Federal Railroad Administration, Office of Railroad Safety

Accident Investigation Summary Report HQ-2023-1824

Norfolk Southern Railway Company (NS) Derailment
Anniston, Alabama
March 9, 2023

1. Executive Summary

On March 9, 2023, at 6:19 a.m., CST, Norfolk Southern Railroad Company (NS) westbound freight train 245A109 derailed at Milepost (MP) 721.3 on NS's East End Subdivision, in Anniston, Alabama. The train was 9,769 feet long and weighed 9,175 tons configured with 6 locomotives and 108 railcars. Two of the locomotives were being transported as waybill locomotives.

Two locomotives and a total of 37 cars derailed in two separate locations within the train. The west derailment site contained the 2 locomotives and 29 cars (lines 5 through 35 of the consist), while the east derailment site contained 8 cars (lines 89 through 96).

Three of the derailed cars contained residue hazardous material. The hazardous material cars were not breached, and no hazardous materials were released; however, approximately 500 gallons of diesel fuel leaked from a refrigerated box car and absorbed into the soil. Reported damages to track and equipment were $2,930,949.

The Federal Railroad Administration's (FRA) investigation and analysis found that the cause of this accident was excessive buffing or slack action[1] due to improper train make-up. Additionally, FRA concluded defects to the coupler and draft system, improper placement of two non-alignment control locomotives, improper training, and human error by the employee who inspected the revenue freight locomotives were contributing causes to the accident.

2. Accident Description

Having departed Atlanta, Georgia, on March 8, 2023, with a destination of Birmingham, Alabama, NS train 245A109 was operating on the East End Subdivision, which runs from Villa Rica, Georgia (MP 671) to Birmingham (MP 791), and the maximum freight train speed is 50 mph. On March 9, 2023, as the train approached MP 719.6, the engineer prepared for the upcoming grade change. When traveling west on the East End Subdivision the grade, at MP 719.6, changes

[1] Slack action is the coupler forces that are parallel to the longitudinal axis of equipment. Compressive coupler forces are called buff forces, while tensile coupler forces are called draft forces.

from an undulating grade to a descending grade of 1.29-percent. The engineer stated he topped the hill under the speed limit and used a landmark to know when most of the train was over the crest, triggering him to increase dynamic brake usage to control his speed, thus increasing the dynamic brake amperage. As the heaviest portion of the train crested the hill it increased the buff forces on the head-end resulting in the train speed increasing from 28 mph to 32 mph.

At about 6:19 a.m. CST, the train was traveling westbound at 30 mph on a descending grade when an undesired emergency brake application[2] occurred as it exited a left-hand curve at MP 721.2. Two locomotives and a total of 37 cars derailed in two separate locations within the train. The west derailment site contained 2 locomotives and 29 cars (lines 5 through 35), while the east derailment site contained eight cars (lines 89 through 96).

3. INVESTIGATION AND ANALYSIS

Train Makeup

Train 245A109 was assembled at NS Inman Yard, in Atlanta, and was made up of 6 locomotives, 32 loads, and 76 empty rail cars. The loaded cars included a block of 20 intermodal cars on the rear of the train. The distribution of loaded cars on the rear of the train can significantly increase the draft forces due to the higher braking ratios of empty cars. The increased breaking ratio of the empty cars in the train creates a larger speed differential, and results in higher buff forces.[3] This is particularly true given the descending 1.29-percent grade, and the use of only dynamic breaks to control the train speed.

Two of the 6 locomotives were being used for tractive effort, with 2 locomotives isolated,[4] and 2 locomotives dead-in-tow being transported as revenue freight.

Position	Locomotive	Status
1	UP 5574	Online
2	UP 9039	Isolated
3	NS 4408	Online
4	NS 9485	Isolated
5	RMEX 08	Dead-in-tow
6	RMEX 06	Dead-in-tow

Table 1: Locomotive Consist

The revenue freight locomotives were not equipped with an alignment control draft system. Coupling two non-alignment control locomotives in train operations is prohibited by NS Rules

[2] An "undesired emergency brake application" means an unintentional and irretrievable brake application resulting in 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).

[3] Loumiet, James R., "Freight Train Slack Action Effects Analysis", 6th Annual Meeting of National Association of Railroad Safety Consultants and Investigators, Nashville, TN (May 1996).

