Finescale Standards – the Whys and Wherefores

1. Background

The fundamental standards on any railway are those relating to the wheels and track, especially if interchangeability of rolling stock is required. Common track standards allow stock from more than one source to use the same track. Similarly, common wheelset standards allow an individual modeller to use stock from different suppliers. This becomes essential, not just for good running, but for guidance through the points and crossings that are an intrinsic feature of any working railway. Unlike the prototype, wheels are components that are generally bought in, since making wheels is a task for which many modellers lack either the skill, facilities and/or time. That makes it essential that the wheels available commercially, either individually or as part of ready to run stock, are both to a consistent standard and matched to the dimensions of the track.

Within 0 gauge, there are now three basic standards of track and wheelset dimensions, which can be characterised as:

Coarse

In the beginning, which really means the years before World War 2, the smallest of the modelling gauges was ‘No. 0 Gauge’ as described by the likes of Greenly. It was based on a nominal 1.25” gauge / ¼”/ft scale, one of a series that went up to 15” gauge / 3”/ft. It was very much a toy gauge, as against model engineering, and in many ways was characterised by the use of modular tinplate track designed to be assembled on the floor. Circumstances demanded wide ‘steamroller’ wheel treads and deep flanges in order to cope with the unevenness inherent in such set ups. Even after the wealthier modellers took to building permanent layouts using brass bullhead rail and whitemetal chairs, wheel standards changed little. It remained the standard for some time, until modellers like Norris showed that track and wheels to much finer standards was a practical proposition, effectively creating what we now refer to as Fine Standard. The older standard became, perforce, Coarse Standard.

Fine (or Finescale)

The work of Norris and others created modern 0 gauge, with finer wheels and track that was more like the prototype to look at. The track gauge was still nominally 1.25” (31.75mm), although the wheel and track standards of the various manufacturers of the time – late 1940s/early 1950s – were not entirely consistent with each other. gauge was retained. The BRMSB (British Railway Modelling Standards Bureau) in 1950 proposed a gauge of 31.56mm for what was then christened 0-Fine, widened on tight curves up to 32mm. For reasons that are now obscure, 32mm was adopted as the standard for straight track, with further widening on curves. In doing so, the seeds were sown for the inconsistencies that now exist between 0-Fine track and wheelsets. Those were then compounded in later years, as Fine Standard became dominant, by changes that the trade made to the wheel profile and gauge dimensions.

The result is that traditional 0 Fine has become something of a pig's ear. The gauge is too wide for the wheels, leading to considerable lateral slop between the wheels and the track. Because of that, the flangeways have become over wide, leading to both wheelset drop in the crossings and wheels striking the ends of check rails. All in all, it works, but only tolerably well

The pursuit of better standards

The late 1960s saw the emergence of Protofour as a refined version of EM gauge, and a vast improvement on 00. Not far behind that was an understandable desire to come up with something better for 7mm scale, a move that is generally believed to have fallen on deaf ears amongst the 0 Gauge leadership. The result was the creation of ScaleSeven which, like P4, started afresh by defining its wheel and track standards as scale versions of the prototype. One consequence of that is that with a track gauge of 33mm, rolling stock built to ScaleSeven standards will run only on track built to the same standards; there is no interchangeability with Finescale 0.

There are many modellers who already have substantial collections of rolling stock, and who, understandably, would not want to adopt S7 on account of the need to replace all of the wheelsets. One result of that situation was the development around 20 years ago of a variation on the existing 0 Fine standards that, by reducing the track gauge, allowed the track to be improved whilst retaining the existing Fine standard wheelsets. The latter is important not only for those who own rolling stock but because it preserves the ability to interchange stock between layouts.

The result has been a divergence from the 'traditional' 32mm gauge standards in two opposite directions. Some have chosen to abandon 32mm-ish gauge in favour of 33mm and the S7 standards. Others, potentially with more established collections and/or a desire to retain interchangeability within a club environment, have elected to adopt the narrower versions of Finescale. These have become known as 0-MF [0-Medium Fine - 31.50mm gauge] and 0-SF [0-Super Fine - 31.25mm gauge]. Both are compatible with wheels to the normal Finescale standards and require no alterations to rolling stock.

2 Determining Standard Dimensions

The defining factors in setting the dimensions of both the track and the wheelsets are:

- the need for the gauge of the wheelsets, ie the distance between the flange fronts, to be sufficiently well matched to the track gauge to ensure that the wheelsets do not slop about between the rails
- the need for the wheels to be able to be guided through crossings, where one rail is necessarily gapped and cannot provide guidance

Although the latter may concern only a tiny proportion of any railway's trackwork, in both model and prototype form, it is actually the most critical part, as any failure to guide the wheels through crossings will result in derailments.

