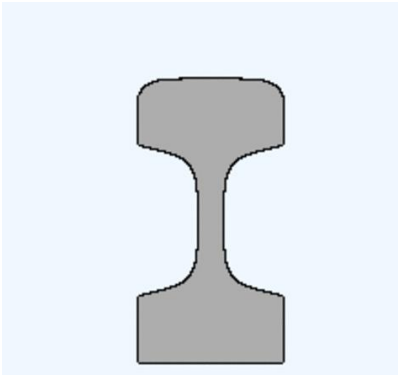
- **Aluminium rail profile** (miniature railways only)

- **Steel rail profile (Flat bottomed)**





- **Steel rail profile (Bullhead)**



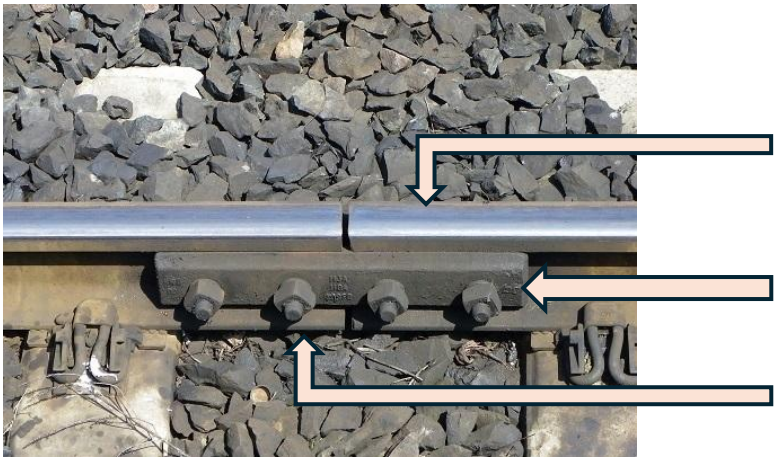
Whatever rail material is used, they will be fixed to cross timbers called sleepers using stainless steel washers and hex head screws, rail chairs or, in the case of flat bar, it is welded to bar that is laid flat on the sleeper.

Sleepers

Sleepers can be made from timber, recycled plastic or reinforced concrete. Many miniature railways are using recycled plastic sleepers as part of an environmental recycling program.

Fishplates

Fishplates, sometimes called a joint bar, is used to join two rails together. They are bolted either side of the rail of the rail web and act as a support to the rails when rail traffic passes over the joints.



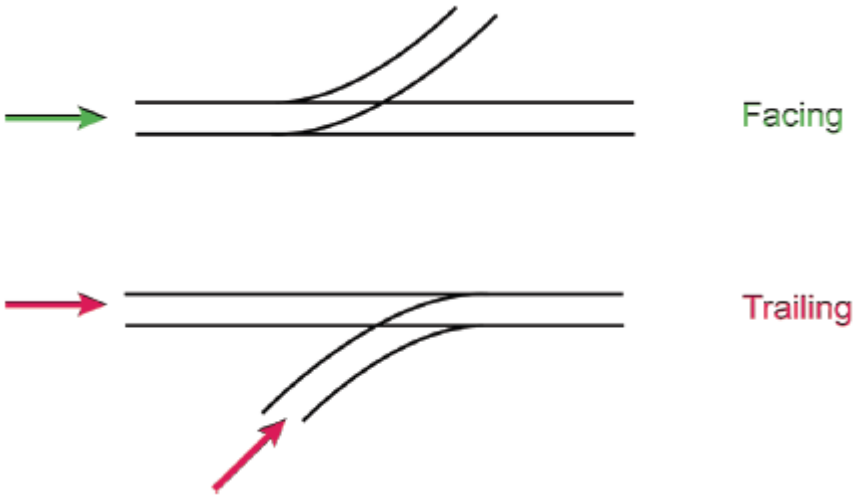
Method for diverting trains from one track to another

Naturally a train needs to be able to go to many destinations and therefore there needs to be means by which it can be diverted onto different tracks. The means for this are called points. (In the USA they are called turnouts or switches). In addition, there are additional terms for these, depending on which way the train enters the point.