[4] When a locomotive is isolated, it cannot produce tractive, or dynamic breaking effort.

for Operations and Train Handling,[5] due to the increased lateral movement of the coupler. FRA determined the makeup of train 245A109 resulted in excessive buff forces.

Alignment Control Draft System

The revenue freight locomotives in train 245A109, RMEX 6 and RMEX 8, were not equipped with alignment control couplers, which limit lateral coupler movement under buff forces. Alignment control draft systems limit the lateral force transferred to the track under high longitudinal buff forces and reduce the risk of derailment. Locomotives without alignment control tend to "jackknife" when placed behind locomotives that generate high dynamic brake (DB) forces, particularly when exposed to significant trailing tonnage and subject to high buff forces.

Alignment control draft systems use a mechanical means to control lateral movement of the coupler. This normally consists of specific couplers that use wings to compress wedges that push against the draft gear in the direction of swing. Non-alignment systems do not cushion nor control lateral forces. The non-alignment control systems, mostly used in switching service, are designed to allow additional travel motion of the coupler shaft in the draft pocket. This additional travel is used to navigate tight track curvatures of industry tracks during switching operations.

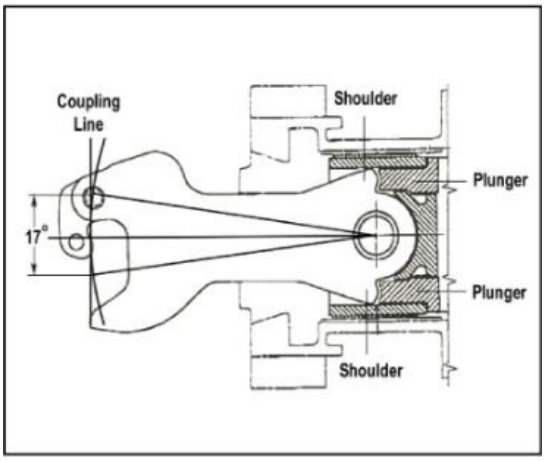

Figure 1: Alignment Control

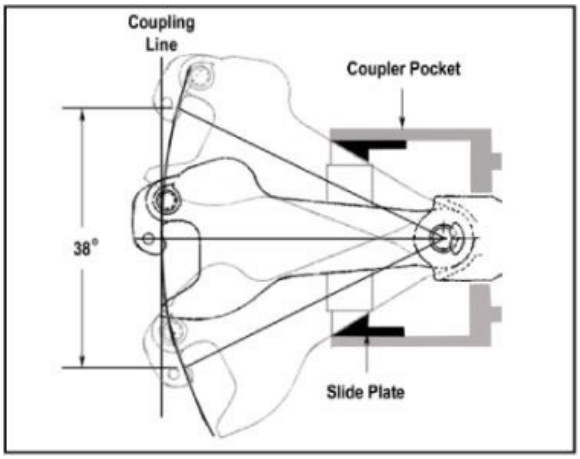

Figure 2: Non-alignment Control

Coupler stop blocks, either metal or rubber, are used to reduce the amount of side-to-side movement of the coupler shaft on non-alignment control couplers, but do not reduce lateral forces. The rear draft pocket, of the RMEX 6, showed evidence that the right rear coupler stop block had recently been dislodged. The rear draft pocket of RMEX 8 showed evidence that the left rear coupler stop block had been recently dislodged. The metal mounting brackets displayed signs of a fresh break, evidenced by shiny metal.

[5] NS-1, Rules for Equipment Operation and Handling (effective January 1, 2019). Rule L-212 (b). Alignment Control Draft Gear (stating "Locomotive(s) not equipped with alignment control draft gear, when moving dead-in-tow in a locomotive consist or train, must not be coupled to another locomotive that does not have alignment control draft gear").

