Issued: February 12, 2025 Railroad Investigation Report: RIR-25-03

BNSF Railway Derailment with Bridge Strike and Fatality

Location	Pueblo, Colorado
Date	October 15, 2023
Accident type	Derailment
Train	Freight train C-ATMCRD0-31D 2 crewmembers 3 locomotives, 124 railcars
Track	Main track, signalized
Hazardous materials	None
Fatalities	1
Injuries	0
Damages	$15.6 million

Summary

On October 15, 2023, about 3:24 p.m. local time, southbound BNSF Railway (BNSF) freight train C-ATMCRD0-31D derailed 31 hopper cars loaded with coal and subsequently killed a nearby driver in Pueblo, Colorado.[1] The hopper cars derailed near a track switch north of a railroad bridge that crosses over Interstate 25.[2] Derailed hopper cars struck and partially collapsed the bridge over the northbound lanes. Six derailed hopper cars fell to the interstate below, with at least one falling on a northbound truck-tractor in combination with a utility trailer (combination vehicle), killing the driver.[3] The combination vehicle came to rest beneath the collapsed bridge span, derailed hopper cars, and lading. (See figure 1.) No members of the train crew were injured.

[1] (a) All times in this report are local times. (b) Visit ntsb.gov to find additional information in the public docket for this NTSB accident investigation (RRD24FR001). (c) Use the CAROL Query to search safety recommendations and investigations.

[2] (a) The switch was northeast of the bridge, but for simplicity, this report will use timetable directions. (b) A track switch (usually called a switch) allows trains or railcars to be diverted to other tracks.

[3] The combination vehicle consisted of a 2019 Freightliner Cascadia and a 2020 utility trailer carrying general grocery items. The vehicle was operated by Coastline Trucking.

Figure 1. The derailment site. (Courtesy of BNSF.)

The National Transportation Safety Board (NTSB) reviewed videos from the outward-facing image recorders from the lead and rear locomotives of train C-BTMSPS0-33D, the last train to traverse the area before the accident train. Video from the lead locomotive of train C-BTMSPS0-33D showed no unusual track conditions when this train was approaching the area, but video from the rear locomotive of train C-BTMSPS0-33D showed that the west rail was broken within a railroad switch north of the railroad bridge.

Examination of two recovered broken sections of rail by the NTSB Materials Laboratory showed that the rail broke at the location where the rails had been attached using a thermite weld. The profiles of the two rail sections at the thermite weld did not match; the south section of rail was about 0.177 inches (about 3/16 inches) taller than the north section, leaving a gap at the base that was partially filled with extraneous molten weld material (or weld flash).[4] The weld flash contained voids, oxides, and entrained nonmetallic materials.[5] The examination also showed that fatigue cracking had initiated

[4] *Thermite welding*, also known as aluminothermic welding, is a process that creates a joint between two rails through a chemical reaction that generates intense heat. This reaction produces molten metal, which fills the gap between the rails to form a strong, seamless weld.

[5] (a) A *void* is a hollow spot within steel rail that is susceptible to facilitating a crack within the rail. (b) *Porosity* refers to the presence of small cavities or voids within a welded joint.

near the weld flash under the base of the rail and propagated upward until the rail fractured.[6]

A review of BNSF records showed that the failed weld had been completed on May 24, 2023, when the south section of the rail was installed.

BNSF welding procedures allow for the joining of rails with different profiles (that can result from rail wear or a joint between different rail weights), but if the profiles differ by more than 0.125 inches, a welder must use a compromise kit to account for the difference. Typically, the top edges of the rails must be aligned, and the compromise kit includes a mold that is designed to ensure that the difference in rail profiles does not create a gap at the base of the rail that can allow weld flash to pool under the rail.

When interviewed by the NTSB, the welder who made the weld did not recall performing this weld several months earlier. He was properly trained, demonstrated knowledge of when a compromise kit should be used according to BNSF procedures, and reported that he had used them in the past.

Analysis

The derailment resulted from a broken rail north of the bridge. Video from the lead and rear locomotives of train C-BTMSPS0-33D showed that the rail broke as this train passed through the area of the accident. Laboratory examination of the rail sections showed that fatigue cracking had initiated at the base of the rail and propagated upward until the rail fractured in bending under the weight of the last train to traverse the area before the accident train.

The rail break occurred at a thermite weld completed less than 5 months before the derailment, and the rail fractured from a small fatigue crack in the base at the thermite weld. This fatigue crack initiated along a layer of underlying weld flash, which had flowed into a gap beneath the base during welding. This gap was created by a mismatched weld configuration. Measurement of the rail sections showed a difference in rail profile that, under BNSF rules, would have required a compromise kit that would have prevented flash from pooling under the base of the rail, but the welder likely did not use one of these kits. The resulting accumulation of weld flash at the base served as an adequate stress concentration to initiate for fatigue cracking while the rail was under cyclic loading.

[6] *Fatigue* is a phenomenon leading to fracture under repeated or fluctuating stresses having a maximum value less than the ultimate tensile strength of the material. Fatigue failure generally occurs at loads that if applied statically would produce little perceptible effect. Fatigue fractures are progressive, beginning as minute cracks that grow under the action of the fluctuating stress.

Railroads are required to regularly inspect sections of track likely to develop into broken rails, as well as individual rails for internal defects (such as a void/pocket inside the steel of the rail).[7] Ultrasonic testing is one common method, but defects near a rail's base can be difficult for this method to detect because the geometry of the rail can reduce the strength of ultrasonic signal reflections from these flaws. BNSF conducted inspections of the track and individual rails near the derailment site but did not identify any defects.[8]

Track circuits are designed to detect track occupancy, not to detect broken rails or prevent trains from traversing them. In some cases, the system may indicate a restricting signal when a rail is broken, but that did not occur here.

A truck driver was killed following the derailment because the train derailed near a bridge. Derailed hopper cars had enough energy to strike the bridge, partially collapse it, and fall to the interstate below, landing on a combination vehicle and killing the driver.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the derailment of BNSF Railway train C-ATMCRD0-31D was the train encountering a rail break that occurred when a mismatched thermite weld failed; the thermite weld cracked near the rail's base because the welder, for unknown reasons, likely did not use a compromise kit during the welding as required by BNSF Railway procedures.

Lessons Learned

In response to this accident, BNSF adopted a policy of analyzing every failed weld to determine why they failed. If welding practices contributed to the failure, the responsible team is retrained. Additionally, briefing materials have been distributed to employees who weld rails to emphasize the importance of proper kit selection.

BNSF also enhanced welding oversight by implementing mandatory audits conducted by welding supervisors. Each supervisor is auditing 10 random thermite welds per month to confirm that the correct kit was used.

[7] Title 49 *Code of Federal Regulations* 213.233 and 213.237.

[8] (a) The FRA has undertaken research in improving internal defect detection and allocated more than $11 million in 2024 to fund research projects aimed at reducing derailments caused by track defects. (b) FRA 2024 research projects: https://railroads.dot.gov/elibrary/fra-office-research-development-and-technology-current-projects-2024-0.

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For more detailed background information on this report, visit the NTSB Case Analysis and Reporting Online (CAROL) website and search for NTSB accident ID RRD24FR001. Recent publications are available in their entirety on the NTSB website. Other information about available publications also may be obtained from the website or by contacting—

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