



***Federal Railroad Administration
Office of Railroad Safety
Accident and Analysis Branch***

***Accident Investigation Report
HQ-2019-1373***

***Union Pacific Railroad
Medicine Bow, Wyoming
December 26, 2019***

Note that 49 U.S.C. §20903 provides that no part of an accident or incident report, including this one, made by the Secretary of Transportation/Federal Railroad Administration under 49 U.S.C. §20902 may be used in a civil action for damages resulting from a matter mentioned in the report.

SYNOPSIS

Synopsis

On December 26, 2019, at 3:59 a.m. MST, Union Pacific Railroad Company (UP) eastbound intermodal, extended haul train, Train No. ZBRG3 24 (Train 1), with 36 loads, and 2 empties, weighing 3,372 tons, and 3,446 feet in length, derailed 19 cars at Milepost (MP) 632.9 on the Laramie Subdivision, in Medicine Bow, Wyoming. The train was operating in double main track territory on Main Track No. 2. The method of operation at this location is Traffic Control System (TCS), supplemented by a Positive Train Control (PTC) overlay.

The UP reported \$1,386,850 in equipment damage, and \$1,231,576 in track and signal damage. Weather at the time of the derailment was dark and snowing, with a temperature of 26°F.

The Federal Railroad Administration (FRA) investigation determined the probable cause of the accident was E53C -- roller bearing failure from overheating.

TRAIN SUMMARY

1. Name of Railroad Operating Train #1 Union Pacific Railroad Company	1a. Alphabetic Code UP	1b. Railroad Accident/Incident No. 1219RM017
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GENERAL INFORMATION

1. Name of Railroad or Other Entity Responsible for Track Maintenance Union Pacific Railroad Company		1a. Alphabetic Code UP	1b. Railroad Accident/Incident No. 1219RM017	
2. U.S. DOT Grade Crossing Identification Number		3. Date of Accident/Incident 12/26/2019	4. Time of Accident/Incident 3:59 AM	
5. Type of Accident/Incident Derailment				
6. Cars Carrying HAZMAT 1	7. HAZMAT Cars Damaged/Derailed 0	8. Cars Releasing HAZMAT 0	9. People Evacuated 0	
10. Subdivision UNION PACIFIC RAILROAD COMPANY - LARAMIE				
11. Nearest City/Town MEDICINE BOW		12. Milepost (to nearest tenth) 632.9	13. State Abbr. WY	14. County CARBON
15. Temperature (F) 26 °F	16. Visibility Dark	17. Weather Snow		18. Type of Track Main
19. Track Name/Number Main Line No. 2		20. FRA Track Class Freight Trains-80, Passenger Trains-90		21. Annual Track Density (gross tons in millions) 71.6
				22. Time Table Direction East
23. PTC Preventable N/A		24. Primary Cause Code [E53C] Journal (roller bearing) failure		25. Contributing Cause Code(s)