The consequence of this is that for the wheels and track to function as a system, there are three key dimensions:

- track gauge - the distance between the inside faces of the rails
- wheelset gauge - the distance between the flange fronts
- the check gauge - for the wheels, the distance between the front of one flange and the back of the opposite flange, and for the track, the distance from the guiding face of the check rail to the gauge face of the opposite rail

For the wheel and rail system to work, these dimensions are interdependent.

2.1 Check Gauge

On plain track, the wheelsets are guided by the fact that the flanges fit between the rails. However, wherever tracks diverge or cross, it is necessary to create gaps in the rails to let the flanges of the wheels on one route pass through the rails of the other route. This leaves the wheels momentarily unguided, with the risk that they may take the wrong route and become derailed.

To prevent this happening, an additional rail, the check rail, is provided at crossings, located adjacent to the rail opposite the gap. The wheel on that side of the track is now prevented from moving out of line by virtue of its flange being trapped between the running rail and the check rail, as shown in Figure 1 below.

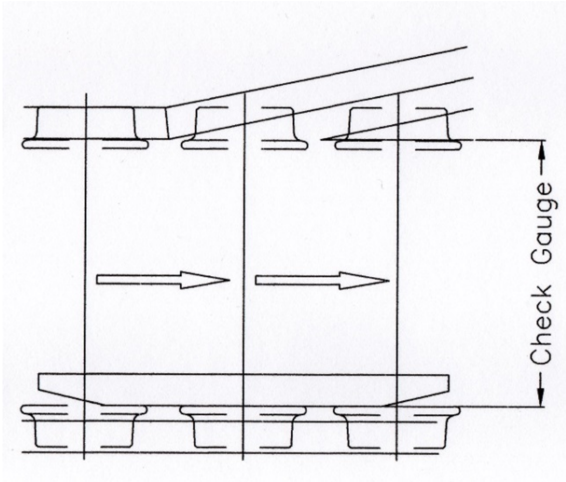

Figure 1 - The correct functioning of the check rail, showing how the wheels are prevented from deviating into the crossing gap

The check rail is gauged from the face of the crossing nose, so that whilst the flange on that side is in the gap, the wheelset is prevented from moving sideways and striking the nose of the crossing or going the wrong side of it. Ideally, the track check gauge is a tad larger, and definitely no smaller, than wheelset check gauge. That way, the back of the other flange just kisses the face of the check rail with the minimum of sideways jerk as it strikes the entry flare.

For convenience, we can refer to the wheelset check gauge as 'c' and the track check gauge as 'C'. (It is a convention in full size practice to give wheelset dimensions lower case letters and track dimensions upper case.)

There is a critical relationship between c and C, in that c must not be greater than C; if it is, then the check rail can no longer ensure that the opposite flange remains clear of the crossing nose. The same will happen if the check rail is incorrectly set too near to the crossing nose, as illustrated by Figure 2 below.

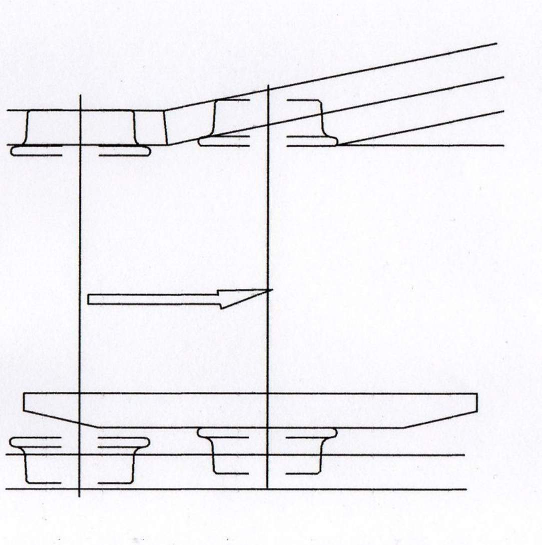

Figure 2 - The effect of the check rail being under gauge (or the wheelset being over gauge). The check rail can no longer hold the opposite wheel flange clear of the crossing gap, resulting in the crossing nose being struck and the wheel derailed.

Technically, it does not matter if the check rail is over-gauged, i.e. set too far from the crossing nose, in that the flange on that side will be kept clear of the nose. However, what will happen is that the wheel on the opposite side will strike the flare at the end of the check rail, causing it to be jerked sideways. The ideal situation is where the back of the flange just touches the check rail as it enters the flangeway.

For the wheelset, under gauging is tolerable only up to a point. If the wheels are under gauge by too much, the distance between the flange backs (the 'back to back') can be less than the width between the wing and check rail faces. When this occurs, whilst the wheels will still be guided correctly, the flange of the wheel next to the crossing will either become jammed against the wing rail, impeding free running, or in extremis, ride up onto the top of the wing rail, as illustrated in Figure 3 below.

