National Transportation Safety Board
Office of Railroad, Pipeline and Hazardous Materials Investigations
Washington, DC 20594

Mechanical and Engineering Group Factual Report

Railroad Employee Fatality
BNSF Railway Globeville Yard
Denver, Colorado
February 9, 2022

RRD22FR006

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Accident

Accident Number:	RRD22FR006
Accident Type:	Employee Fatality
Location:	Denver, Colorado
Date of Accident:	February 9, 2022
Carrier:	BNSF Railway
Job Assignment:	YDEN1152-09i
Injuries:	1 Fatality

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Accident Summary

For a summary of the accident, refer to the IIC/Operations Group Factual Report within this docket

Figure 1. BNSF 1961 Final Resting Positions Post-Accident

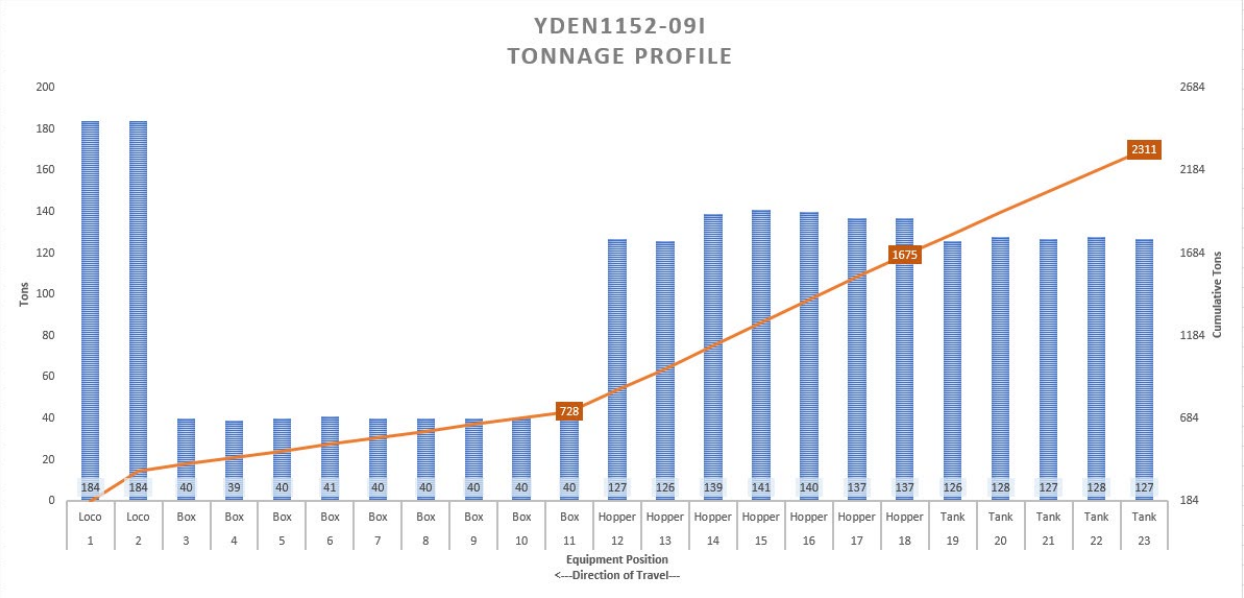
Railroad Equipment Involved in the Accident

On-Track Equipment

At the time of the accident the two-person switching crew was controlling 2 locomotives coupled to 21-mixed freight cars. The consist was traveling from east to west with the locomotives at the west, or front, of the movement. Three of the last four tank cars had hand brakes tied. The air hoses were not connected between the locomotive consist and the cut of cars, meaning the pneumatic brakes on the cars were released and could not be applied using locomotive controls. This is a normal practice for switching freight cars in the railroad industry and in the Globeville yard.