OPERATING TRAIN #1

1. Type of Equipment Consist: Freight Train					2. Was Equipment Attended? Yes		3. Train Number/Symbol ZBRG3 24				
4. Speed (recorded speed, if available) R - Recorded 63.0 MPH E - Estimated		Code R	5. Trailing Tons (gross excluding power units) 3372		6a. Remotely Controlled Locomotive? 0 = Not a remotely controlled operation 1 = Remote control portable transmitter 2 = Remote control tower operation 3 = Remote control portable transmitter - more than one remote control transmitter					Code 0	
6. Type of Territory Signalization: <u>Signaled</u> Method of Operation/Authority for Movement: <u>Signal Indication</u> Supplemental/Adjunct Codes: <u>J, Q</u>											
7. Principal Car/Unit		a. Initial and Number	b. Position in Train	c. Loaded (yes/no)	8. If railroad employee(s) tested for drug/alcohol use, enter the number that were positive in the appropriate box			Alcohol	Drugs		
(1) First Involved (derailed, struck, etc.)		ARMN 110538	6	yes				0	0		
(2) Causing (if mechanical, cause reported)		ARMN 110606	7	yes	9. Was this consist transporting passengers?			No			
10. Locomotive Units (Exclude EMU, DMU, and Cab Car Locomotives.)	a. Head End	Mid Train		Rear End		11. Cars (Include EMU, DMU, and Cab Car Locomotives.)	Loaded		Empty		e. Caboose
		b. Manual	c. Remote	d. Manual	e. Remote		a. Freight	b. Pass.	c. Freight	d. Pass.	
(1) Total in Train	2	0	0	0	0	(1) Total in Equipment Consist	36	0	2	0	0
(2) Total Derailed	0	0	0	0	0	(2) Total Derailed	19	0	0	0	0
12. Equipment Damage This Consist 1386850			13. Track, Signal, Way & Structure Damage 1231576								
Number of Crew Members						Length of Time on Duty					
14. Engineers/Operators 1		15. Firemen 0		16. Conductors 1		17. Brakemen 0		18. Engineer/Operator Hrs: 5 Mins: 24		19. Conductor Hrs: 5 Mins: 24	
Casualties to:		20. Railroad Employees		21. Train Passengers		22. Others		23. EOT Device? Yes		24. Was EOT Device Properly Armed? Yes	
Fatal		0		0		0		25. Caboose Occupied by Crew?		N/A	
Nonfatal		0		0		0					
26. Latitude 41.910276000				27. Longitude -106.383688000							

ARMN 110538 is out of frame to the left (East)

This view is from the North looking South
The train was traveling East (toward the left)

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ARMN 110280

ARMN 110606 suspect car

General pile of cars and containers; IAIC 55125, IAIA 55125, TTAX 753196 (5 pack), DTTX 865584 (2 spine), DTTA 888953, DTTC 888953, DTTB 888953, DTTX 646798 (2 spine)

