

Preventive Rail Grinding

The relationship between rail wear, rail fatigue, lubrication, and grinding has been the focus of a large amount of research, particularly over the last several years. This activity stems directly from the importance of rail life, thus rail replacement costs, to maintenance officers. There is an ongoing concern for extending the life of rail in track. As such, the relationship noted above has been the subject of several previous *Tracking R&D* columns (see *RT&S* Feb., 1986, Oct., 1985, Jan., 1985).

Amid the ongoing research on rail is a specific series of studies into the nature of rail contact or surface

fatigue as it occurs in the contact band between the wheel and the surface of the rail. This band is taken nominally as 2½-inches wide. Under study too is the relationship between rail wear and rail surface fatigue.¹ By varying the type and rate of rail wear, which can be either abrasive or adhesive in character, the initiation and propagation of contact fatigue are in turn affected.

This phenomenon is noticeable particularly in well-lubricated track under heavy axle loadings. Here, surface fatigue cracks can begin to a depth of 50 microns (.002 inches) because of a plastic instability of the surface layer of the rail steel.¹ Other researchers, though, have suggested that this fatigue initiation depth is more in the range of .0016 to .012 inches.²

Thus, the cracks will be at or near the surface of the head of the rail. If the rail has not been well lubricated, the surface cracking leads to the formation of wear particles. These would be removed under traffic and would result in the very short rail lives experienced commonly in unlubricated curves under heavy axle loads. However, in the case of well-lubricated curves, these particles will not be worn away and will remain in place on the head of the rail. And though initially small, these fissures will propagate as contact fatigue cracks. They in turn will lead to spalling and corrugation in the head of the rail.

Preventive grinding

In order to control these surface fatigue cracks effectively, and to prevent their growth into spalls and/or corrugations, it has been suggested that light and frequent "preventive" rail grinding be employed as an alternative to traditional "corrective" grinding techniques. Corrective rail grinding is used when corrugations are already present in track. However, in such corrective action, multiple passes of a grinding train are often required to eliminate *all* of the corrugations. Yet, even this is not general practice, since railroads traditionally do not grind to the bottom of the deepest corrugation. Nonetheless, as seen in the included figure, part (a), small fatigue cracks are often present below the bottoms of corrugations.

Thus, if the rail is only ground to the bottom of the corrugations, these cracks will still remain and will serve

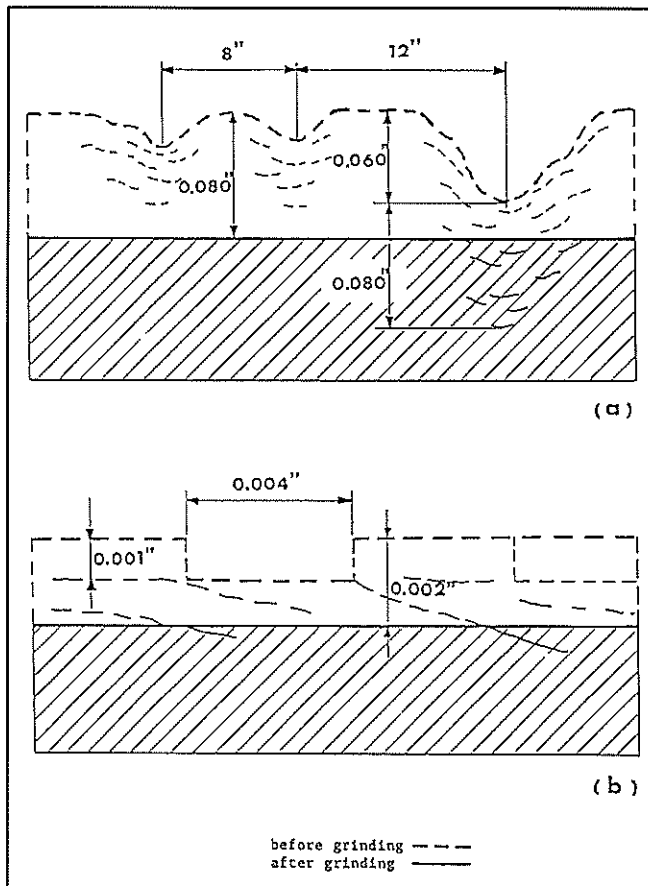


Figure 1 — Schematic of (a) corrective and (b) preventive grinding shown on (a) longitudinal and (b) transverse sections of railhead.

as starting sites for recorrugation. This is particularly true in North America, where *overgrinding* of corrugations, that is, to below the bottom of corrugations, is not employed generally.

If these surface fatigue defects or surface cracks can be eliminated *before* they extend and grow into corrugations, then — it is suggested — the overall life of the rail can be extended and the cost of maintaining that rail reduced throughout its life.

By the use of preventive grinding, these defects can be removed while they are still in the form of small surface cracks, as illustrated in part (b) of the figure, thus keeping the rail surface free of corrugations during its service life. This approach would require frequent “light”

grinding that would remove significantly less metal per pass than the more traditional “heavy” corrective grinding. In this manner, the rail would be more effectively maintained. And when used in conjunction with a program of effective lubrication, this approach will result in an increased life for rails under conditions of heavy axle loading.

References:

1. Kalousek, J., “Rail Wear and Contact Fatigue Model Utilizing Lubrication and Grinding to Extend Rail Life,” Seminar on Rail Freight R&D, Montreal, June 1986.
2. Ichinose, H., et al., “An Investigation on Contact Fatigue and Wear Resistance Behavior in Rail Steels,” Heavy Haul Railways Conference, Perth, Western Australia, Sept. 1978.