

LOG R-651C

# NATIONAL TRANSPORTATION SAFETY BOARD

Washington, D.C. 20594



## Safety Recommendation

**Date:** March 8, 1995

**In Reply Refer To:** R-95-4 and -5

Railway Associations  
(see attached list)

---

On January 13, 1994, a northbound Ringling Bros. and Barnum & Bailey Circus (RBB&BC) train derailed about 9:08 a.m., eastern standard time, while passing through Lakeland, Florida, on CSX Transportation railroad en route to Orlando, Florida. A witness observed the train go by and saw two pieces of a wheel fly off a passenger car and land in nearby woods. The train continued 2.7 miles, across five grade crossings, with the broken wheel. When it reached the Park Spur turnout, 15 other passenger cars and 3 freight cars derailed. Of the 16 derailed passenger cars, 5 turned on their sides; the rest remained upright. Two circus employees were killed, and 15 received minor injuries.<sup>1</sup>

The postaccident investigation found that the wheel broke from the fatigue failure of a thermally damaged wheel due to fatigue cracking initiated at a stress raiser associated with a stamped character on the wheel rim.

The railroads have long understood the criticality of identifying overheated thermally damaged wheels. However, it is still practically impossible to detect a thermally damaged wheel outside a laboratory. The cracked and thermally damaged wheel was not detected before failure despite the fact that the RBB&BC train was inspected at Tampa by CSXT and RBB&BC personnel, passed a defect detector 18 miles from the derailment point, passed an observant maintenance-of-way gang that paused to inspect the train as it passed by, and was stopped and inspected by the train crew 10 miles from the point of derailment. The Safety Board concludes

---

<sup>1</sup>For more information, read Railroad Accident Report--*Derailed of the Ringling Bros. and Barnum & Bailey Circus Blue Train Near Lakeland, Florida, on January 13, 1994* (NTSB/RAR-95/01).

that thermal damage and cracking in the wheel could not be detected by routine railroad field inspection currently in practice.

Even in a laboratory, the only reliable methods of determining a thermally damaged wheel are destructive. One method is to radially cut the wheel. Such a cut in a thermally damaged wheel will generate a crack that will quickly propagate into the hub. Another method is an evaluation of the microstructure and hardness of a section cut from the wheel rim. The Safety Board metallurgical postaccident examination of the accident wheel showed that detection of small fatigue cracks in the wheel rim can be hindered because of their location and the amount of corrosion filling the cracks.

Research done by the Association of American Railroads (AAR) indicates that the stresses in thermally damaged railroad wheels are greatest on the back face of the wheel rim. Stamping the back of the wheel rim, as had been done to the RBB&BC accident wheel, provides a stress concentration point for a crack to start. Consequently, in 1978 the AAR prohibited the manufacture of rim-stamped railroad wheels on interchange freight cars. According to the AAR, few if any rim-stamped wheels are still in use on interchange freight cars, due to the relatively high attrition rate of freight-car wheels. However, some locomotives, transit cars, and private passenger cars still have wheels with stamped rims. Generally the wheels on these types of railroad vehicles are not as subject to thermal damage in normal operation as freight-car wheels are. Also, these types of railroad vehicles are not regularly interchanged as freight cars are.

Straight-plate wheels, which the RBB&BC train had, are more subject to thermal damage resulting in residual tensile stresses in the rim than curved-plate wheels. The curved-plate wheel acts much like a thermal expansion joint, which allows for elastic bending during overheating and consequently is less prone to formation of residual tensile stresses in the rim. As of January 1, 1994, the AAR prohibited freight-car wheel replacement with straight-plate wheels; all wheels on freight cars must be replaced with appropriate curved-plate wheels. About 90 percent of the 12 million wheels on the interchange freight-car fleet in this country are curved-plate wheels.

The Safety Board concludes that tread-braked rim-stamped straight-plate wheels are more prone to thermal damage and subsequent fatigue cracking. Currently the greatest number of straight-plate rim-stamped tread-braked wheels are found on private (non-Amtrak) passenger cars. Many of these cars are owned and operated by tourist railways, railroad museums, railway excursion operators, private car owners, and historical groups. Most of these organizations are nonprofit and belong to the Tourist Railway Association, Inc. (TRAIN)<sup>2</sup> and/or the American Association of Private Railroad Car Owners, Inc. (AAPRCO). According to TRAIN, "well over 500 passenger cars were in private hands in 1986." According to a June 1994 letter from AAPRCO, its members have about 140 Amtrak-certified cars and about 300 additional cars in

---

<sup>2</sup>TRAIN is a nonprofit New York State corporation chartered for the purpose of furthering the aims of its membership. Members include tourist railways, railroad museums, railway excursion operators, private car owners, suppliers, and other groups and people. Many members of TRAIN also belong to AAPRCO.

various stages of rebuilding. Almost all railroads also maintain for excursions and inspections a number of business cars that fall into the private category.