Position (West->East)	Locomotive/Car Number	Type; Empty/Load	Weight (Tons)
1.	BNSF 1961 (Remote Equipped)	SD40-2	184
2.	BNSF 1601 (Conventional)	SD40-2	184
3.	BNSF 761771	Box (Empty)	40
4.	COER 502992	Box (Empty)	39
5.	TBOX 664536	Box (Empty)	40
6.	TBOX 670635	Box (Empty)	41
7.	LRS 130119	Box (Empty)	40
8.	TBOX 665709	Box (Empty)	40
9.	KCS 112318	Box (Empty)	40
10.	TBOX 665064	Box (Empty)	40
11.	BNSF 763061	Box (Empty)	40
12.	GACX 12302	Covered Hopper (Load)	127
13.	FURX 809089	Covered Hopper (Load)	126
14.	NAHX 328047	Covered Hopper (Load)	139
15.	BNSF 409266	Covered Hopper (Load)	141
16.	TILX 789	Covered Hopper (Load)	140

17.	HWCX 10632	Covered Hopper (Load)	137
18.	FCTX 805955	Covered Hopper (Load)	137
19.	SHPX 202353	Tank (Load)	126
20.	GATX 69606	Tank (Load); Hand Brake Applied	128
21.	GATX 68597	Tank (Load); Hand Brake Applied	127
22.	GATX 28046	Tank (Load); Hand Brake Applied	128
23.	GATX 28031	Tank (Load)	127



Slack and in-train force management

The ends of freight cars are designed to transfer the longitudinal loads of in-train forces, switching, and coupling through the ends of the cars where the couplers themselves connect to the car body through a draft pocket assembly. To manage these large forces without damaging equipment or lading, North American freight cars generally have either a standard draft gear, made up of resilient blocks or cast wedges, or a hydraulic end of car cushioning unit (EOCC). Draft gear systems have approximately 6.5-inches of travel over which the forces are absorbed in each device. EOCC systems absorb forces through hydraulic pistons in various ranges, generally about 15-inches per device.

Based on experience of the investigators, industry standards, and on-car markings, investigators characterized the approximate amount of 'travel' in the cut of cars in the following table.

Position	**Car No.**	**Type**	**Approx. End of Car Travel (inches)**	**Consist Approx. Total Run-out (inches)**
3.	BNSF 761771	Box (Empty) - EOCC	30	30
4.	COER 502992	Box (Empty) - EOCC	30	60
5.	TBOX 664536	Box (Empty) - EOCC	30	90
6.	TBOX 670635	Box (Empty) - EOCC	30	120
7.	LRS 130119	Box (Empty) - EOCC	30	150
8.	TBOX 665709	Box (Empty) - EOCC	30	180
9.	KCS 112318	Box (Empty) - EOCC	30	210
10.	TBOX 665064	Box (Empty) - EOCC	30	240
11.	BNSF 763061	Box (Empty) - EOCC	30	270
12.	GACX 12302	Covered Hopper (Load) - Gear	13	283
13.	FURX 809089	Covered Hopper (Load) - Gear	13	196
14.	NAHX 328047	Covered Hopper (Load) - Gear	13	309
15.	BNSF 409266	Covered Hopper (Load) - Gear	13	322
16.	TILX 789	Covered Hopper (Load) - Gear	13	335
17.	HWCX 10632	Covered Hopper (Load) - Gear	13	348
18.	FCTX 805955	Covered Hopper (Load) - Gear	13	361

19.	SHPX 202353	Tank (Load) - Gear	13	374
20.	GATX 69606	Tank (Load) - Gear	13	387
21.	GATX 68597	Tank (Load) - Gear	13	400
22.	GATX 28046	Tank (Load) - Gear	13	413
23.	GATX 28031	Tank (Load) - Gear	13	426

Remote Control Equipment

Locomotive Number BNSF 1961 was equipped with a system that enables railroad employees to operate a locomotive via a wireless control system. The system consists of a Locomotive Control System (LCS) installed on-board the locomotive and two Operator's Control Unit's (OCU). On BNSF 1961 the LCS was an "Electrical Control Unit (ECU) II – Beltpack" model built by Canac. The OCUs being used were "OCU-III for Rail - Accuspeed" built by Cattron.

