

Federal Railroad Administration, Office of Railroad Safety

Accident Investigation Summary Report HQ-2022-1777

Norfolk Southern Railway Corporation (NS) Derailment
Sandusky, Ohio
October 8, 2022

1. EXECUTIVE SUMMARY

On October 8, 2022, at 4:19 p.m., EDT, Norfolk Southern Railway Corporation (NS) freight train 310B (Train 1) derailed 20 cars and 1 locomotive at Milepost (MP) CD240.7 on track Main 2 of NS's Chicago Line subdivision, Great Lakes division, in Sandusky, Ohio. The train was 6,082 feet long and weighed 12,091 tons, configured with 6 locomotives and 98 cars.

Lines 7 through 26 of the train consist derailed, with some of the cars coming to rest hanging over, and falling from, the Columbus Avenue overpass onto the roadway below. One of the cars carrying paraffin wax was breached, resulting in a release of wax.

The Federal Railroad Administration's (FRA) investigation and analysis found that the probable cause of this accident was that the No. 3 axle installed under HZRX 187, which was a locomotive that was being towed in the train, broke near the R3 wheel bearing. FRA determined the accident could have been prevented if the chief dispatcher or the dispatcher had permitted the Train 1 crew to set out HZRX 187 following a stop and subsequent inspection at MP CD244.

2. ACCIDENT DESCRIPTION

Before departing Elkhart Yard, Elkhart, Indiana, on October 8, 2022, with a destination of Binghamton, New York, Train 1 received a Class I air brake test and locomotive calendar inspection, performed by the mechanical department. The train was configured with 6 locomotives (including 3 dead-in-tow locomotives that were not being used for tractive effort), 88 loaded freight cars, and 10 empty freight cars.

Train 1 traveled to Toledo, Ohio, where a crew change occurred. The crew that assumed control of the train consisted of an engineer and a conductor, both of whom reported for duty at 12:45 p.m., EDT, on October 8, 2022, in Toledo.

The Chicago Line subdivision, Great Lakes division, has two main tracks labeled Main 1 and Main 2. The maximum speed on these tracks was 60 mph, but NS operating rules restricted Train

1 to 50 mph because it was classified as a key train¹ due to the number of tank car loads of hazardous materials in the train.

At approximately 2:16 p.m., EDT, Train 1 near MP CD249, an NS dispatcher contacted the crew to inform them that a wayside hot bearing detector (HBD) had detected a possible hot bearing condition on the sixth piece of equipment. The dispatcher instructed the crew to stop the train for inspection.

The crew brought the train to a stop with the head end near MP CD244. The conductor inspected the equipment and noted that a cloud of either smoke or steam, and an unusual odor, were being emitted from near the right No. 3 (R3) wheel on locomotive HZRX 187, which was not being used for tractive effort.

The crew requested mechanical assistance, and a locomotive electrician was sent from Bellevue, Ohio, arriving at approximately 3:30 p.m., EDT. The electrician determined that there were no visual exceptions that he could identify while inspecting the locomotive. At approximately 4 p.m., EDT, the electrician communicated that he could not see anything wrong with HZRX 187, but he cautioned that he was not a machinist. The electrician communicated to the dispatcher that the crew desired to set HZRX 187 out of the train and that he was in support of this idea.

The electrician explained to the dispatcher that the crew was concerned about continuing to pull HZRX 187 on account of anticipating further issues with the equipment.

At approximately 4:04 p.m., EDT, at the direction of the on-duty chief dispatcher, the dispatcher contacted the crew and instructed them to continue their trip east with HZRX 187 remaining in the train. The crew resumed eastward movement at 4:07 p.m., EDT.

At MP CD242.5, the R3 wheel of HZRX 187 derailed, however, the crew was unaware that the wheel had derailed so the train continued east. When the train reached the crossover switch at MP CD240.7 it traversed through a left-hand turnout onto track Main 1, where additional cars began to derail.

