

THE EFFECT OF FOOT GALL AND CORROSION PITTING ON THE STRENGTH OF RAILS

This report contains the results of fatigue tests carried out on a large number of full-section rail specimens taken from running lines. These results are analysed to provide stress-life and fatigue limit data for 'used' rail, including the effects of foot gall and corrosion pitting.

Under service conditions, rails tend to be corroded, particularly in locations where the rail is usually wet, such as wet spots in tunnels. As well as causing loss of section, which increases the applied stresses in the foot, specific corrosion pits tend to form, which act as stress concentrators and reduce the fatigue life of the rail. In addition, over sleepers, particularly where the rail bears directly on a rail chair or baseplate with no pad in between, the rail can become what is known as galled. It is believed that the products of corrosion and fretting act as an abrasive and grind away the rail foot as the wheel passes over the rail and the rail moves slightly in the chair or baseplate. The result is a further, often significant, loss of section; moreover the transition between normal and galled rail can be abrupt, and such a transition acts as another stress concentrator.

Included in this report is an investigation as to whether there is any correlation between the condition of the rail as recorded by the Ultrasonic Test Unit (UTU) and its fatigue performance.

The conclusions are as follows:

- In general, used rail is less strong than new rail
- Rail foot failures tend to occur at gall transitions and corrosion pits
- In general, rail type and geographic location do not have any effect on fatigue strength
- Used rail appears to exhibit a fatigue limit in the region of one million cycles.
- Except where severe gall occurs (which would be identified ultrasonically), the fatigue strength of galled or pitted rails falls in a well-defined scatter band. For such rails the lower bound fatigue limit range is 163MPa at an applied load ratio of zero.
- The fatigue strength of badly galled rail can be approximated, with a fatigue limit of 127MPa.
- Ultrasonic rails do indicate badly galled rails as such, but cannot be relied upon to detect even serious corrosion pitting.
- The method of predicting rail stress factors by height and head measurements is accurate to within 1% overall, but the error in stress for individual cases can occasionally be as large as 10%.
- Values of rail fatigue strength used in the past are realistic.