



National Transportation Safety Board

Washington, DC 20594

Safety Recommendation

Date: April 7, 2014

In reply refer to: R-14-10

Mr. Edward R. Hamberger
President and Chief Executive Officer
Association of American Railroads
425 Third Street, SW
Washington, DC 20024

The National Transportation Safety Board (NTSB) is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant accidents in other modes of transportation—railroad, highway, marine, and pipeline. The NTSB determines the probable cause of the accidents and issues safety recommendations aimed at preventing future accidents. In addition, the NTSB carries out special studies concerning transportation safety and coordinates the resources of the federal government and other organizations to provide assistance to victims and their family members affected by major transportation disasters. The NTSB urges the Association of American Railroads (AAR) to take action on the safety recommendation issued in this letter.

This recommendation addresses the need for more thorough nondestructive testing (NDT) of secondhand-use railroad axles.¹ The recommendation is derived from the NTSB's ongoing investigation of the BNSF Railway Company (BNSF) accident that occurred on December 30, 2013, near Casselton, North Dakota. As a result of the investigation to date, the NTSB is issuing one safety recommendation to the AAR. Information supporting this recommendation is discussed below.

On Monday, December 30, 2013, at 2:11 p.m. central standard time, westbound BNSF grain unit train G-RYLRGT9-26A derailed 13 cars at milepost 28.5 near Casselton, North Dakota. The grain train, operating on main track 1, consisted of 2 head-end locomotives, 1 rear distributive power unit (DPU) locomotive, and 112 cars. The 45th car from the head end of the grain train derailed onto main track 2, blocking the track.

¹ *Secondhand-use* refers to reusing an axle, which is a common industry practice used when installing new wheels or bearings on axles.

Eastbound BNSF petroleum crude oil unit train U-FYNHAY4-05T, operating on main track 2, collided with the derailed grain train car that was blocking the track. The crude oil train consisted of 2 head-end locomotives, 1 rear DPU locomotive, and 106 cars. The 2 head-end locomotives and the first 21 cars of the crude oil train derailed during the collision, releasing nearly one-half million gallons of crude oil and fueling a fire. An estimated 1,400 people were evacuated from the town of Casselton. No injuries to the public were reported. The accident occurred on the BNSF KO Subdivision, where train movements were governed by the signal indications of a traffic control system.

During the examination of the wreckage, NTSB investigators located a broken axle—an AAR Class K (6 1/2 X 9) axle manufactured for freight car service. Mounted to the axle were two 36-inch AAR 1-B wide-flange wheels with a 1:20 taper for freight car service. Each wheel was stamped with a manufacturing date of January 2010. The serial number stamped on the end of the broken axle was SSD 1102 7A1 E 0912 F, indicating Standard Steel, LLC manufactured it in November 2002.² As part of the ongoing investigation, NTSB investigators are examining the broken axle at the NTSB Materials Laboratory. Initial findings indicate the axle fractured because of a void defect along its longitudinal center axis.³

NTSB investigators researched BNSF maintenance records, which showed the wheel axle assembly had been replaced on two of the derailed cars from the grain train in the 4 years before the accident. Records also showed the bearings and wheels on the broken axle had been remounted in April 2010 at the BNSF Havelock Wheel Shop, in Havelock, Nebraska.

The mandatory interchange rules governing wheel shop practices are defined in the AAR *Manual of Standards and Recommended Practices* (MSRP), Section G—Part II, “Wheel and Axle Manual.”⁴ Specifically, Rule 1.1.8 of the MSRP states that wheel seats, journals, and journal fillet portions of unmounted secondhand axles in freight car service must be inspected by qualified persons holding NDT level I certifications using a magnetic particle inspection (MPI) method before being remounted.⁵

MPI is a commonly used, low-cost, rapid NDT method for ferromagnetic materials, such as steels and cast irons.⁶ Although MPI reveals cracks and flaws on or near the material surface, it cannot reveal defects that may be present below the surface of the material being examined outside the applied magnetic field.

According to MSRP Specification M-101, dated May 1, 1998, newly manufactured axles are ultrasonically inspected after the ends are machined and centered. Ultrasonic testing (UT) is a

² An AAR serial number designation contains a heat identification number (to identify a production run) stamped on the end of an axle. The heat number is assigned by the manufacturer and used for quality control. This axle had heat number E0912.

³ A *void* is a manufacturing defect in an otherwise solid material that can lead to premature failure of a component.

⁴ See Segment 1.0, S-659, “Mandatory Rules Governing Wheel Shop Practices as Required by Interchange Rules,” dated February 2008.

⁵ NDT level I certification is the first, or lowest, of three certification levels defined in the American Society for Nondestructive Testing Recommended Practices SNT-TC-1A, latest edition.

