Effective Rail Inspection

The effective inspection of rail for internal fatigue defects is an ongoing concern of railroad maintenance-of-way officers. This subject has been addressed in previous *Tracking R&D* articles (see *RT&S* March 1986, December 1985 and July 1985). However, rail inspection continues to be the focus of several major research activities. These fall under the general heading of "Rail Integrity." As such, these efforts have recently been addressing the development of optimum rail inspection procedures with the use of existing rail flaw inspection equipment.[1,2]

One aspect of this activity has been the selection of optimum inspection intervals for rail flaw test cars. It is an issue reaching even greater importance as effective lubrication practices shift the primary mode of rail failure on heavy freight railroads from gage face wear to fatigue defects (see *Tracking R&D*, *RT&S*, January 1985).

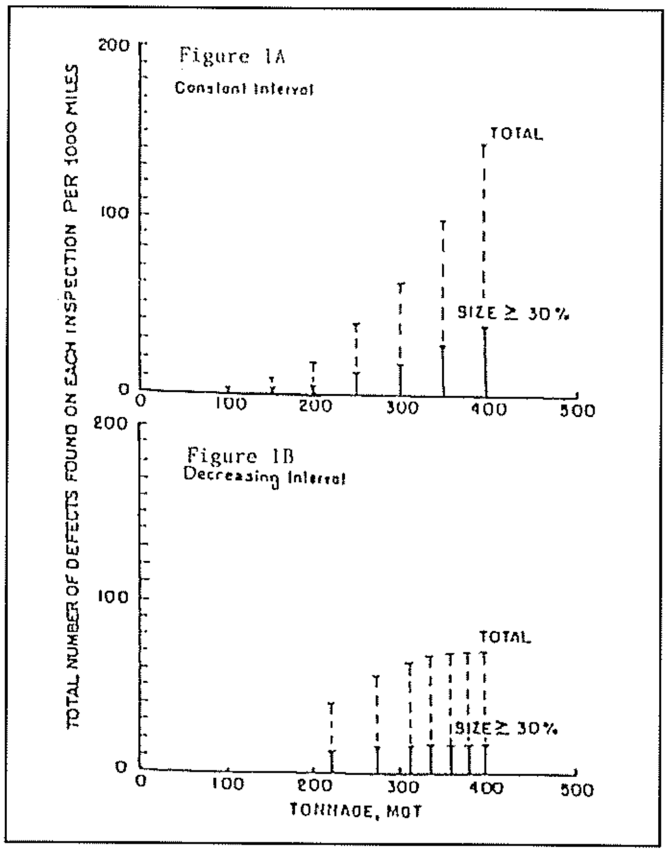

Figure 1 — Comparison of Alternate Inspection Strategies

Tonnage breeds defects

It has been documented that rail under heavy axle loadings, and as it accumulates tonnage, will exhibit an increasing number of fatigue defects. Thus, if the traditional approach to inspection is used, which investigates the condition of rail after a set time period or according to a set tonnage interval, the number of defects detected by test cars will increase. This is demonstrated in Figure 1A, which is based on an illustrative analysis.[1] The chart shows that the number of defects found per 1000 miles increases for each subsequent inspection.

This increasing number of defects per inspection interval is of great concern to track maintenance officers. The defects are distributed in size.[2] And the reliability of the conventional test equipment is a function of defect size. This is illustrated in Figure 2.[2] Thus, as the number of defects between inspections increase, the number of undetected defects that will remain in track during that inspection interval will also increase.[2]

Variable inspection cycles

A recent alternative approach[2] suggests that the inspection interval be varied as the rail ages. Specifically, as the rail accumulates tonnage, the interval between rail flaw inspections (either in time or in tonnage) should be decreased. By properly decreasing this interval as the rail ages, and thus becomes more prone to developing fatigue defects, the actual number of defects found at each inspection can be maintained at a constant level. This is illustrated by Figure 1B. It shows that using an appropriately decreasing inspection interval — for instance, increasing the number of inspections per year as the rail ages can result in a constant level of detected defects.

By varying the inspection interval with rail age, the number of detected defects per inspection cycle can thus be held constant. Consequently, the number of unde-