Facing Point vs Trailing Point

Fundamentally, if a train enters a facing point and the point is engaged, then the train will be diverted onto another track. If the train enters a facing point and it is not engaged, it will continue straight on.

In the case of a trailing point, the train will continue straight on and will not be diverted.



For a train to move onto another track, it will need to enter a facing point which will lead into a curved track as a transition mechanism.

Transition Curve

Ideally a shallow curve will be used, and this is called a Transition Curve. The curve will enable the train to transition to another track initially with a shallow curve which does become tighter as the train progresses. The reason why the gentle curve progresses to a tighter curve is to enable the train to adapt gradually to the sideway forces as the train passes through the junction, which can be considered to be the main curve. Another transition curve is used off of the main curve to enable the train to join the straight track.

Super Elevation or Cant

When the line supports train speeds over walking pace, a Super Elevation or Cant is used. This is where the outside rail is raised in order to reduce the tendency of the wheel flange to travel from the inside of the rail thereby causing a derailment. (See diagram below) A cant has a similar benefit as well as reducing the wear of the inside edge of the rail. By having a cant on the rail, it is also considered a more comfortable ride for passengers as this has a tendency to balance the centrifugal force and thereby balancing outward forces.

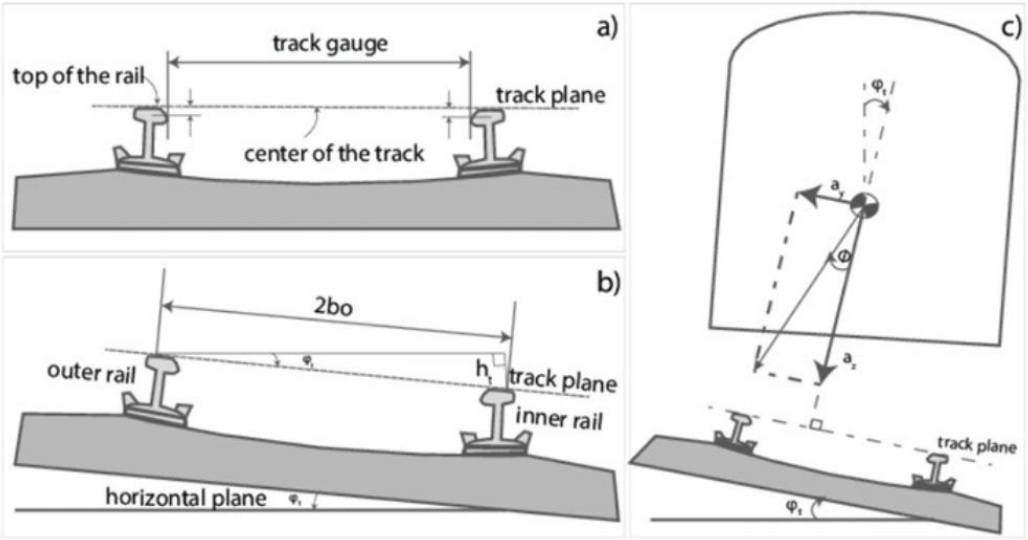


Diagram of a Cant

Permanent Way Maintenance

The Track

All tracks require regular inspection irrespective of whether they are new or well established. Environmental and physical stresses can have an adverse effect on the rails in both their seating and condition; so regular inspections with records of results are advisable, indeed, we would stress that these are essential.

Environmental

The soil upon which the rails have been laid will have an impact on how the rails behave over time. Dry weather, wet weather and hot weather can cause the rails to dip, twist and warp. For example, heavy rainfall can cause ground movement and this may be particularly noticeable in clay soils. The reverse is also true where long periods of lack of rain on clay type soils can cause cracks and movement which, when added to heat, thermal buckling can occur.

To endeavour to allow for environmental damage, an allowance for such events need to be taken into account. The level of allowance and how much twist can be accommodated will depend on the length of the rail and also the longest vehicle whose wheelbase needs to safely travel without risk of damage to the vehicle, passengers or rail. Fortunately, miniature locomotives and rolling stock often have a degree of suspension to accommodate this too.