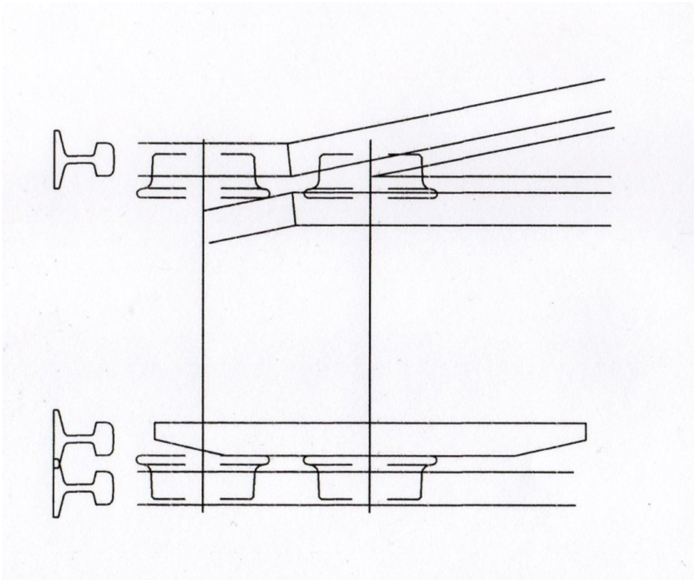

Figure 3 - The effect of the wheelset being excessively under gauge (or the check rail being excessively over gauge). Instead of passing through the crossing flangeway, the flange rides up the wing rail.

Because of the critical nature of the check gauge dimensions in determining whether or not wheels will successfully negotiate crossings, they are the defining dimension for any wheelset and track combination, from which all of the other dimensions are determined.

2.2 Flange Width

In terms of guidance, the width of the flange (e) is unimportant. However, both it and the crossing flangeway width (W) are inseparably linked with the width of the wheel tread by the need for the latter to provide, and be provided with, continuous support through the gap in the crossing required for the intersecting route.

As the flange width is increased, so too does the width of the flangeway between the crossing rails and the wing rails. In turn, as the flangeway increases, so does the width of the wheel tread, otherwise it will run off the edge of the wing rail before reaching the crossing nose, thus dropping into the crossing gap. That is best seen on the 'steamroller' wheels found on early 0 gauge trains and still retained by the 0 Coarse Standard. There is no true algebraic relationship between these dimensions as the ability of any given width of tread to support the wheel through a crossing is limited by the crossing angle. In practice, a compromise set of dimensions is chosen that will provide adequate support to the wheels for the range of crossing angles normally encountered. In modelling, this is also influenced by the desire towards maintaining a reasonably prototypical appearance. For 0 Finescale, the flange width has become a *de facto* 0.75mm as a result of its near universal adoption by the trade in preference to the older 1.00mm standard.

2.3 Back to Back / Width over Checks

These are another two consequential dimensions, in that they are defined from the check gauge and the flange width/flangeway width. Clearly, the width over the wing and check rails at the crossing must not exceed the distance between the backs of the flanges on the wheelset, i.e. the back to back.