crossover

M2

M1

building and electrical power poles

IAIB 55125

ARMN 110865

ARMN 110864

ARMN 111208

ARMN 110178

ARMN 110186

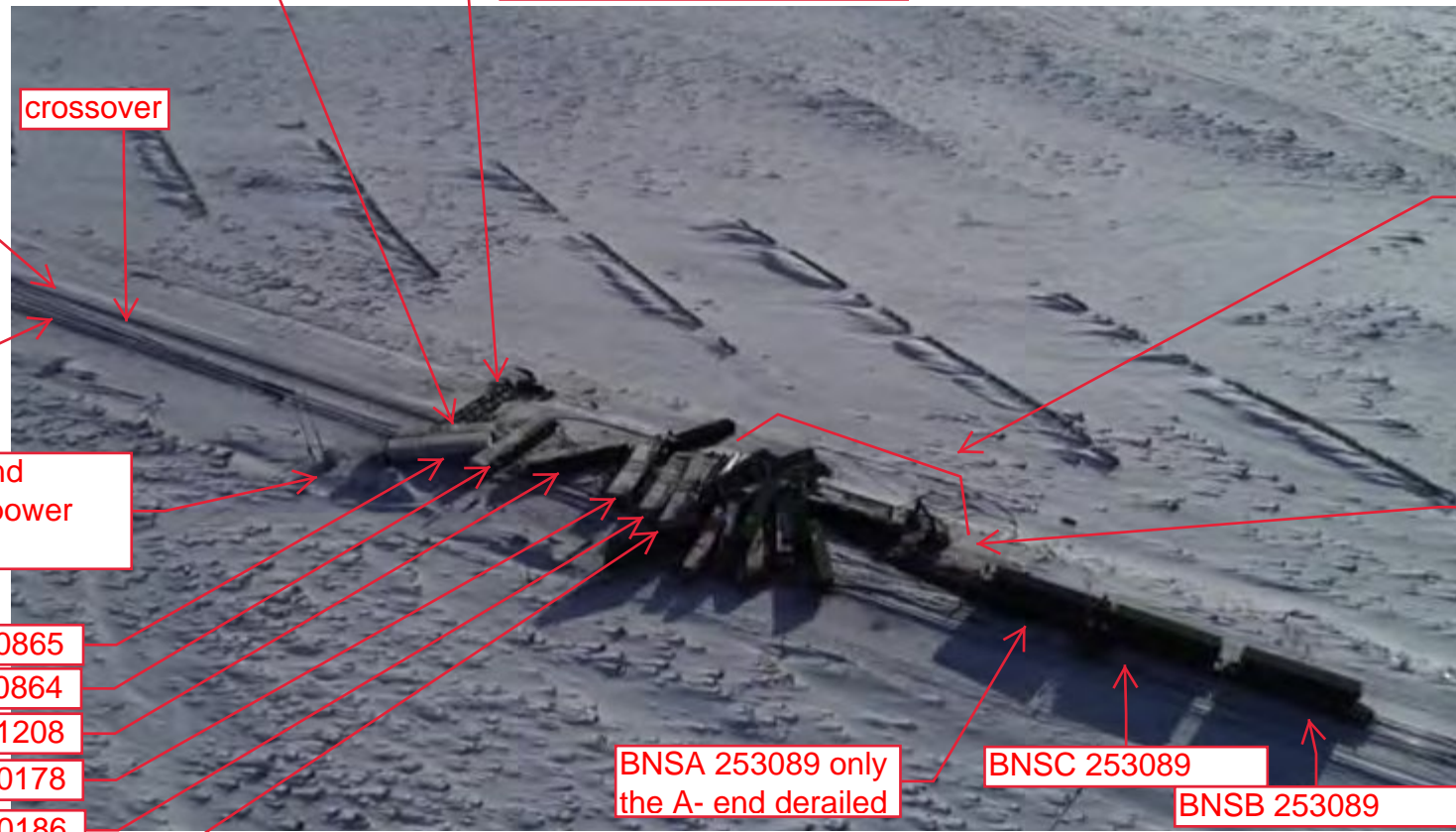
ARMN 111482

BNSA 253089 only the A- end derailed

BNSC 253089

BNSB 253089

These two cars not derailed



NARRATIVE**Circumstances Prior to Accident**

The Union Pacific Railroad Company (UP) eastbound intermodal, extended haul train, ZBRG3 24 (Train 1), originated at Brooklyn, Oregon, on December 24, 2019, with a destination of Chicago, Illinois. The original train makeup consisted of 2 locomotives, on the head end, with 22 loads and 24 empties. Train 1 was 7,947 feet in length, with 3,225 trailing tons. The TTX Company (TTX) performed the required pre-departure inspection and Class I extended haul train air brake test using qualified mechanical inspectors (QMI) in Brooklyn, with no exceptions noted.

Train 1 departed Brooklyn on December 24, and picked up 14 loaded cars at Hinkle, Oregon. This changed the train makeup to 36 loads and 24 empties, 9,011 feet in length, with 5,000 trailing tons. On December 25, the train arrived at Minidoka, Idaho, and set out 22 empty cars, changing the train make up to 36 loads and 2 empties, 3,446 feet in length, and 3,372 trailing tons. This was the makeup at the time of derailment in Medicine Bow, Wyoming.

The Train 1 relief crew consisted of a locomotive engineer and a conductor. The train crew went on duty at 10:35 p.m. MST, on December 25, 2019, in Green River, Wyoming. This is the away terminal for both crew members, and both had received the statutorily required off-duty period prior to reporting for duty.

The locomotive engineer was seated at the controls on the right side of the locomotive, and the conductor was seated on the left.

Train 1 was operating on the Rocky Mountain Service Unit, Laramie Subdivision, in Medicine Bow. The Laramie Subdivision travels geographic and timetable direction east and west. Timetable direction will be used throughout this report. The area of the derailment consists of two main tracks with a maximum authorized speed of 70 mph. The method of operation on the Laramie Subdivision is Centralized Traffic Control (CTC), with a Positive Train Control (PTC) overlay. Train 1 was operating east bound on Main Track No. 2 on a clear signal. Train 1 was traversing a slight right-hand curve with a 0.43 percent descending grade at the time of the accident.