The system is capable of applying throttle and brakes to maintain a speed selected by the Remote Control Operator (RCO) on their (OCU) without the RCO being in the locomotive cab like a traditional locomotive engineer. Only one OCU can control the locomotive at a time.

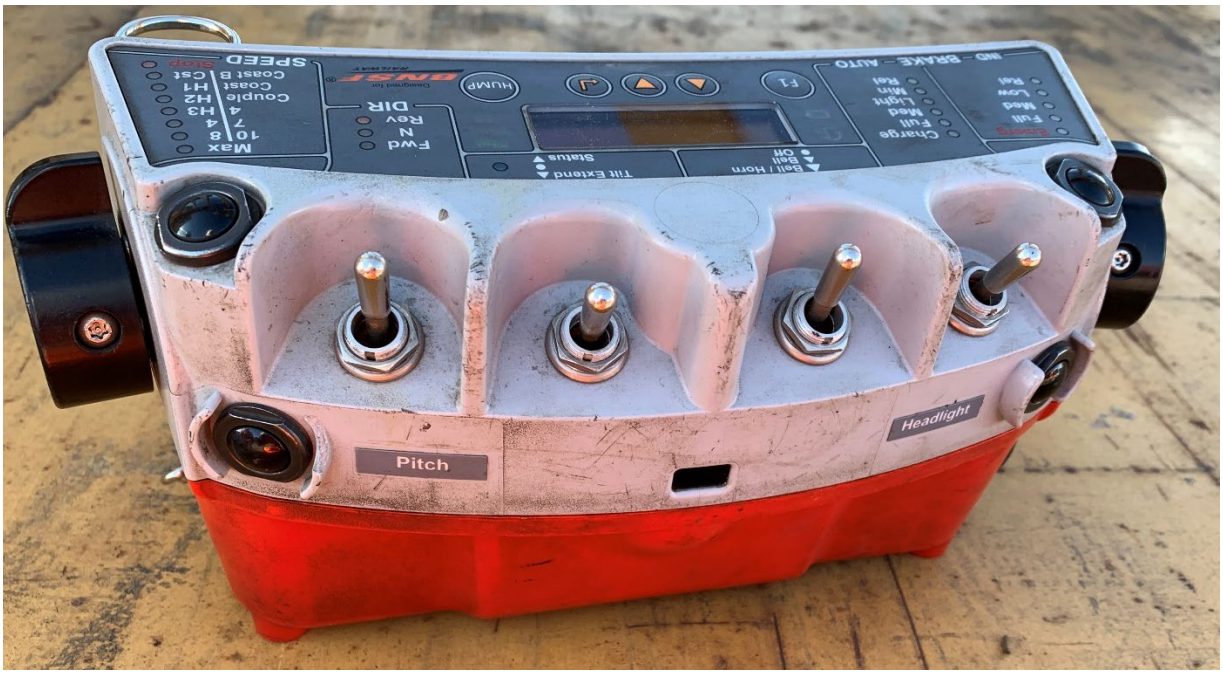


Figure 2. The Switchman Foreman (b) OCU from the accident consist.

Track Infrastructure in the area of the Accident

Track Description

The Globeville Yard at the "Teen Lead" between Switch Numbers 15 and 16 is made up of jointed 112 pound rail dated 1945. Anchor pattern is every tie and missing anchors intermitted. Tie plates are double shouldered with standard BNSF spiking pattern with cut style 6 inch spikes. Plates are worn with spikes intermitted high. Crossties are a mix of hard and soft wooden switch ties. Tie condition is marginal. Ballast condition is made of 3/4 inch yard ballast. Sub-grade is soft with one defective ballast condition noted at a joint ahead of No. 16 switch. Switches in the area of concern are No. 9 turnouts, with hand throw (Racor 22P) Switch Stands, 16 foot 6 inch standard switch points and self-guarded frogs.