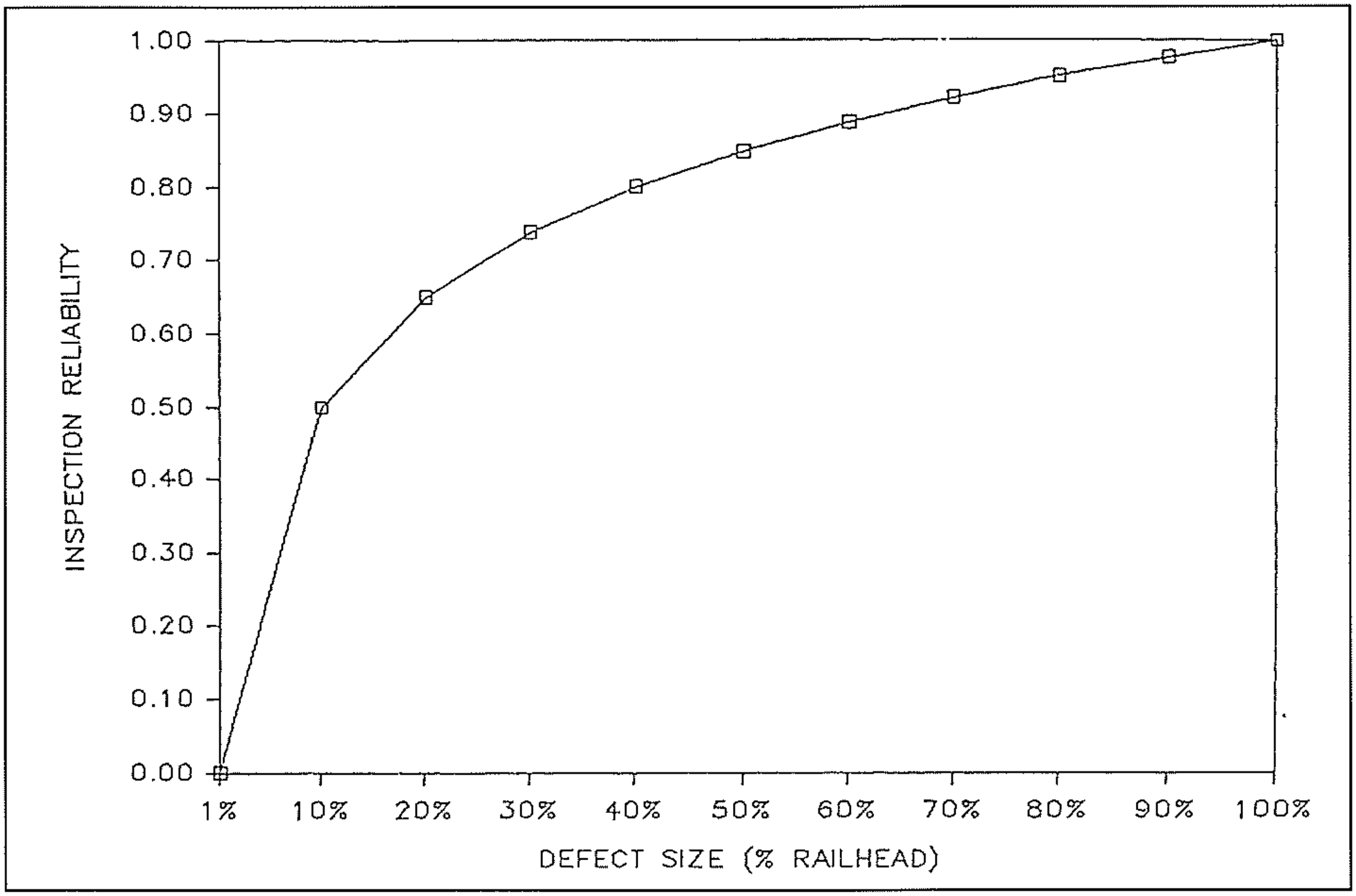

Figure 2 — Reliability of Conventional Rail Test Equipment (AAR/TSC Model)

tected defects will likewise be held constant. This of course assumes the level of inspection reliability is maintained, not an unreasonable assumption.

Defect count trigger

With this concept in mind, the question emerges as to just what is the optimum inspection interval for the rail as it accumulates tonnage. One recent attempt to define a varying inspection interval made use of the defect count including service breaks and detected defects, between inspections as a trigger to control testing frequency.[2] In this approach, an initial test frequency of 16 MGT was suggested, after a 100 MGT test-free interval following initial mill testing. However, the total defect count — again both service breaks and detected defects—is monitored for each inspection period. If this defect count exceeds 1.2 defects per mile per inspection interval, the test frequency is doubled. That is, the test interval is cut in half. In this way, the testing frequency is linked directly to the rail's defect count.

The intent of this method is to concentrate rail inspection along that track having high cumulative tonnages, high traffic densities, and high defect rates. Consequently, rail testing can be directed to those locations which are in greatest need of investigation and for which the potential of rail failure is the greatest.

References:

1. Steele, R. K., "Rail Integrity: Recapitulation and Use of Concepts", Rail Integrity Meeting, Danvers MA, October 1983.
2. Davis, D. D., Joerms, M. J., Orringer, O., and Steele, R. K., "The Economic Consequences of Rail Integrity", Third International Heavy Haul Railway Conference, Vancouver, BC, October 1986.