The Accident

At approximately 3:58 a.m. MST on December 26, Train 1 was traveling at a recorded speed of 64 mph as it passed a dragging equipment detector at Milepost (MP) 634.1 on Main Track No. 2, which gave a verbal announcement of dragging equipment. Upon hearing the alert, the engineer moved the throttle from Notch 8 to Notch 1, and began to make a service application to the air brakes. As the engineer initiated the air brake application, the train experienced an undesired emergency brake application (UDE). The train crew contacted the Rawlins dispatcher and reported the event at about 4 a.m. The conductor exited the locomotive and began inspecting the train while the engineer stayed in the cab, in contact with the dispatcher. The conductor first discovered Car No. ARMN 110538 with a set of trucks missing. Upon further inspection, he found rail damage and cars across both main tracks. All this was communicated to the dispatcher. A total of 19 cars derailed mostly in an accordion fashion. Starting from

the headend, the derailed cars were car 6 through car 24.

UP reported \$1,386,850 in equipment damage and \$1,231,576 in track and signal damage. Weather at the time of the derailment was dark and snowing, with a temperature of 26°F.

Post-accident Investigation

On December 26, 2019, the Federal Railroad Administration (FRA) began an investigation of this accident. The investigation included FRA investigators inspecting the accident site, toxicology analysis, fatigue analysis of the crew, mechanical records review, and rules compliance. Additionally, FRA conducted interviews with the train crew involved.

After their on-site inspection and investigation, FRA inspectors requested, and received, all records, forms, and other documentation necessary to conduct their final analysis and draw conclusions concerning the pertinent facts of the derailment.

The following analysis and conclusions, as well as any contributing factors and the probable cause in this report represent the findings of FRA's investigation.

Analysis and Conclusions

Analysis - Toxicology: Federal Post Accident Toxicology Testing was conducted on the locomotive engineer and conductor with negative results.

Conclusion: FRA determined drugs and alcohol did not contribute to the cause or severity of the derailment.

Analysis - Fatigue: FRA uses an overall effectiveness rate of 72 or less for 80 percent or more of the time as the baseline for fatigue analysis. This is the level at which the risk of a human factors-related accident is calculated to be equal to chance. Below this baseline, fatigue was not considered as probable for an employee. Software sleep settings vary according to information obtained from each employee. If an employee does not provide sleep information, FRA uses the default software settings.

FRA obtained fatigue-related information, including work history, for all train operating employees involved in this accident. Based on the Fatigue Audit InterDyne (FAID) analysis, fatigue was not probable for any of the crew members involved in the accident.

Conclusion: FRA concluded fatigue did not contribute to the cause or severity of this accident.

Analysis- Track Structure: This portion of the UP Railroad, the Laramie Subdivision, consists entirely of double main track between Rawlins and Medicine Bow, MP 682.8 and MP 623.48. In the accident area, the track centers are spaced 26 feet apart. Per UP documentation, the 2018 total tonnage figure for each main track between MP 682.8 and MP 623.48 was about 71.6 million gross tons. Significant track

structure damage in the immediate area of the derailment prevented detailed inspection of an intact track structure in the disturbed track area. During post-accident observations by investigators, they noted that the track construction consisted primarily of 141-pound continuously welded rail (CWR). The CWR was seated in 16-inch double shoulder tie plates that lay between the bottom surface of the rail and the top surface of concrete crossties, with 24-inch tie centers. The rail was fastened with Safe Lock One clips, a very common fastener used by UP. Track repairs consisted of 11 track panels for Main Track No. 1 and 40 track panels for Main Track No. 2. Control Point (CP) W633 required three No. 20 crossover switches to be completely replaced.

The overall condition of the ballast and geometry in the area just west of the track disturbed by the derailment, was compliant with all standards for FRA Class 5 Track. The overall crosstie conditions surpassed the minimum regulatory standards for sufficient number of crossties required in 39 feet and were distributed effectively. Overall, the components of the track structure appeared to be well maintained and of suitable construction.

Analysis- Regular Track Inspection: The FRA required track inspection frequency in the area in which the derailment occurred, MP 633 on Main Track No. 2, on the Laramie Subdivision is twice weekly with at least one calendar day interval between inspections. An analysis of UP's track inspection records revealed that UP met the required frequency of inspection for the month prior to the derailment, from November 27, 2019, to the day of the derailment, December 26th.