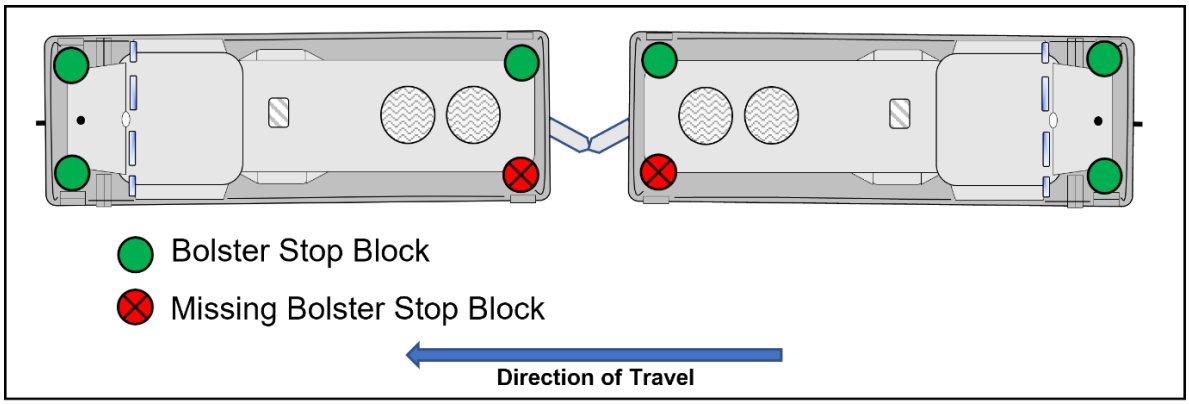

Figure 3: Position of Missing Stop Blocks

FRA conducted a simulation using Train Energy and Dynamics Simulator (TEDS) which identified the train had experienced excessive buff forces around MP 707 (14 miles prior to the POD) exceeding 300 KIPS.[6] These forces likely caused the coupler stop blocks to break away. The missing stop blocks were not recovered.

The alignment control draft system on the leading four locomotives of train 245A109 limited the coupler angle to about 8-degrees, where the non-alignment control draft system on the revenue freight locomotives had a coupler angle up to 15-degrees. As a result of the high buff forces, exceeding 225 KIPS, the large coupler angle of the revenue freight locomotives magnified the lateral drawbar force, distributed from the drawbar through the wheel, and produced a high L/V ratio[7] resulting in the rail gauge spreading, and the derailment.

Revenue Freight Locomotive Inspection

NS requires an inspection of revenue locomotives be performed and documented on NS form ME-925: In Tow Unit Inspection Form. Inspection records show both RMEX 6 and RMEX 8 received an in-tow unit inspection on January 18, 2023, and February 2, 2023, respectively. At that time, both locomotives were incorrectly identified by the inspecting employee as being equipped with alignment control couplers. In an interview with FRA, the employee indicated he did not know what an alignment control coupler was.

The employee who performed the inspection had 11 years of experience as an electrician and had only performed a locomotive alignment control inspection once before, in late 2022. The employee performed the inspection alone and did not receive prior training.

FRA concluded NS did not provide the proper training to the employee who performed this inspection beyond a basic overview of the locomotive components. Therefore, FRA determined the employee who inspected the revenue freight locomotives was not properly trained to perform this inspection.

[6] KIPS is the measure of coupler impact force in thousands. E.g., 300 KIPS is 300,000-pounds of force on the coupler.

[7] L/V is the ratio of the sum of lateral forces (L) of the wheel against the rail divided by the sum of the vertical forces (V) of the wheel on top of the rail at a given time.

Crew Member Training, Experience and Qualifications Analysis
FRA's investigation of this accident included evaluation of each crew member's qualification, certification, and testing records, as well as the crew's actions. FRA found no evidence of deficiencies, irregularities, or non-compliance in the crew's training, qualification, and testing records or to the crew's hours of service records. FRA also conducted a fatigue analysis of each crew member's relevant work/rest schedule and found no excessive fatigue risk. In addition, the results of each crew member's FRA Post-Accident Toxicological Testing were negative, indicating that neither drugs nor alcohol contributed to the cause or severity of the accident. FRA found no evidence of deficiencies, irregularities, or non-compliance in the crew's operation of the train. Similarly, FRA's investigation evaluated and took no exception to the track structure and rails over which the train was traveling at the time of derailment.

4. CONCLUSION

The FRA investigation and analysis found that the cause of this accident was excessive buffing or slack action due to improper train make-up. Additionally, FRA concluded defects to the coupler and draft system, improper placement of two non-alignment control locomotives, improper training, and human error by the employee who inspected the revenue freight locomotives were contributing causes to the accident.

In response to this accident FRA recommended, and NS adopted, an improvement to the NS form ME-925 to better identify non-alignment control couplers during an inspection.