Physical

Physical damage needs to be combined with environmental to provide a complete picture of potential issues. Physical damage can occur as a result of twisted rails, derailing, incorrect rolling stock gauges to name a few. So, whilst it may appear that there are fewer aspects to checks relating to physical damage, any inspection needs to be carried out as a whole.

Fishplate Joints

As you would expect, any point where two rails are joined can be considered a weak point. This is the case with fishplate joints which can be inspected using a long straight edge as a starting point. The straight edged tool can be metal or wood in nature.

> Method: place a long straight edge on the head of the rail and observe any vertical rail deflection.
>
> Solution: apply packing to the nearest sleepers to the rail joint in question. Care needs to be taken not to over pack, as this will then raise the rail joint above the rest of the rail head. If this happens, then this is just as damaging as a dipped joint.

Fishplates are subject to thermal movement as well as rail creep.

Additional note: Fishplates retaining bolts need frequent tightening as vibration due to rail traffic movement will occur. Checking the fishplate bolts and joints are an important track inspection and track maintenance task, and one for which there is no shortcut.

Rail Creep

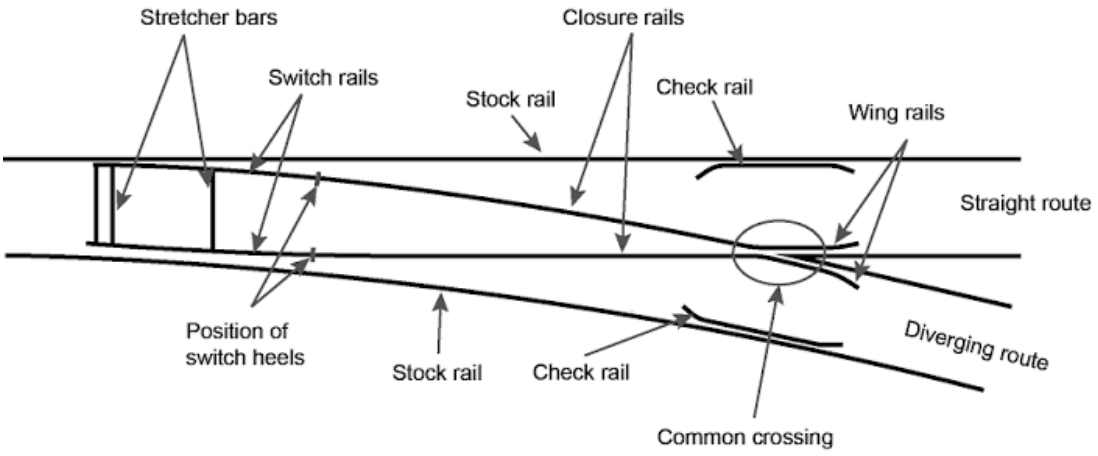
Rail creep is the gradual, lengthwise (longitudinal) movement of steel rails relative to the underlying sleepers in the direction of dominant traffic flow. It happens over time due to the weight of trains, braking and acceleration forces, and temperature changes.

Solution: To rectify a closed joint, the fishplate bolts should be loosened and the rail fixings eased. A rail pulling tool can be used or a wedge placed in the rail joint and then use a hammer to ease the wedge or rail pulling tool into the gap. This will then open the rail joint. Once opened to the correct distance, the fishplate and any disturbed rail fixings need to be tightened in place.

Points or Turnouts

Points require special attention. Bear in mind that these can be single, dual or triple gauge, and more gauges can potentially give more cause for damage if the gauges are not correct or heavyweight vehicles with, say, larger wheels (albeit in the correct gauge), can cause damage.

Point switches need to be checked to ensure there is free movement and there is nothing preventing the points from working correctly. Track inspections should include looking for debris, for example small tree branches, leaves, soil, stones and gravel, in the points themselves. In addition, people walking directly on the points may cause damage as well as wildlife deciding that a rather delicious worm resides next to the point and digs up dirt which in turn lodges itself into the point.