At 4:19 p.m., EDT, near MP CD240.7, the train line between locomotive HZRX 187 and car TATX 117047 (lines 6 and 7, respectively) separated, resulting in an undesired emergency brake application.² Lines 7 through 26 of the train's consist derailed, with some of the cars coming to rest hanging over, and falling from, the Columbus Avenue overpass onto the roadway below. Of the derailed equipment, 19 cars contained paraffin wax, and 1 car contained hydrogen peroxide. One of the cars carrying paraffin wax was breached, resulting in a release of wax.

¹ A key train is a train that contains; one or more carloads of Toxic Inhalation or Poison Inhalation Hazards (TIH/PIH), 20 or more tank car loads of hazardous materials, or one or more car loads of spent nuclear fuel or high level radioactive waste.

² An "undesired emergency brake application" means an unintentional and irretrievable application of the maximum braking force available from a train's brake system. An undesired emergency brake application is not intentionally initiated by the crew and occurs when there is a separation in a train's air line and air pressure is released from the system (e.g., when a derailment occurs).



Figure 1: Derailment Site

INVESTIGATION AND ANALYSIS

FRA conducted a comprehensive investigation and analysis of this accident. FRA's investigation included evaluation of each crew member's qualification, certification, and testing records, as well as the crew's actions, and took no exception.

Similarly, FRA found no evidence of deficiencies, irregularities, or non-compliance in all aspects of the relevant signal and train control system; the track over which the train was traveling at the time of derailment; and the various brake tests, equipment inspections, and repairs performed on the equipment in the train's consist prior to the derailment.

FRA's investigation determined the probable cause of this accident was that the No. 3 axle installed under HRRX 187 broke near the R3 wheel bearing. FRA further determined the accident could have been prevented if the chief dispatcher or the dispatcher had permitted the Train 1 crew to set out HRRX 187 following a stop and subsequent inspection at MP CD244. Finally, FRA determined that a potential contributing cause to the severity of the derailment was Train 1 operating over the crossover switch near MP CD240.7 with locomotive HRRX 187 partially derailed.

Failure of the No. 3 Axle on HRRX 187:

HRRX 187 was a diesel electric locomotive owned by Horizon Rail, located in Euclid, Ohio. The locomotive was originally manufactured by Electro-Motive Diesel, (model No. SD-18M), and built on April 3, 1960. The locomotive consisted of 2 trucks, each with 3 axles, for a total of

6 axles. The locomotive was equipped with air brake model No. 26L and had a 92-day periodic inspection period, which had last been performed on October 4, 2022, by Horizon Rail.

During the inspection on October 4, 2022, an inspection of the truck components and running gear, including traction motor components, was performed. No defective conditions were identified at that time.

FRA investigators visited the Horizon Rail Locomotive Shop, located in Fairport Harbor, Ohio, on October 25, 2022. All documents regarding locomotive HZRX 187 were reviewed, along with certifications of Horizon Rail Locomotive employees performing all necessary work and routine maintenance on HZRX locomotives and equipment. No defects were observed pertaining to the mechanical records associated with locomotive HZRX 187.

The root cause of the axle failure was metal fatigue of the No. 3 axle installed on HZRX 187. The axle failed due to fatigue initiating in the outside areas of the axle. The crack propagated by fatigue across 85 percent of the axle cross-section before the final “fast fracture,” which occurred while the train was moving. The axle crack was located between the R3 wheel and bearing journal box.

The area in which the crack on the R3 axle was located would have been extremely difficult to see while inspecting HZRX 187 trackside. On HZRX 187, there was very little room between the truck components and the frame of the locomotive to permit a visual inspection of the inward facing bearing journal box and axle.

If the locomotive had been inspected in a shop setting, it is still unlikely that such a crack would have been discovered, utilizing common inspection methods. Most shop inspections of locomotive “bottom side” components are conducted simply with a flashlight. Usually, truck components are not frequently cleaned, not even when a locomotive receives a periodic inspection, as the presence of dirt does not inhibit such inspections in most cases. To locate a crack like the one that caused the R3 axle to break, some sort of non-destructive testing such as magnetic particle inspection (MPI)³ or X-ray would likely have to be utilized.