In summary, tread braking is a significant source of wheel overheating and thermal damage; straight-plate wheels are vulnerable to thermal damage, and rim stamping provides a stress concentration for crack initiation. Wheels that are particularly susceptible to thermal damage and subsequent fatigue failure are relatively few but have the potential to injure and kill passengers beyond their numbers since most of the problem wheels that are left are on private passenger cars.

The Safety Board is concerned about straight-plate rim-stamped tread-braked wheels that may remain in service for an extended period of time before requiring change out. Because of the extremely diverse conditions and environments in which private passenger cars operate, the Safety Board cannot assess the long term safety risk of such cars and their wheels. However, the Safety Board believes that all private railroad car organizations and private car owners should conduct a periodic inspection of their tread-braked rim-stamped straight-plate wheels to find any cracks emanating from the rim stamping and to remove the affected wheels. The Safety Board also believes that the AAR should prohibit the interchange of any tread-braked railroad car with rim-stamped straight-plate wheels unless adequate inspection procedures are developed. The Safety Board further believes that the Federal Railroad Administration should prohibit future wheel replacement with rim-stamped straight-plate wheels on tread-braked cars.

The Board acknowledges that insisting on the immediate removal of all rim-stamped tread-braked straight-plate wheels would severely damage private passenger-car owners economically. Because private passenger cars employ low speeds and have a good accident history, the Board believes that the wheels could be replaced gradually without significantly jeopardizing public safety.

Therefore, the National Transportation Safety Board recommends that the American Association of Private Railroad Car Owners, Inc., the American Short Line Railroad Association, the Association of Railway Museums, Inc., the National Passenger Car Alliance, the National Railroad Historical Society, and the Tourist Railway Association, Inc:

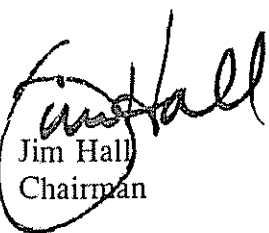
Inform your members about the derailment of the Ringling Bros. and Barnum & Bailey Circus blue train at Lakeland, Florida, on January 13, 1994, and request that they prohibit the replacement of wheels on nonstatic tread-braked railroad cars with straight-plate rim-stamped wheels. (Class II, Priority Action) (R-95-4)

Inform your members that all private railroad car organizations and private car owners should conduct a periodic inspection of their tread-braked rim-stamped straight-plate wheels to find any cracks emanating from the rim stamping and to remove the affected wheels. (Class II, Priority Action) (R-95-5)

Also, the Safety Board issued Safety Recommendations R-95-1 to the Federal Railroad Administration; R-95-2 to the Association of American Railroads; R-95-3 to the National Railroad Passenger Train Corporation; R-95-6 and -7 to the Ringling Bros. and Barnum & Bailey Circus; and R-95-8 to CSX Transportation.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any action taken as a result of its safety recommendations. Therefore, it would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter. Please refer to Safety Recommendations R-95-4 and -5. If you need additional information, you may call (202) 382-6840.

Chairman HALL, Vice Chairman FRANCIS, and Member HAMMERSCHMIDT concurred in these recommendations.

  
By Jim Hall  
Chairman

Mr. Paul L. DeVerter II  
Chairman  
American Association of Private Railroad Car Owners. Inc.  
1301 McKinney, Suite 5100  
Houston, Texas 77010-3095

Mr. William E. Loftus  
President  
The American Short Line Railroad Association  
1120 G street N.W., Suite 520  
Washington, D.C. 20005

Mr. Brian L. Norden  
Secretary  
Association of Railway Museums, Inc.  
P.O. Box 3311  
City of Industry, California 91744-0311

Mr. William C. Fuehring  
President  
National Passenger Car Alliance  
P.O. Box 18322  
BWI Airport, Maryland 21240

Mr. V. Allan Vaughn  
Chairman  
National Railway Historical Society  
P.O. Box 58153  
Philadelphia, Pennsylvania 19102-8153

Mr. Fred Bartels  
President  
Tourist Railway Association, Inc.  
P.O. Box 460537  
Aurora, Colorado 80046-0537