More Rail Reliability Issues

Effective and reliable inspection of rail for internal flaws or defects remains a key concern for railway maintenance personnel. This has been addressed previously in *Tracking R&D* (July 1988, January 1987, March 1986). Because of its importance, however, it remains an important area of research and investigation.

The issue of testing reliability, and in particular the ability of conventional inspection techniques to reliably locate defects of differing sizes, has been a focus of recent attention. One such recent set of railroad tests[1] examined three different testing contractors on two different track segments. In each of these two test sections, two contractors tested the same stretch of track independently without any knowledge of the results of the other contractor. In fact, the order of testing was reversed to insure the fairness of the test. The results of these tests are presented in Table 1.

As can be seen from these results, at the first test site only 66 defects out of a total of 220 defects were found by both contractors. This represents only 30 percent of the total number of defects. This is in spite of a relatively low false alarm rate for both contractors. This difference was also noted in the type of defects found, where contractor A found more vertical split heads and contractor B found more web defects.[1] Contractor B was also noted to have improved performance in the joint area, in jointed rail territory.

These results support earlier research that showed the reliability of detecting internal defects, using conventional test equipment, varies as a function of defect size, with defects less than 10 percent of the railhead having a less than 50 percent probability of detection.[2]

The results at the second test site were similar. At this site, contractor A and contractor C both detected only 16 defects out of a total of 48 defects located. This represents only 33 percent of the total defects detected. However, in this case, contractor C had a very high false alarm rate, due to the contractor's low detection threshold.[1] It was noted that this also tended to overburden the operator, a potential problem with any of the current operator-dependent flaw detection equipment.

This current dependence on operator "skill" has been noted to cause a variation in the detection reliability, as a function of operator experience or simply level of fatigue. This has resulted in increased interest in the use of computer systems to analyze the output signals from the detection equipment and interpret them. Fig. 1 illustrates how this type of computerized analysis, sometimes referred to as "artificial intelligence," would fit into the testing process. By working in parallel with — or possibly even replacing — the detector car operator, the computer consistently can analyze the inspection signals accurately and objectively. This has the potential to increase the ability of even current inspection equipment to detect a larger percentage of defects — i.e., to increase their reliability.

By focusing on the reliability of test equipment, either through improved data analysis or by means of

Table 1 ***Railroad Comparison Test***

Rail Test Contractor Performance

Site No. 1	Contractor A Only	Contractor B Only	Contractor A + B (Both)	Total
Detected Flaws	36	118	66	220
False Alarms	10%	18%		

Site No. 2	Contractor A Only	Contractor C Only	Contractor A + C (Both)	Total
Detected Flaws	21	11	16	48
False Alarms	5%	56%		

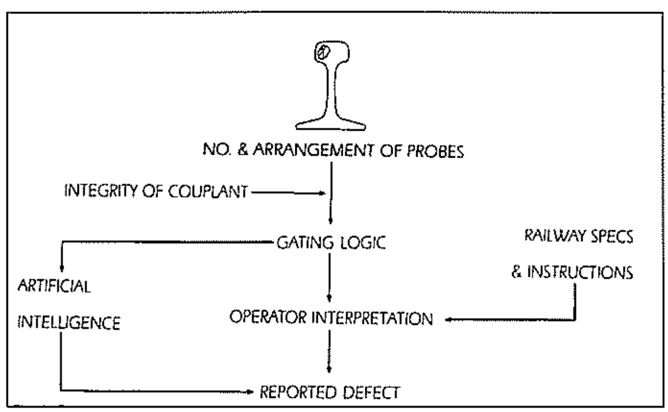

Figure 1 — Components of rail test reliability.

improved inspection equipment, this type of research offers an opportunity to improve the overall effectiveness of the rail detection process. By coupling this work with improved techniques for scheduling rail detection, such as through the development of inspection schedules tied into defect history, it is possible to continue to reduce the incidence of rail breaks and broken rail derailments even under the severe load environment of today's (and tomorrow's) traffic.

The following letter was written in reference to "More rail reliability issues," a Tracking R&D column that appeared in RT&S, April, p. 11.

Undetected weld fractures

To the Editor:

I was very interested in the article by Allan M. Zarembski on the reliability of rail testing.

While the experience we have in rail testing using various contractors is similar to what you describe, my question raises another issue about which I seek information. After we have our rails tested we still have some broken welds that were not detected by the testing contractor. These contain large defects across most of the rail head and the fracture face is black due to oxidation. In some cases these failures are known defects and when hand tested, do not indicate the true size of the defect as seen when the weld fails. After failure, the ultrasonic examination does indicate the true size of the defect so the question is, does some of the sound cross the detect interface when the cavity, as such, contains the product of oxidation under pressure, and perhaps some moisture.

If this does happen, and I suspect it does, then this could explain some of the problems of rail testing and the detection of defects in a reliable way.

I would like to hear your comments on this problem.

J. Mullen, Chief Civil Engineer
Australian National Rail

Zarembski responds:

Black oxide may give false defect indication

Dear Mr. Mullen:

Although I am not personally aware of a problem with an oxidation layer affecting ultrasonic detect measurements in welds, I consulted several of my colleagues (Roger Steele of the AAR and Oscar Orringer of TSC) who indicated that it was indeed possible for a thin layer of oxide (the black oxidation surface on the fracture face) to give a false or inaccurate defect indication. This is due partly to the nature of this nonbonded surface (which can be difficult to detect), and partly due to the relative orientation (angle) of the conventional transducers and this type of defect.

However, it should be noted that the presence of a black oxide layer in a weld is unusual since its formation would require oxygen penetration of the metal plasma of the arc.

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References

1. Roney, M. D., "Rail Flaw Detection — Where Is It Headed?," Symposium on Automated Track Measurement, Committee 2, *American Railway Engineering Association*, Chicago, IL, March 1988.
2. David, D. D., Joerms, M. J., Orringer, O, and R. K. Steele, "The Economic Consequences of Rail Integrity," Third International Heavy Haul Railways Conference, Vancouver, BC. October 1986.