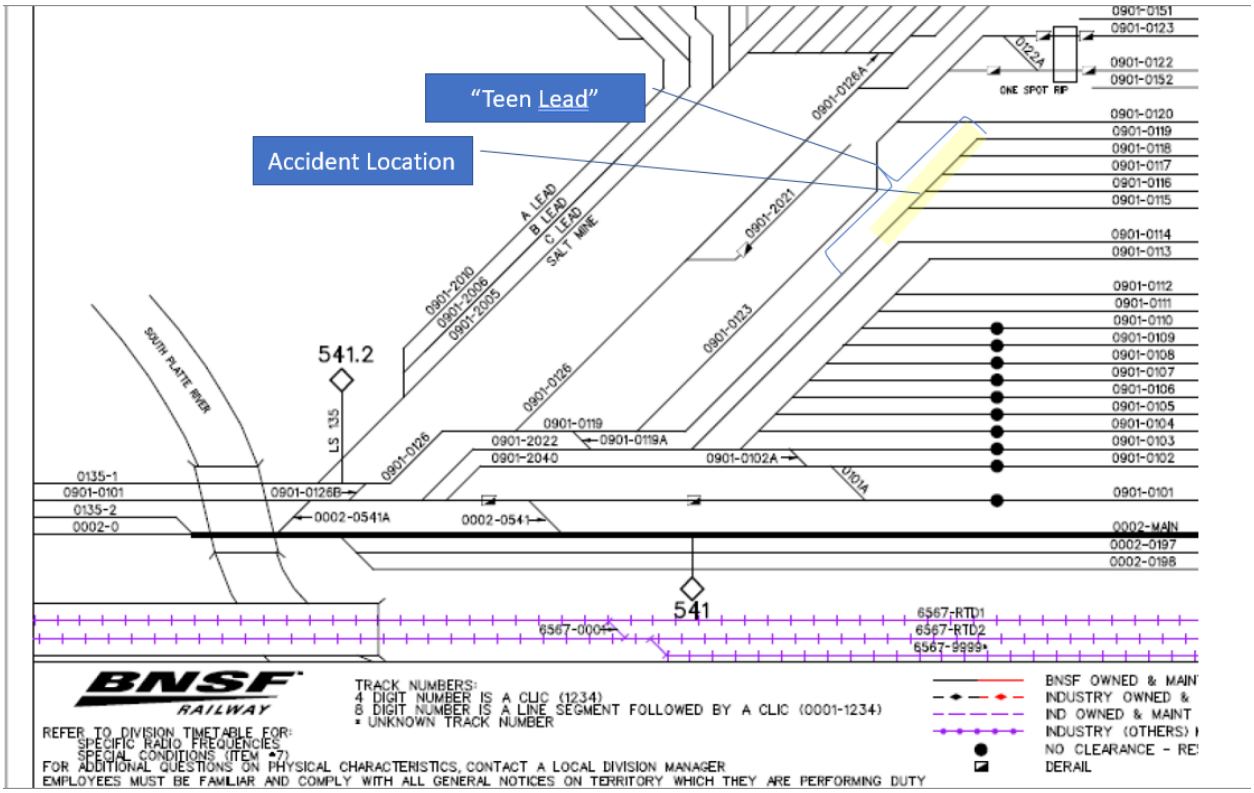


Figure 3. BNSF Globeville Yard

Post-Accident Inspections and Testing

Mechanical Inspections

Investigators conducted inspections of the equipment involved in the accident. The following items were noted.

