

Buckled rails and saggy wires: high temperatures and the railways

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Nigel Wordsworth looks into the issues heat can cause for the railways, and what experts do to combat the scorching hot weather's effects.

On the hottest day of the year, train companies are cancelling services and changing timetables.

Why? What is the connection between high temperatures and disrupted train services?

It all comes down to the steel rails that the trains run on. Most materials expand and contract when they are heated up or cooled down. Metals, such as the steel in the rails, do so more than most other materials.

When rails used to be made in lengths of around 60 feet (18 metres), the joints between the comparatively short sections gave an uncomfortable ride, the 'diddley dee' people often joke about. However, those joints also allowed for a degree of expansion in hot weather.

To give a smoother ride, rails are now much longer. As manufacturing techniques have improved, they are now rolled into 108-metre lengths straight from the steel mill and welded together in a factory

environment into 216-metre lengths for delivery to site. Once on the railway, they are welded into even longer lengths.

While this makes for a smoother ride, it does mean that each rail will expand a lot more in real terms. A 500-metre rail will expand by 6cm if its temperature increases by 10 degrees centigrade, a one-mile length (1,600 metres) will expand by 17cm – six inches in imperial units – and that's a lot.

To control expansion in normal conditions, continuous welded rail (CWR) is 'stressed' to a predetermined level. This means it is stretched, using hydraulic rams, to the length that it would be at a temperature of 27 degrees, known as the Stress-Free Temperature (SFT). So, the rail therefore has to reach a temperature of 27 degrees before it will expand at all.

Furthermore, track in good condition can reach a temperature of 32 degrees above the SFT before there is a risk of it buckling – that's 59 degrees.

Which is all well and good. However, temperatures are hitting 40 degrees at the moment, and unprotected steel rails can reach temperatures of up to 20 degrees above air temperature – which would get them to almost 60 degrees – above the safe working temperature. And that is why temporary speed limits are being introduced and services are being cancelled.

Other measures are being taken too. There have been photographs in the popular press of track workers painting the sides of rails white. This is actually surprisingly effective and can reduce rail temperatures by up to ten degrees, so bringing it safely under the 59-degree threshold. While the whole network can't be painted, points and junctions can be treated this way, so moving parts don't jam due to expansion, as well as known trouble spots.

Hot weather can cause other problems too. Overhead electrification wires, made from copper, expand and then sag, although later system fitted with pretensioners are less liable to this.

So next time you are on a train on a hot day, enjoy your air-conditioned carriage and look out of the window to see if you can spot any white rails...