

# Temperature and Rail Laying

Track buckling is of real concern to M/W officers. Maintenance gangs must therefore follow specific procedures to eliminate — or at least minimize — the occurrence of this undesirable phenomenon.

Track buckling is associated with the build up of longitudinal compressive forces in continuous welded rail. These forces arise from an increase in temperature<sup>1,2</sup>. This rise in temperature is referenced against the “neutral” or force-free temperature of the rails—the temperature at which the thermal force induced in the rail is zero.

## Compressive and tensile effects

Compressive forces are developed when the temperature of the rail is greater than this neutral temperature. Conversely, if the temperature of the rails decrease below the neutral temperature, tensile forces are developed. If these forces become great enough, they can cause rail pull-aparts. Thus, the actual longitudinal thermal force in rail, at any given time, relates directly to the difference between the actual (instantaneous) temperature of the rail and the neutral or force-free temperature. During hot weather, the actual temperature in the rail can be 30 to 40 degrees F. above ambient air temperature.

Most railroads have well-defined guidelines and specific temperature ranges for the laying of CWR<sup>3</sup>. This ‘laying temperature’ is usually defined for each geographical region. Generally, it is set to avoid the extremes of track buckling, on the one hand, and pull-aparts on the other. For those geographical locations where the ambient temperature range is very large, the tendency has been to place the laying temperature at the higher end of the region’s temperature range to prevent track buckling. Reliance then is on the track circuits in signal territories for detecting rail pull-aparts<sup>2</sup>. If the rail is laid at a high enough temperature, the temperature increase in the rails should never be sufficient to buckle the track.

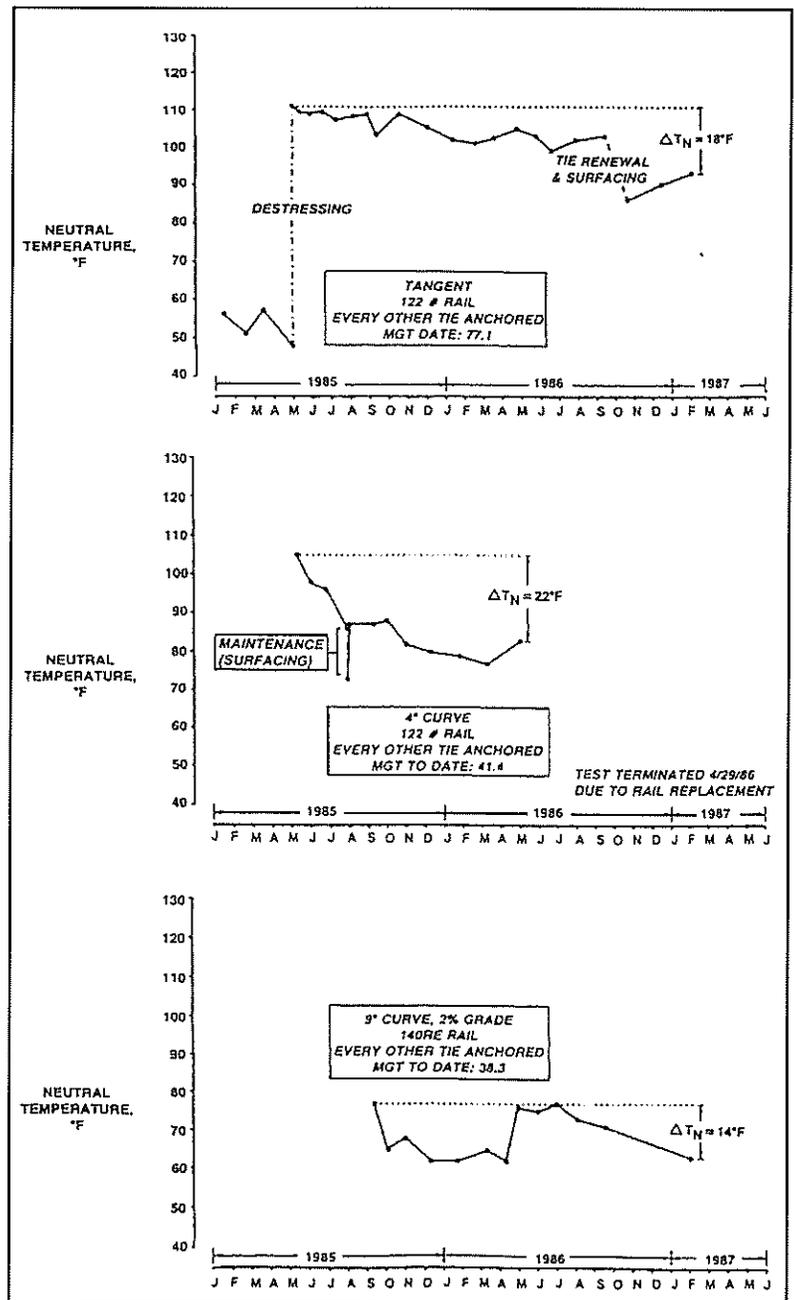


Figure 1 — Average Neutral Temperature Shift on Three Test Sites<sup>1</sup>

### *An inconstant temperature*

Recent research, however, indicates that the rail laying temperature is not constant with time<sup>1</sup>. It appears to vary as a function of traffic and maintenance activity, and has an overall tendency to decrease. This results in rail neutral temperature that is below the rail laying temperature. Correspondingly, there is a greater potential for high longitudinal compressive forces to build up in the rail.

The results of the mentioned research are illustrated in Fig. 1. (see p. 113). It shows the average neutral temperature measured at three railroad test sites over a one- and two-year period. In all three cases, the rail neutral temperature decreased by 14 to 22 degrees F. from the initial rail laying temperature. In addition, significant short-term temperature changes representing greater variation in the neutral temperature over short periods of time were also observed. As illustrated by the figure, these short-term variations appear to be associated with track maintenance operations, such as surfacing and tie renewal. Seasonal temperature fluctuations in the neutral temperature of the rails were also observed during this test period. This is particularly evident at the site bottommost in Fig. 1. (see p. 113).

These results also indicate:

1. On tangent track, the temperature decrease occurs predominantly during the fall-winter-spring months.
2. Larger decreases in neutral temperature occurred on curves as opposed to tangent track.
3. Short duration shifts are associated with track surfacing activities.
4. The general tendency is for the neutral temperature to decrease and possibly stabilize at a reduced value.

These results strongly suggest that simply setting a rail laying temperature, particularly a high temperature, is not sufficient in itself to guarantee the elimination of track buckling. Rather, a comprehensive effort based on an understanding of the phenomenon and its mechanisms is needed to properly establish and implement an effective track maintenance and buckling prevention program.

#### References:

1. Kish, A.; Samavedam, G.; Jeong, D.: "The Neutral Temperature Variation of Continuous Welded Rail"; AREA Bulletin 712, October 1987.
2. Kerr, A.D.: "Thermal Buckling of Straight Tracks, Fundamentals, Analyses, and Preventive Measures"; AREA Bulletin 669, September 1978.
3. Zarembski, A.M.; Magee, G.M.: "An Investigation of Railroad Maintenance Practices to Prevent Track Buckling"; AREA Bulletin 684, September 1981.