- Locomotive No. BNSF 1961 did not have a tag identifying it as operating in RCL mode and the control stand reverser handle was not locked out.[1]
- Locomotive No. BNSF 1961 had excessive brake piston travel at the R2 and R3 locations and Locomotive No. BNSF 1601 had excessive brake piston travel at the L2 location.[2]
- Locomotive No. BNSF 1601 had a hole in the conductor side front sand hose.[3]

Locomotives are required to have a continuous barrier across the full width of the end of a locomotive or have a continuous barrier between locomotives.[4] Locomotive No. BNSF 1961 had a continuous barrier chain as required. Its height was measured from the eyelets used to connect the chain. The lowest portion of the chain was 8 – inches below the center of the eyelets. The lowest portion of the chain was 11-inches below the top of the continuous barrier railing.

Investigators observed BNSF Qualified Mechanical Persons complete pneumatic brake tests and daily locomotive inspection.

Investigators observed a Technician from Cattron conduct a functional test of the OCU devices.

Investigators linked the OCUs to the RCL and conducted functional tests including testing the tilt time out feature.

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[1] Title 49 CFR Section 229.15(9,11)
[2] Title 49 CFR Section 229.55(b)
[3] Title 49 CFR Section 229.45
[4] Title 49 CFR Section 229.119(e)

Track Inspections

Detailed track measurements (Gage, Alinement, loaded crosslevel, loaded warp) were conducted a 15.5 feet stations, 10 stations behind final resting place of the locomotive and 2 stations ahead of final resting place of locomotives, as well as all joints within the stations, with the following observations and standards for the Class of Track (Class I)[5]:

- Highest Warp measurement is 1 - 9/16 inches. The upper limit for Class I track is 3 inches.
- Highest X Level measurement is 1 - 11/16 inches. The upper limit for Class I track is 3 inches.
- Highest Profile measurement is 1 - 3/4 inches humped. The upper limit for Class I track is 3 inches.
- Highest Gage measurement is 57 - 5/8 inches. The upper limit for Class I track is 58 inches.

During the investigation, FRA Inspectors documented 4 non-class specific defects and 3 operating defects. They filed no violations and found no class specific defects. The non-class specific defects included ballast failing to restrain the track which allowed for 1 – 11/16 inches of crosslevel with evidence of entrapped water; a broken switch plate; improper fit between switch point and stock rail, and insufficient fasteners to effectively maintain gage allowing for 57- 5/8 inches of gage[6]. The operating defects were 3 occurrences of failure to ensure a switch is latched when not in use[7].

[5] Title 49 CFR Sections 213.53, 55, 63
[6] Title 49 CFR Sections 213.103(b), 127(a)(3), 133(a)(10), 135(b)(1)
[7] Title 49 CFR Section 218.103 (b)(8)