The last FRA recorded track inspection, in the area of the derailment, was on December 24, 2019, by an FRA-qualified UP track inspector. That track inspection record noted no defects.

Analysis - Ultrasonic Rail Inspection: A qualified FRA track safety inspector conducted an inspection of the last three ultrasonic internal rail tests conducted by UP, with detector Car No. DC 48. Per UP's documentation, Car No. DC 48 operated and tested rail on Main Track No. 2 of the Laramie Subdivision on March 6, May 28, and August 27 of 2019. During the last internal rail flaw inspection, one defective rail was marked in the immediate area of the derailment footprint at MP 632.96, on August 27, 2019. The defective rail was reported repaired on August 28, 2019.

Analysis- Geometry Car Inspection: UP operated a geometry car, Car No. EC4, over the Laramie Subdivision on October 23, 2019. From the data of that test, it shows that the car began its inspection and measured the track structure, which included the portion of track east and west of the immediate derailment footprint. One geometry defect was noted from a review of the data at MP 632.905, on October 23, 2019. That defect was reported repaired the same day on October 23.

Conclusion: FRA determined track structure, track inspection frequency and systemic geometry issues did not contribute to the cause or severity of the accident.

Analysis - Operating Practices - Crew: The lead locomotive, UP 4868, was equipped with a speed indicator and event recorder. The relevant event recorder data was downloaded by UP officials at the accident site and analyzed, then sent to FRA for analysis. A graph format and table format were

requested and provided by UP.

The table format provided begins recording on December 26, at 3:45:15 a.m. MST, and continues to 4:05:25 a.m. At 3:58:13 a.m., and approximately MP 634.122, the throttle was in Notch 8 and the recorded speed was 65 mph. In response to the dragging equipment detector message, the next several recorded events show the throttle being progressively decreased from Notch 8 to Notch 1. At 3:59:26 a.m., the last recorded tractive effort in Notch 1 was recorded and the speed showed 63 mph. At 3:59:27 a.m. and 3:59:28 a.m., the brake pipe (BP) was reduced from the normal pressure of 90 pounds per square inch (psi) to 86 psi, showing the engineer was making an automatic brake application via BP reduction. The next second, 3:59:29 a.m., showed BP at 7 psi, which was a one second BP pressure change from 86 psi to 7 psi. Recorded speed was 63 mph. This rapid change of BP pressure indicates a UDE occurred.

At 3:59:45 a.m., with a recorded speed of 53 mph, the locomotive pneumatic control switch (PCS) opened cutting power to the propulsion system. One minute and 9 seconds later, at 4:00:54 a.m., the recorded speed was 0 mph. From initial UDE to full stop there was 85 seconds and a distance of 0.924 miles. From initial throttle movement to full stop was 2 minutes and 41 seconds with a distance of 2.281 miles traversed.

During interviews, both crew members reported an uneventful trip. The crew of Train 1 stated they did not observe any issues with their train. The conductor stated 11 wayside detectors were passed and they met a couple of trains with the last train meet at Ramsey Siding MP 639. Both the engineer and conductor stated that trains will receive a roll by at these meets and if no defects are noted by the observing crew, no acknowledgment of the roll by will be broadcast. This is to alleviate radio chatter. No defects were reported by any of these events. FRA reviewed available data, audio recording, interviews, and event recorder data to determine if any carrier rules were violated.

Conclusion: FRA determined operating crew performance did not contribute to the cause or severity of the accident.

Analysis - Car Mechanical Information: FRA reviewed available brake test and inspection records, as well as wayside detector data including wheel impact data and wheel bearing temperature data. The focus of the wayside detector data was on the first and second cars derailed, Car No. ARMN 110538 and Car No. ARMN 110606, respectively. Wheel impact data (kips) for these cars did not indicate a defective condition. The four temperature detector readings prior to the derailment were the focus of the investigation. UP officials on scene stated the Hot Box (overheated bearing) and Dragging Equipment Detectors (HBD) at MP 650.23 reported 164 axles, and the HBD at MP 634.1 reported 162 axles, just prior to the derailment.