3 Track and Wheel Standards Defined

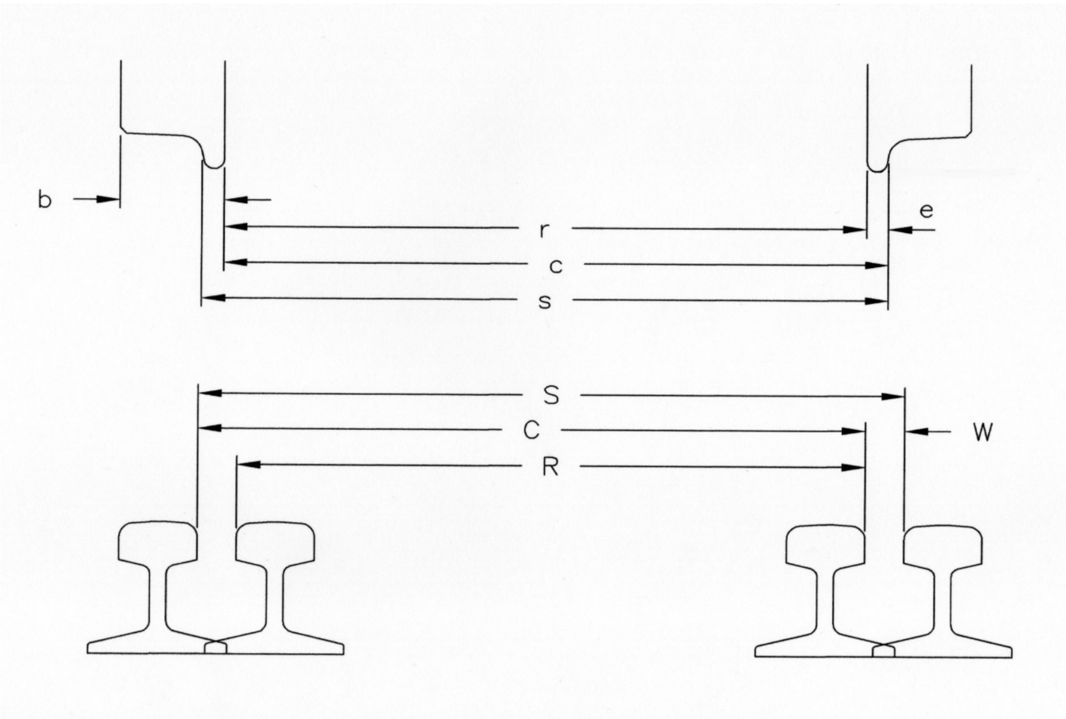

Figure 4 - Critical dimensions for track and wheelsets

Referring to Figure 4, the various dimensions interrelate with each other as follows:-

Dimension			
Wheelset Check Gauge	**max**	**c**	r + e
Flange width	**max**	**e**	
Back to back (min)		*r*	*c - e*

Wheelset gauge		*s*	*c + e*
Wheel width (min)		*b*	
Flange height		*h*	
<u>Track Check Gauge</u>	**min**	**C**	C ≥ c
Track gauge	*min*	*S*	*C + W* *S ≥ s*
Flangeway		*W*	*S - C*
Width over check/wing rails (max)		*R*	*S - 2W* *≤ r*
Switch throw (min)		*PT*	*S-c*

Notes: Entries in **bold text** are the defining values for that standard's set; all other dimensions, shown in *italic text* are derived values.

4 Finescale Track Standards

These are applicable to 4ft 8½in prototype gauge models and 7mm = 1ft scale. For other gauges, the principles set out in sections 2 and 3 above should be applied to generate the standard dimensions for that combination of gauge and wheelset dimensions.

Dimension		Fine Standard	Fine 0-MF	Fine 0-SF	Scale Seven	Exact Scale	Notes
<u>Wheelset Check Gauge</u>	c	29.95			31.96	31.95	Maximum
<u>Flange Width [1]</u>	e	0.75			0.63	0.64	Nominal
Back to back	c-e	*29.2*			*31.33*	31.26	*Nominal*
Wheelset gauge	c+e	*30.7*			*32.59*	32.6	*Maximum*
Wheel width (min)		*3.50*			*3.16* *3.26*	3.35 2.92	*Maximum* *Minimum*
Flange height		1.00			0.66	0.69	
<u>Track Check Gauge</u>	C	30.00			31.98	31.98	Minimum

Track gauge [4]	S	32.00	31.50	31.25	33.00 min 33.45 max	32.96	
Crossing flangeway	*W (S-C)*	*1.75*	*1.50*	*1.25*	*1.02* *1.08*	*1.01*	*Minimum* *Maximum*
Width over check / wing rails (max)	*R (C-W)*	*28.25*	*28.50*	*28.75*	*30.96*	*30.91*	*Maximum*
Switch throw (min) [3]	*PT (G-c)*	*2.05*	*1.55*	*1.30*	*1.04*	*2.48*	*Minimum*

Notes:

[1] Flange width –

A nominal flange width of 0.75mm has become a de facto standard, together with a 29.2mm back to back dimension as a result of most manufacturers having followed a lead set by Slaters many years ago. There are a few manufacturers, mostly of cast iron wheels, who use flange widths of around 1.0mm. This does not present a problem in compliance with the key standards provided that the back to back dimension is adjusted accordingly so as to maintain the maximum check gauge value. Similarly, it is possible to use S7 profile wheels on track built to 0-F/0-MF/0-SF standards, with the back to back increased to compensate for the thinner flanges.

The table below gives the variation required for various common flange thicknesses -

Nominal flange thickness	Resultant back to back for 29.95mm check gauge	
0.63mm	29.3mm	S7 wheels regauged
0.75	29.2	Normal standard
0.87	29.1	
1.00	29.0	Typical CI wheels

[2] Gauge widening –

The need for gauge widening depends on the radius and the difference between the wheelset and track gauge dimensions, becoming more necessary as the difference reduces. For practical purposes, in 0-F, 0-MF, 0-SF, gauge widening is not generally necessary other than for very small curve radii, such as would be found in industrial environments. For S7, reference should be made to prototype practice.

[3] Switch openings –

The values given are the minimum required to ensure that the flange will clear the back of the open switch rail. In practice, the switch throw is greater than this to allow for narrowing of the flangeway towards the heel end of the planed section of the switch rail. Modellers may wish to adopt a smaller than prototype throw for reasons of improved appearance.

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