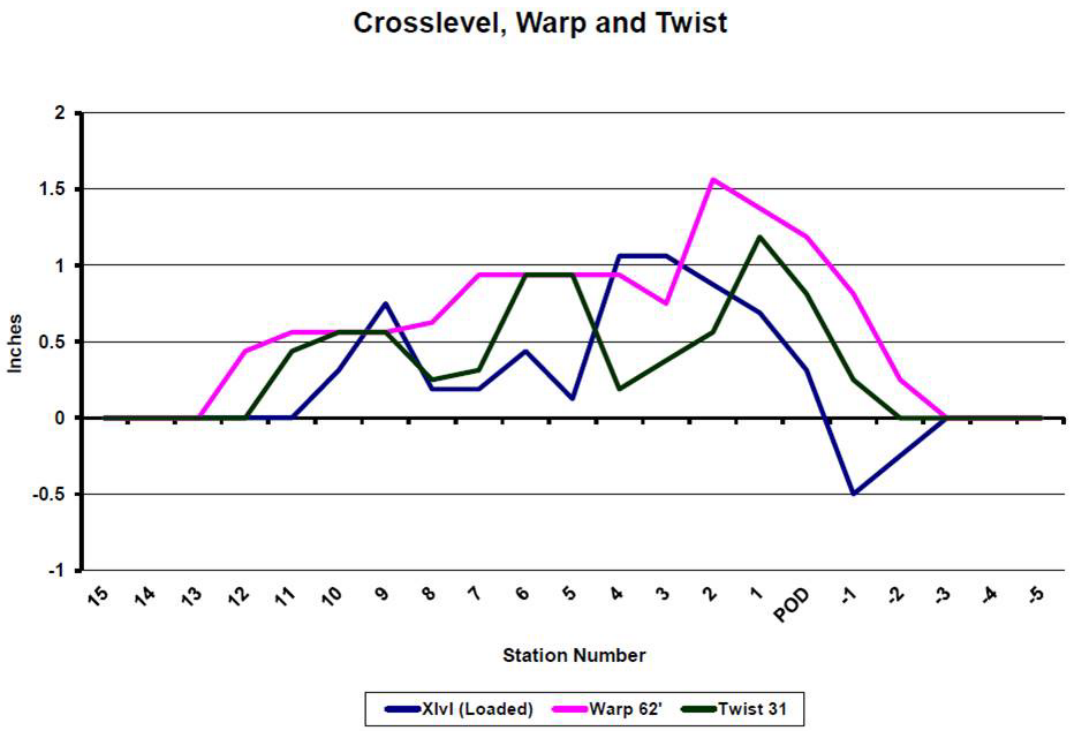


Figure 4. Chart of crosslevel, warp and twist 5 stations past the incident location (marked as "POD") and 15 stations prior to the incident location. Note: For Class 1 track, the maximum allowable warp is 3-inches.

Reenactments

Investigators from both groups observed reenactments conducted by the Operations group.

Emergency Response On-Site Observations of the Group

- Investigators from this mechanical and track working group were nearby as part of their normal duties and were on-scene within minutes of the accident.
- Investigators observed the RCO Helper underneath the lead locomotive, mostly under the Number 2 traction motor and partially under the Number 1 Traction motor. He was between the gage but mostly near the rail on the engineer's side of the locomotive.