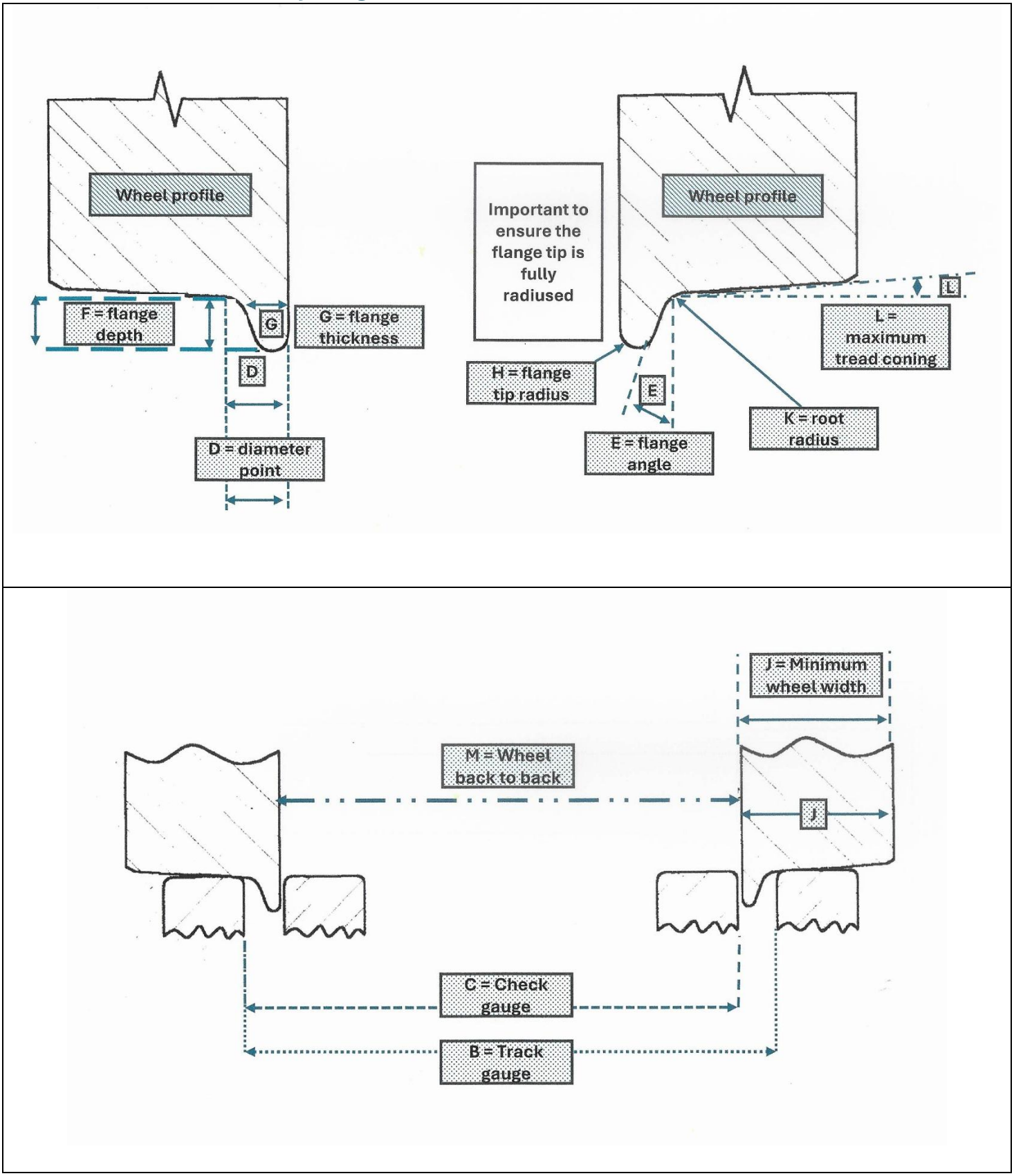


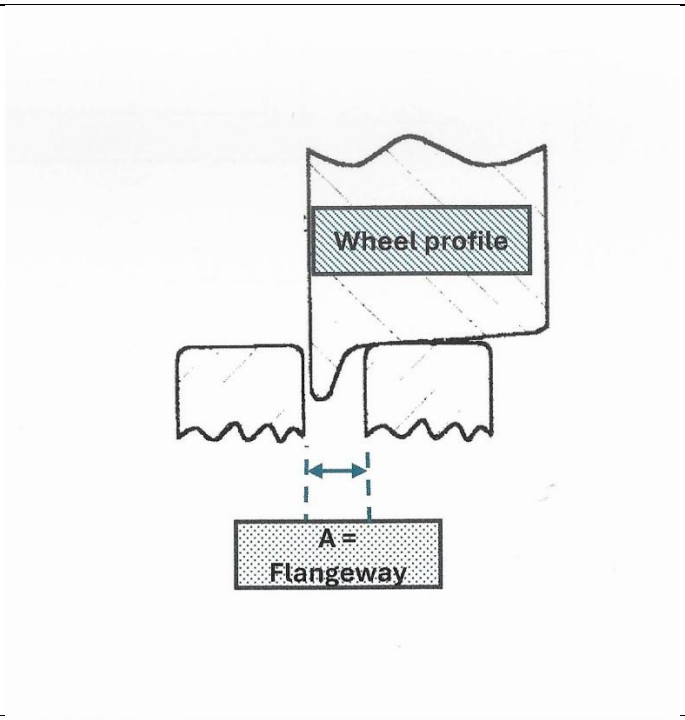
Track Gauge dimensions from the 7 1/4in Gauge Society.

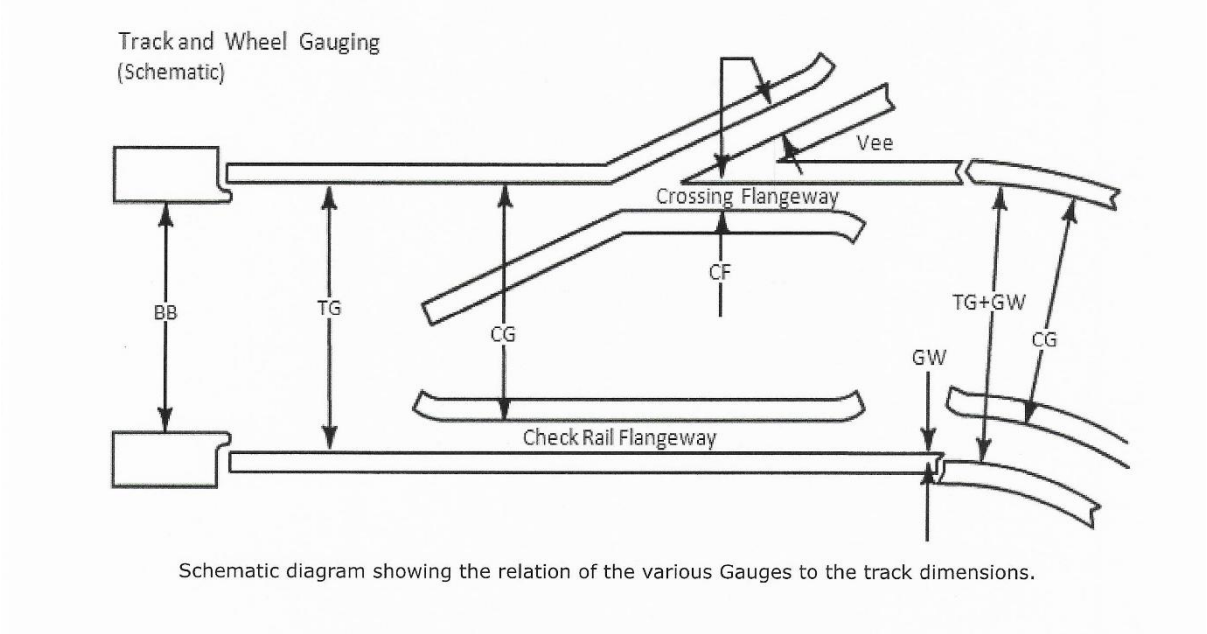
	Reference	Standard Gauge				Narrow Gauge		
		Fraction inches	Imperial inches	Metric millimetres		Fraction inches	Imperial inches	Metric millimetres
		TRACK DIMENSIONS				TRACK DIMENSIONS		
Flangeway	A	$^{9}/_{32}$	0.281	7.15		$^{9}/_{32}$	0.281	7.15
		-0 + $^{1}/_{32}$	-0+0.031	-0 + 0.79		-0 + $^{1}/_{32}$	-0+0.031	-0 + 0.79
