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NATIONAL TRANSPORTATION SAFETY BOARD

Washington, D.C. 20594

Safety Recommendation

Date: March 8, 1995

In Reply Refer To: R-95-3

Mr. Thomas M. Downs
Chairman and President
National Railroad Passenger Train Corporation
60 Massachusetts Avenue, N.E.
Washington, D.C. 20002

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.[1]

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

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

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 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.

Most wheels on locomotives and passenger cars are still straight plate because they are changed infrequently. Locomotive and passenger-car wheel failure resulting from thermal damage to treads and rims is rare because these wheels are inspected more frequently than those on freight cars and because locomotives and passenger cars have better brake control valves. On many passenger and commuter cars, the use of disk rather than tread brakes has eliminated the possibility of overheating the tread and wheel rim, precluding thermal failure on these wheels.

The straight-plate B36 wheel, the type involved in this accident, was designed to be used on passenger trains, which are relatively short,[2] have passenger-brake valves, and receive frequent attention. These considerations greatly reduce the possibility of overheating a wheel. The RBB&BC train however was a mix of passenger and freight cars. It was much longer than a normal passenger train and did not have passenger-brake valves.

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.

Private passenger cars approved or certified by Amtrak are frequently hauled behind Amtrak revenue trains and in Amtrak special trains. These private passenger cars must meet not only all applicable Federal and industrial requirements, but also all of Amtrak's mechanical and safety standards at each Amtrak inspection for each movement. However, based on the above rationale, the Safety Board does not believe that the high speed public carrier operations of Amtrak are an appropriate environment for private passenger cars with rim-stamped straight-plate tread-braked wheels. The Safety Board believes that Amtrak should prohibit the use of such cars.

Therefore, the National Transportation Safety Board recommends that the National Railroad Passenger Train Corporation:

> Prohibit tread-braked passenger cars that are equipped with straight-plate rim-stamped wheels in your trains. (Class II, Priority Action) (R-95-3)

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-95-4 and -5 to the American Short Line Railroad Association, the National Railway Historical Society, the American Association of Private Railroad Car Owners, Inc., the Association of Railway Museums, the Tourist Railway Association, Inc., and the National Passenger Car Alliance; 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 recommendation in this letter. Please refer to Safety

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[2]Shorter trains and their shorter brake pipes preclude many stuck brake problems from localized pressure conditions which are found more frequently in longer trains like freight trains.

Recommendation R-95-3 in your reply. If you need additional information, you may call (202) 382-6840.

Chairman HALL, Vice Chairman FRANCIS, and Member HAMMERSCHMIDT concurred in this recommendation.

By: Jim Hall
Chairman