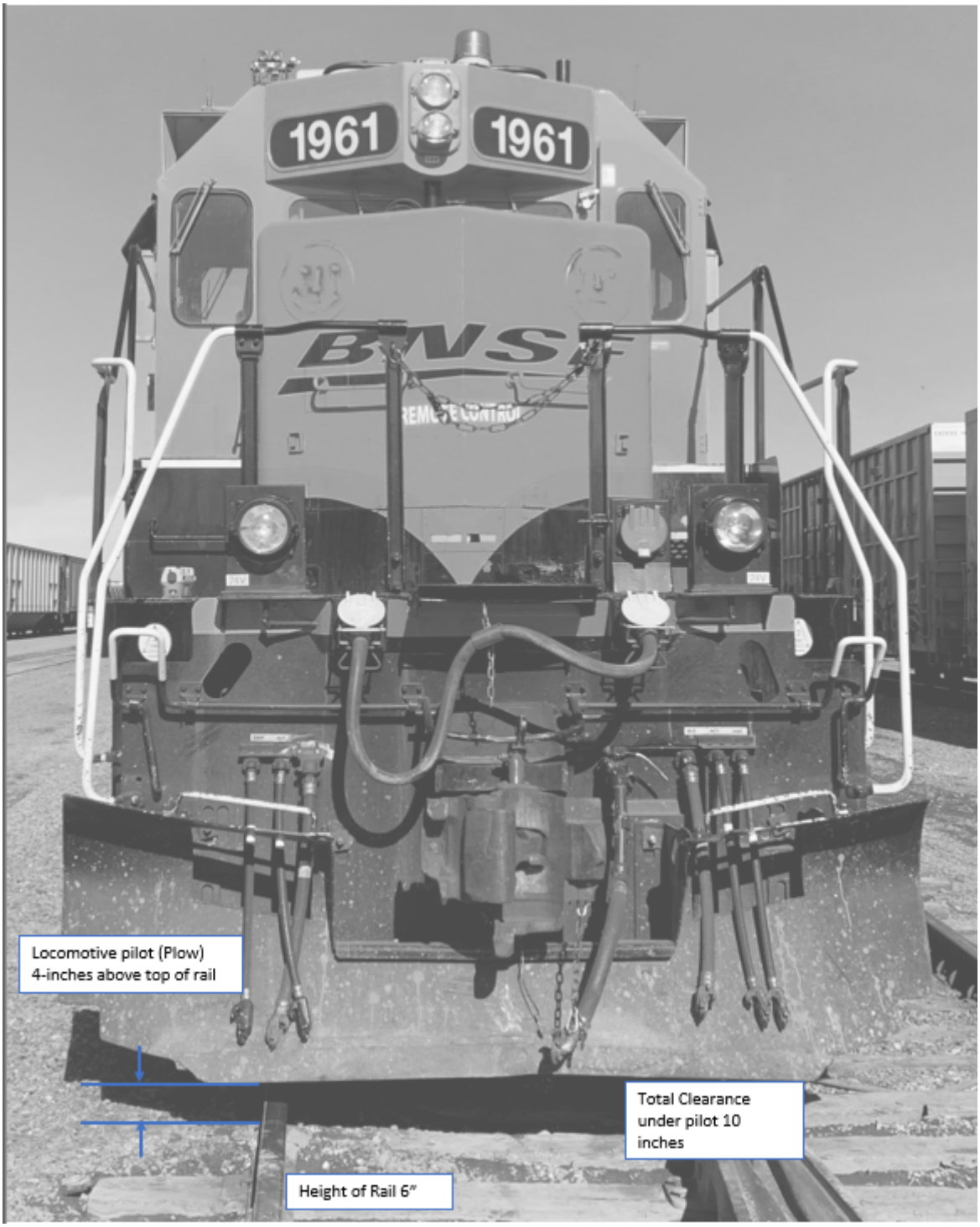
- Investigators observed Denver Fire Department arrive within minutes of the investigators arrival.
    - Fire Department personnel worked under the locomotive to attempt to revive the RCO Helper, which was unsuccessful.
- The coroner arrived within an hour. The RCO Helper was placed on a Fire Department backboard, and a cable was attached to the board. The RCO Helper was extracted using a Fire Department winch, underneath the front of the locomotive plow. The employee was released to the custody of the coroner.
- Investigators observed witness marks on the rails, ballast, and ties are consistent with a person being dragged under the locomotive pilot (plow) and traction motor cases. From the first witness mark to the final resting position there are approximately 22-feet of dragging marks.
- There were witness marks on the front of the locomotive and MU cables.
- Within the gage and dragging witness marks, investigators observed personal effects of the employee including a 'D' ring that holds the RCO box, pliers, glasses, and baseball style hat. Hair was also found embedded in in the conductor's side rail.
- Bodily fluid on the ties between the gage indicated the point where the RCO Helper came to rest. Bodily fluid on the conductor's side rail and conductor's side number two wheel is consistent with the employee being dragged and rolled after passing the plow.