Max Gauge widening on curves		$^{1}/_{8}$	0.125	3.18		$^{1}/_{8}$	0.125	3.18
Track Gauge	B	7¼	7.25	184		7¼	7.25	184
		-0 + $^{1}/_{64}$	-0 + 0.15	-0 + 0.38		-0 + $^{1}/_{64}$	-0 + 0.15	-0 + 0.38
		WHEELSET DIMENSIONS				WHEELSET DIMENSIONS		
Check Gauge	C	6 $^{15}/_{16}$	6.938	176.5		6 $^{15}/_{16}$	6.938	176.5
		-0 + $^{1}/_{32}$	0 + 0.031	-0 + 0.79		-0 + $^{1}/_{32}$	0 + 0.031	-0 + 0.79
Diameter Point	D	$^{17}/_{64}$	0.265	6.73		$^{5/}_{16}$	0.313	7.94
Flange Angle	E	20°	20°	20°		20°	20°	20°
Flange Depth	F	$^{3}/_{16}$	0.188	4.76		$^{1}/_{4}$	0.250	6.35
Flange Thickness	G	$^{9}/_{64}$	0.140	3.55		$^{3}/_{16}$	0.190	4.82
Flange Tip Radius	H	$^{1}/_{16}$	0.063	1.59		$^{5}/_{64}$	0.081	2.06
Min Wheel Width	J	$^{13}/_{16}$	0.813	20.64		1 $^{1}/_{8}$	1.125	28.58
Root Radius	K	$^{1}/_{8}$	0.125	3.18		$^{1}/_{8}$	0.125	3.18
Tread Coning Angle Max	L	3°	3°	3°		3°	3°	3°
Wheel Back to Back	M	6 $^{13}/_{16}$	6.813	173		6 $^{3}/_{4}$	6.750	171.5
		-0 + $^{1}/_{64}$	-0 + 0.015	-0 + 0.38		-0 + $^{1}/_{64}$	-0 + 0.015	-0 + 0.38