FRA’s investigation determined that the root cause of the axle failure was metal fatigue of the No. 3 axle installed on the HZRX 187 locomotive. The axle failed due to fatigue initiating in the outside areas of the axle. The crack propagated by fatigue across 85 percent of the axle cross-section before the final “fast fracture” that occurred while Train 1 was moving. The axle crack was located near the inboard facing side of the R3 wheel bearing journal box.

³ MPI is a non-destructive method that checks for surface discontinuities but can also reveal discontinuities slightly below the surface.



Figure 2: HZRX 187 No. 3 axle

Actions of the Dispatcher and Chief Dispatcher Following the HBD Alert:

Although the presence of a crack in the No. 3 axle would have been difficult to visually detect, the possible presence of an equipment abnormality was detected by the HBD located at MP CD260.9 on October 8, 2022, at 1:59 p.m., EDT. Additional evidence of a potential abnormality was then observed by the Train 1 conductor, who reported that the R3 wheel area of the HZRX 187 was emitting a cloud of either smoke or steam and an unusual odor. By the time the electrician arrived to inspect the HZRX 187, approximately 1.5 hours had elapsed, which would have permitted most hot components to cool down.

Considering the unknown condition of the traction motor internal components, the crew and the electrician both supported the idea of setting HZRX 187 out of Train 1. Despite receiving both this suggestion and the electrician's verbal and recorded warning that he did not know what the equipment was going to do if permitted to continue movement, the chief dispatcher ultimately decided that Train 1 should continue without setting out the HZRX 187. As a result, the R3 wheel of the HZRX derailed when the No. 3 axle subsequently failed.

The FRA determined the root cause of the accident was human error because the accident could have been prevented if the chief dispatcher or the dispatcher had permitted the train crew to set out locomotive HZRX 187 following the stop and inspection at MP CD244.

Operating over a Crossover Switch with HZRX 187 Partially Derailed:

Because the crew was unaware that the R3 wheel of the HZRX 187 had derailed, the train continued east past MP CD242.5. When the train reached MP CD240.7 it traversed through a left-hand turnout onto track Main 1, where the train line between locomotive HZRX 187 and car TATX 117047 (lines 6 and 7, respectively) separated, resulting in an undesired emergency brake

application. The train's consist lines 7 through 26 derailed, with some of the cars coming to rest hanging over, and falling from, the Columbus Avenue overpass into the roadway below.

FRA determined that a potential contributing cause to the severity of the derailment was Train 1 operating over the crossover switch near MP CD240.7 with locomotive HZRX 187 partially derailed. This created additional wheel interaction forces, resulting in the train separation and subsequent derailment of an additional 20 cars.

3. CONCLUSION

FRA's investigation and analysis of this accident determined that the probable cause of the accident was the broken axle on the HZRX 187 near the R3 wheel bearing.

FRA determined the root cause of the accident was human error because the accident could have been prevented if the chief dispatcher or the dispatcher had permitted the train crew to set out locomotive HZRX 187 following the stop and inspection at MP CD244. Instead, the chief dispatcher overruled the advice of the railroad employees on the scene inspecting the train.

FRA further determined that a potential contributing cause to the severity of the derailment was Train 1 operating over the crossover switch near MP CD240.7 with locomotive HZRX 187 partially derailed. This created additional wheel interaction forces, resulting in the train separation and subsequent derailment of an additional 20 cars.

In response to this accident, FRA issued Safety Advisory 2023-01 and Supplemental Safety Advisory 2023-01, recommending that railroads: (1) evaluate the thresholds for inspections based on hot bearing detector (HBD) data; (2) consider the use of real-time trend analyses of HBD data as a criterion for inspection; (3) ensure the proper training and qualification of personnel responsible for the calibration, inspection, and maintenance of HBDs; (4) insure proper inspection of rolling stock with HBD alerts; (5) improve the safety culture of their organization, particularly as it pertains to operational decisions based on HBD data; and (6) take action to evaluate the resiliency and accuracy of the overall process used to monitor and measure bearing health.