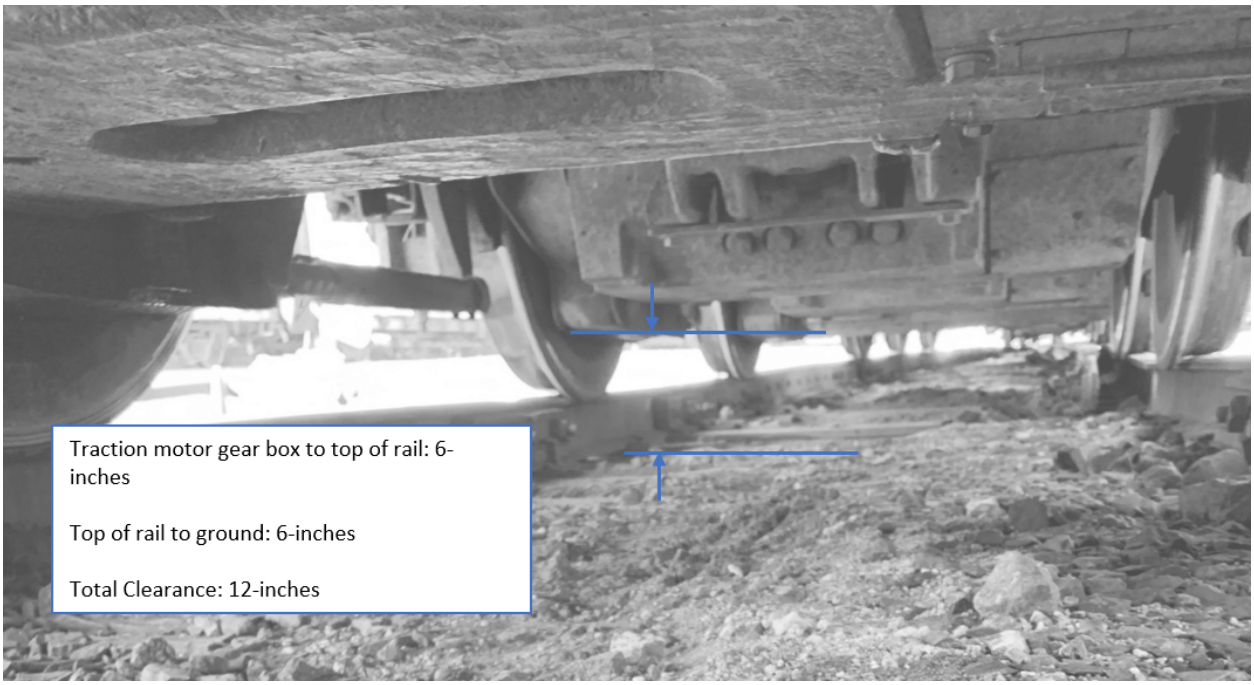
Additional Observations

NTSB staff returned to Denver Globeville yard on Thursday, July 8, 2022. At that time they made observations of two separate exemplary BNSF SD 40-2 locomotives and the area of the accident. Several measurements were recorded to better understand the clearances underneath a locomotive of this type in the accident area.

- The distance from the ground to the top of the rail in the area of the accident is 6.25-inches. In some areas it might be slightly less due to ballast rock, dirt and other debris associated with normal railroad yard conditions.
- The distance from the top of the rail to the bottom of the plow on exemplary locomotive BNSF 1798 was 5-inches as measured in the BNSF Globeville locomotive facility
- The height of the plow above the rail is a Federally regulated item. Title 49 CFR Section 229.123(a) requires the plow to be 3-inches to 6-inches above the top of the rail. This height can change based on wheel wear, weight, and suspension.
- The BNSF records the plow height at quarterly inspections. NTSB received reports for BNSF 1961.
    - On December 14, 2021 the plow height was recorded at Lincoln, Nebraska as 4-inches above top of rail
    - On February 24, 2022 (post-accident), the plow height was recorded at Alliance, Nebraska as 4-inches above top of rail.
- NTSB staff measured the lowest point of the locomotive between the rails and behind the plow, which corresponds with the traction motor gear cases. There is a traction motor and gear case on each axle. The gear case is approximately 6-inches above top of rail.

Clearance Images




Traction motor gear box to top of rail: 6-inches
Top of rail to ground: 6-inches
Total Clearance: 12-inches


Exemplar Locomotive
Plow height above top of rail: 5-inches

Acknowledgement Signatures

Group Member to the Investigation - Acknowledgment Signatures

The undersigned designated Group Member to the Investigation representatives attest that the information contained in this report is a factually accurate representation of the information collected during the on scene phase of this investigation, to the extent of their best knowledge and contribution in this investigation.

_____//s//_____ Date:____9/13/22_____

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NTSB

_____//s//_____ Date:__9/13/22_____

Ken Johnson

FRA

_____//s//_____ Date:___9/13/22_____

Bret Bridges

BNSF

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Shane Mapes

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Michael Glidden

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RRD22FR006 – Denver, Colorado

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