⁶ *Ferromagnetic material* is defined as material that can be magnetized or strongly attracted by a magnetic field, and its magnetic permeability is dependent on the magnetizing force.

commonly used, low-cost, and rapid NDT method that uses high-frequency acoustic energy to detect internal flaws. Specification M-101 was in effect when the axle that broke in the Casselton accident was manufactured in 2002, and it required manufacturers to conduct axial UT on the axle end faces (or free ends) to check for internal defects. A known issue with free-end UT is distinguishing between flaws in the axle material and changes in the axle profile.⁷ MSRP Specification M-101 was updated in July 2009 and now requires radial UT of the axle along the barrel length after the initial turning step during manufacture, which complements the axial free-end UT performed after axle end facing and center drilling. This testing is required only for new axles.

NTSB investigators have learned there were two recent failures of axles from the same manufacturing heat, or production run. The two other failures also were caused by void defects, which can occur in material during casting or forging⁸ Standard Steel stated that it manufactured 48 axles in 2002 with the heat number E0912.

On January 23, 2014, the AAR issued a maintenance advisory to all member railroads requesting the inspection and removal of suspect Class K (6 1/2 X 9) axles.⁹ The maintenance advisory instructs railroads to inspect wheel sets arriving in wheel and axle shops for axles in the serial number range SSD 1102 1A1 E0912 through SSD 1102 12B2 E0912. Identified axles must be immediately removed from the production line, isolated, tagged, and sent to Standard Steel for examination. Standard Steel will advise the AAR of the examination results.

Federal regulations at Title 49 *Code of Federal Regulations* Section 215.105 state the following:

- A railroad may not place or continue in service a car, if –
- (a) An axle on the car has a crack or is broken;
 - (b) An axle on the car has a gouge in the surface that is –
 - (1) Between the wheel seats; and
 - (2) More than one-eighth inch in depth;
 - (c) An axle on the car, used in conjunction with a plain bearing, has an end collar that is broken or cracked;
 - (d) A journal on the car shows evidence of overheating, as evidenced by a pronounced blue black discoloration; or
 - (e) The surface of the plain bearing journal on the axle, or the fillet on the axle, has –
 - (1) A ridge;
 - (2) A depression;
 - (3) A circumferential score;
 - (4) Corrugation;
 - (5) A scratch;
 - (6) A continuous streak;
 - (7) Pitting;

⁷ Gary L. Workman, Doron Kishoni, and Patrick Moore, eds., “Ultrasonic Testing of Axles,” in *Ultrasonic Testing*, 3rd ed., (Columbus, OH: American Society of Nondestructive Testing, Inc., 2007), 538–540.

⁸ *Casting* is a manufacturing process of pouring molten metal into a mold to produce an object of desired shape. *Forging* is a manufacturing process of working metal to a desired shape using pressure or impact, typically performed at elevated temperatures.

⁹ Association of American Railroads, Maintenance Advisory C-12095, MA-144, “Inspection & Removal of Suspect Class K (6-1/2 X 9) Axles,” January 23, 2014.

- (8) Rust;
- (9) Etching.

The axle that broke in the Casselton accident underwent all required NDT prescribed in MSRP S-659 in April 2010 at the BNSF Havelock Wheel Shop; however, the inherent limitations of MPI testing preclude detection of voids or other defects located deep within the material. A more thorough type of NDT, such as UT, is capable of locating internal material defects, including centerline voids. The NTSB concludes that had the broken axle from the Casselton, North Dakota, accident been subjected to more thorough NDT when its bearings and wheels were remounted in 2010, the internal material defect would likely have been found and the axle would not have been allowed to be returned to service.

Therefore, the National Transportation Safety Board makes the following recommendation to the Association of American Railroads:

Require secondhand-use railroad axles to undergo nondestructive testing specifically designed to locate internal material defects in axles. (R-14-10)

NTSB investigators are still examining issues related to the Casselton, North Dakota, accident. At this time, the NTSB has not yet determined the probable cause of this accident. Nonetheless, the NTSB has identified the safety issue described above, which needs to be addressed promptly.

Chairman HERSMAN, Vice Chairman HART, and MEMBERS SUMWALT, ROSEKIND, and WEENER concurred in these recommendations.

The NTSB is vitally interested in this recommendation because it is designed to prevent accidents and save lives. We would appreciate receiving a response from you within 90 days detailing the actions you have taken or intend to take to implement it. When replying, please refer to the safety recommendation by number. We encourage you to submit your response electronically to correspondence@ntsb.gov. If your response exceeds 10 megabytes, including attachments, please e-mail us at the same address for instructions. Please do not submit both an electronic copy and a hard copy of the same response.

[Original Signed]

By: Deborah A.P. Hersman
Chairman