Note: to be read in conjunction with the wheel and rail geometry diagram

Wheel and Rail Geometry Diagrams

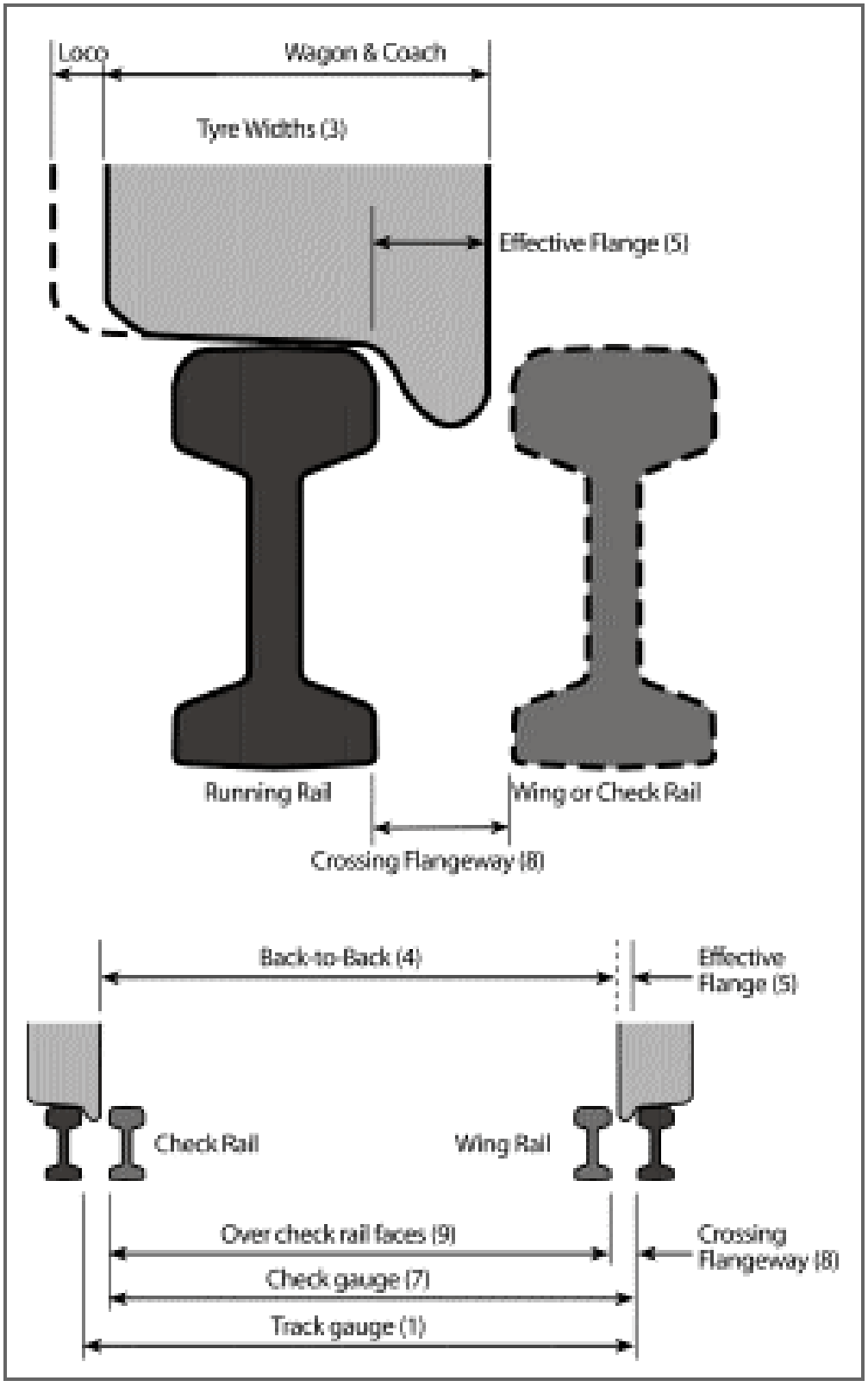






Schematic diagram showing the relation of the various Gauges to the track dimensions.

BB = Back to Back	TG = Track Gauge	CG = Check Gauge
CF = Crossing Flangeway	GW = Gauge Widening	TG + GW = Track Gauge + Gauge Widening


Loco
Wagon & Coach
Tyre Widths (3)
Effective Flange (5)
Running Rail
Wing or Check Rail
Crossing Flangeway (8)
Back-to-Back (4)
Effective Flange (5)
Check Rail
Wing Rail
Over check rail faces (9)
Crossing Flangeway (8)
Check gauge (7)
Track gauge (1)

Glossary

The following terms are not in the main glossary

Term	Meaning
Fishplates	A fishplate (also known as a **joint bar** or **splice bar**) is a heavy metal plate bolted to the ends of two adjoining railway rails to join them together.
Subgrade	In railway track preparation, the **subgrade** is the natural soil or engineered foundation layer directly beneath the track structure. It acts as the primary load-bearing foundation, supporting the weight of the track (ballast, sleepers, and rails) and safely distributing the immense, dynamic loads of passing trains to the ground below
Geotextile	a **geotextile** is a permeable synthetic fabric laid between the soft subgrade (soil) and the overlying aggregate (ballast)
Rail Web	the **rail web** is the vertical, central portion of a steel rail that connects the heavy top part (the **head**) to the broad bottom part (the **foot** or base). It acts as a structural support beam, absorbing and transferring the immense weight of passing trains down to the sleepers
Transition curve	A transition curve is a section of railway track used to connect a straight section to a circular curve, or two curves of different radii. It progressively changes the track radius from infinity down to the curve's radius, allowing trains to adapt gradually to the sideways forces