

Lessons Learned from Accident Investigations

Railroads Urged to Review Welding Procedures for Track Bond Wiring

A train derailment that resulted in the release of hazardous materials has prompted federal safety officials to urge rail maintenance departments to review procedures used in making bond wiring welds on tracks.

The National Transportation Safety Board (NTSB) issued a final report on an accident involving a Canadian National freight train, traveling between Memphis and Chicago, that derailed 22 of its 108 cars in Tamaroa, Illinois, in February 2003.

Nineteen of the derailed cars were tank cars that contained hazardous materials. A fire ensued, and there was a release of vinyl chloride, methanol, phosphoric acid, hydrochloric acid and formaldehyde from several of the tank cars.

About 850 residents within a 3-mile radius of the derailment were evacuated, including the entire village of Tamaroa. There were no fatalities or injuries. Damages to the track and equipment and clean-up costs associated with the accident totaled about \$1.9 million.

“Serious accidents like this point up the need for rigorous maintenance standards to ensure the safety of tracks over which hazardous materials are carried,” said NTSB Chairman Ellen Engleman Connors. “It is an area that demands close attention by both the industry and government.”

The NTSB found that the derailment occurred when a rail broke near an insulated rail joint where bond wires had been welded to the rail head. The exothermic welding procedure used by Canadian National workers produced untempered martensite, a brittle structure in the steel that made the rail susceptible to fatigue cracking.

The known muddy, soft-ballast condition in the area of the insulated joint provided inadequate support for the track and increased the amount of rail flexing which, in turn, significantly increased stresses on the rail. The increased stresses, the Board said, caused the propagation of fatigue cracks that had originated in the areas of untempered martensite at the rail head, leading to a failure of the rail only 17 days after it had been installed.

The NTSB also said the investigation uncovered two vital safety issues that are potential safety problems throughout the rail industry: the effect of bond wire welding on rail integrity, and inconsistent instructions regarding the exothermic welding of bond wires.

In a series of conclusions that focused on the welds, the NTSB also pointed out the following:

- Fatigue cracks developed in the rail from areas of untempered martensite at points where bond wires had been exothermically welded to the rail head.
- The placement of the bond wire welds at Tamaroa, which was authorized by a Canadian National signals supervisor, was not in accordance with the company's exothermic bond wire welding policy that had been promulgated 2 months before.
- The known soft ballast condition in the area of the insulated joint increased the amount of rail flexing in that area which, in turn, significantly increased stresses in the rail.
- The increased stresses due to the flexing of the rail in the area of the insulated joint caused the propagation of the cracks that had originated in areas of untempered martensite at the rail head, causing the rail to fail only 17 days after installation.
- The application literature exothermic bond wire welding provided by the manufacturer, ERICO Products, Inc., was not entirely consistent with recommended industry practices.
- Laboratory tests and examination of field welds indicate that little or no tempering of the affected steel occurs during the exothermic welding process.
- The American Railway Engineering and Maintenance-of-Way Association Railroad Engineering Manual does not adequately address the proper placement of bond wire welds.
- Because most current rail failure tracking methods do not record the cause of rail failures that may have occurred at locations where bond wires have been welded or brazed, no adequate evaluation can be made of the effects of these welds on rail integrity in the U.S. rail system.

The NTSB also urged ERICO Products to revise its instructions for users to make them aware that the welds create untempered martensite that can, under certain conditions, lead to fatigue cracking and rail failure.

It also recommended that the Federal Railroad Administration make regulatory changes to enhance the collection of information about rail cracks and derailments caused by bond wire attachments. And the NTSB recommended that the Railroad Engineering and Maintenance-of-Way Association update its manuals to take into account what had been learned in the Tamaroa investigation.

For a complete copy of the accident report, visit the NTSB's Web site at this address:
<http://www.nts.gov/publictn/2005/RAR0501.pdf>