National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: February 3, 2005

In reply refer to: R-05-01 and -02

Mr. Robert D. Jamison
Acting Administrator
Federal Railroad Administration
1120 Vermont Ave, N.W.
Washington, D.C. 20590

About 9:04 a.m. central standard time on February 9, 2003, northbound Canadian National (CN) freight train M33371, traveling about 40 mph, derailed 22 of its 108 cars in Tamaroa, Illinois. Four of the derailed cars released methanol, and the methanol from two of these four cars fueled a fire. Other derailed cars contained phosphoric acid, hydrochloric acid, formaldehyde, and vinyl chloride. Two cars containing hydrochloric acid, one car containing formaldehyde, and one car containing vinyl chloride released product but were not involved in the fire. About 850 residents were evacuated from the area within a 3-mile radius of the derailment, which included the entire village of Tamaroa. No one was injured during the derailment, although one contract employee was injured during cleanup activities. Damages to track, signals, and equipment, and clearing costs associated with the accident totaled about $1.9 million.[1]

The National Transportation Safety Board determined that the probable cause of this accident was CN's placement of bond wire welds on the head of the rail just outside the joint bars, where untempered martensite[2] associated with the welds led to fatigue cracking that, because of increased stresses associated with known soft ballast conditions, rapidly progressed to rail failure.

The Safety Board found martensite at all the exothermic weld sites examined during the course of this investigation. This prompted investigators to contact railroad engineering personnel from a variety of passenger and freight railroads and the Federal Railroad Administration (FRA) and inquire about their policies and experiences regarding exothermic bond wire welding.

[1] For more information, see National Transportation Safety Board, *Derailment of Canadian National Freight Train M33371 and Subsequent Release of Hazardous Materials in Tamaroa, Illinois, February 9, 2003*, Railroad Accident Report NTSB/RAR-05/01 (Washington, D.C.: NTSB, 2005).

[2] *Martensite* is a hard and brittle crystal structure that occurs as a result of very rapid cooling (quenching) of heated steel (at about 1000º C or 1832º F per minute). Subsequent reheating of the steel to about 400º C (752º F) and holding it at this temperature for a time (tempering) produces a strong and tough steel with lower hardness and brittleness.

Amtrak's director of engineering tests and standards stated that Amtrak does not allow exothermic bond wire welding to the rail web because of anecdotal evidence that such welding creates martensite that could lead to rail failures. Amtrak had no records of rail failures that had been caused by exothermic bond wire welding.

The principal engineer for signals for the Long Island Railroad stated that his company uses exothermic bond wire welding for both track circuit wires and bonding wires within the joint bars. The Long Island Railroad principal engineer for track maintenance stated that rail defects caused by exothermic welds to rail heads would be noted on the ultrasonic/induction internal rail inspections records but not with a separate code. Therefore, without looking at each report, he could not determine the number of rail defects the Long Island Railroad had found at such weld sites. The railroad did not keep records to reflect service failures from exothermic welding, and the engineer was not aware of any rail failures that had been caused by exothermic bond wire welding at the rail web.

The Burlington Northern Santa Fe Railroad (BNSF) assistant vice president of signals stated that BNSF uses exothermic bond wire welding for both track circuit wire welding and joint wire welding. Track wires are installed on the rail web, and joint wires are welded on the rail head. For new construction projects, track wire comes preinstalled, via pin brazing, on the rail web. The BNSF director of rail stated that he did not maintain records of either rail service failures or defects detected by internal inspection that were caused by exothermic bond wire welding.

The CSX Transportation (CSX) engineer of field services stated that the CSX does not track rail defects or rail service failures caused by exothermic bond wire welding. He said he did not recall any major occurrences attributed to that type of rail defect or failure. The CSX uses exothermic bond wire welding on the head of the rail for both joint wire bonds and track circuit wire bonds.

The Union Pacific Railroad (UP) general director of derailment prevention stated that because of split rail web defects that were detected during internal rail inspections, the UP has examined its practice of exothermic bond wire welding to the rail web. The split web problems occurred primarily on the heavy-haul lines when multiple applications of exothermic bond wire welds were made near the same spot. The UP still uses exothermic bond wire welding for existing track. For new track components, such as insulated joint plugs, frogs, switch points, and stock rails, the company specifies that the component manufacturer install bonds using a low-temperature pin brazing process that does not create martensite. The UP does not track service failures from exothermic bond wire welding, but it notes on inspection reports those rail defects attributed to exothermic bond wire welding found during internal rail inspections. However, because these rail defects are not coded separately, each inspection report must be examined to determine the number of defects caused by exothermic welding.

The FRA does not have a cause code for derailments caused by rail failures resulting from exothermic bond wire welding and cannot quantify the number of rail defects caused by exothermic bond wire welding. Therefore, if a derailment occurs as a result of a rail failure caused by an exothermic bond wire weld, it would be reported in a general category of "Other" for types of broken rails.

Reviewing its internal rail inspections for a 3-year period, CN found that 327 rail defects[3] on its system had been caused by exothermic bond wire welding. However, CN did not track the rail service *failures* that such welding may have caused. CN reported the rail service failure at Tamaroa to the FRA under the "Other" code of rail failures. Specifically, it was reported as cause code T 299, "Other Rail and Joint Bar Defects."

The size and extent of the exothermic bond wire welding rail defect problem throughout the railroad industry cannot be evaluated because, as shown above, most railroads and the FRA do not record which rail defects or rail service failures may have resulted from exothermic bond wire welding.

The National Transportation Safety Board therefore makes the following safety recommendations to the Federal Railroad Administration:

> Require in 49 *Code of Federal Regulations* Part 213, "Track Safety Standards," that rail cracks originating from bond wire attachments be identified as rail defects and that information be collected on the methods and locations of those attachments. (R-05-01)
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> Require in 49 *Code of Federal Regulations* Part 225, "Guide for Preparing Accident/Incident Reports," that derailments caused by rail cracks originating from bond wire attachments be reported with a specific cause code and that information on the methods and locations of those attachments be provided in the accident narrative. (R-05-02)

The Safety Board also issued safety recommendations to ERICO Products, Inc., and the American Railway Engineering and Maintenance-of-Way Association. In your response to the recommendations in this letter, please refer to R-05-01 and -02. If you need additional information, you may call (202) 314-6177.

Chairman ENGLEMAN CONNERS, Vice Chairman ROSENKER, and Members CARMODY, HEALING, and HERSMAN concurred in these recommendations.

Original Signed

By: Ellen Engleman Conners
Chairman

[3] These were defects that were corrected before they led to failures.