Of all the available data, the left No. 4 wheel bearing (L4) temperature on the second car (ARMN 110606) shows the highest bearing temperature of the two cars. UP HBDs are programmed to alert the train crew if

an individual bearing temperature is 190°F above ambient or 117°F differential between bearings of the same axle. Per UP Timetable, an audible alert is only broadcast if a defect is detected. The details of the HBDs traversed by Car No. ARMN 110606 are as follows: at 2:19 a.m., at Creston East MP 710.68, the L4 bearing was 3°F above ambient temperature; 2:39 a.m., at Hadsell MP 692.27, the L4 bearing was 68°F above ambient temperature; at 3:13 a.m., at Benton MP 672.96, the L4 bearing was 70°F above ambient temperature; and at 3:38 a.m., at Durrant MP 650.23, the L4 bearing was 1°F above ambient temperature. After passing the last HBD at Durrant, it is believed the bearing temperature began to rise rapidly. The rising temperature reached a point the bearing disintegrated and the bearing mounting location of the axle detached (burned off). This allowed the "A" end truck side frame to drop to the track surface. The first signs of dragging or derailed equipment were discovered on Main Track No. 2, at MP 638.37, which is just east of Ramsey Siding MP 639. Train 1 traveled approximately 5 miles to the next HBD located at Como MP 634.1, before the crew was made aware of a problem with their train. As Train 1 was slowing, the dragging equipment became snared on the switch point of the crossover at MP 632.9, resulting in the derailment.

During the initial scene investigation, both FRA and UP viewed Car No. ARMN 110538, the sixth car behind the locomotives as the first car derailed. The A-end truck (the rear truck in relation to direction of travel) was missing, and the B-end was still coupled to the train and not derailed. Subsequent investigation by FRA and UP determined that Car No. ARMN 110606, the seventh car behind the locomotives, was the causal car. The A-end truck (the forward truck in relation to direction of travel) was the first location derailed. The wheel information for the No. 4 position of Car No. ARMN 110606 matches closest to the wheel found onsite.

To confirm this, FRA requested UP trace the causal wheel set serial number and match it to a car. UP informed FRA their records are not that detailed and could not complete the request. FRA used what information UP did provide and correlated it with the Association of American Railroads (AAR) Field Manual, Railinc, and the Universal Machine Language Equipment Register (UMLER) to determine the following: Car No. ARMN 110606 had a built date of December 2004. The causal wheel set is a 36-inch curved plate, heat treated, H36 wheel manufactured in April 2011 by Standard Wheel LLC. The remaining bearing is a 6-1/2 x 9-inch roller bearing manufactured by Brenco Inc. with an installation date of May 2011 by Progress Rail in Little Rock, Arkansas. The wheel was installed by CSXT Railroad on July 11, 2011.

In the initial investigation, FRA focused on the No. 4 wheel from Car No. ARMN 110538; car repair records for this car revealed the No. 4 wheel was installed on July 25, 2019, as a turned wheel (reconditioned), not a new wheel. The causal set is an H36 class wheel; H designates the wheel as a one-wear wheel and not designed to be turned. This information coupled to the wheel build and installation date led FRA to change the causal car number.

Due to the general pile and scattering of various car components, it was impossible to reconstruct, or find and identify, every component of every car.

Track inspection west of the derailment location indicated marks from dragging equipment but the burnt off bearing could not be located. UP elected not to send the causal wheel set out for additional laboratory analysis, due to the wheel set axel showing evidence of a burned off journal. FRA determined the brake test and train inspection process did not contribute to the cause or severity of the derailment.

Conclusion: Based upon the available evidence and scene investigation, FRA determined the left No. 4 bearing of Car No. ARMN 110606 experienced a catastrophic failure from overheating, causing the derailment.

Overall Conclusion

This derailment was caused by a catastrophic failure of the No. 4 bearing on Car No. ARMN 110606.

Probable Cause and Contributing Factors

The FRA investigation determined the probable cause of the derailment was E53C -- Roller Bearing Failure from Overheating.