

# Federal Railroad Administration Office of Railroad Safety

Accident Investigation Report HQ-NS-2022-0305-1543

Norfolk Southern Railway Corporation (NS) Perryman, Maryland March 5, 2022

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.

## FEDERAL RAILROAD ADMINISTRATION BASIC ACCIDENT INVESTIGATION

FRA File Number HQ-NS-2022-0305-1543

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1. Primary Railroad Norfolk Southern Railway Company						, 1	1a. Alphabetic Code			1b. Class Class I				1c. Railroad Accident Number 144643					
2. Other Railroad/Entity Involved					2	2a. Alphabetic Code			2b. Class				2c. Rai	Iroad A	.ccident	Numbe	r		
								NA											
3. Railroad/Entity Responsible for Track Maintenance					3	3a. Alphabetic Code			3b. Class				3c. Railroad Accident Number						
Amtrak					4	ATK			Pass				169963						
4. Date and Time of Accident (local)       6. Division/Operating Unit         3/5/2022 01:58       NEC					ting Unit	Philadelphia to Washington Line									;				
7. State (Abbr.)	8. Cou Ha					9. City/1 Per	Town (close <b>VMAN</b>	10 <b>3</b>			0. Latitude/Longitude 39.44518, -76.2251				16	6			
11. Milepost	12. Tra	ack Nam	ne/Number			13. Trac	k Type	1.			14. FRA Track Class				5. Timetable Direction				
71.0	Ma	/lain 2			Main						7			S	South				
16. Signalization	Signalization 16a. Meth			Method	od of Operation			16b. Supplemental			Codes (Select up to 5)			Oslasta Oslast					
Signaled Signal			nal Ir	Indication ment Damage			J Signal/Stru			lect:	Select:	20 Tata	Total Damage			select:			
Derailment				quipin	ent Dunio	\$828	,118.00	19. Track/Signal/Struct			\$1,837,109.00			20.1018	\$2,665,227.00				
21. Temperature (degrees Fahrenheit)22.26Data				22. V Dai	'isibilitv <b>'k</b>			23. Weather Clear			her			23 N	23a. Warnings/Advisories None				
23b. Weather Related Conditions None				24. Ty Freig	pe of Eq ght Tra	uipment ain						25. Train Symbol <b>Y92H202</b>							
26. Trailing Tons 27. Train Length				28. Empty			29. Att	ended	30. Remote		ote	31. Speed (		(mph) 31a. Estimat			d/Reco	rded	
18,438		6,767			1.5			Yes			No		30				Recorded Speed		ed
32. Total Locomotives in Accident 32a. Head-end Lo				end Lo	comotives 32b. Mid-Train			ocomotives 32c. M			Train Lo	comotiv	e Position			32d. R	lear-end	l Locom	otives 0
32e. Total Locomotives Derailed 32f. Head-end E			nd De	erailed 32g. Mid-Train			Derailed 32h. Mic			d-Train Derailment Positi			32i. Rear-e			ear-end	Deraile	<sup>.d</sup> 0	
33. Configuration Traditional Operation - Head-End Locomotives Only																			
33a. Locomotive Control																			
33b. PTC Information																			
34. Total Cars in Accident 34a. Loaded Freight 34b. I				Loaded Passenger 34c. Emp			ty Freight 34d. Emp			ty Passenger 34e. U O Shovi		Unoccupied Caboose/ ing Platform		oose/	34f. Occupied Caboose/ Shoving Platform				
35. Total Cars Derailed 35a. Load		ided Freight	Freight 35b. Loaded		Passenger 35c. Empt		y Freight 35d. En		pty Passenger 35e.		r 35e. U Shovi	e. Unoccupied Caboo oving Platform		bose/	ose/ 35f. Occupied Caboose/ Shoving Platform		ose/		
36a. HAZMAT in Ti	20 rain	36b. HA	ZMAT	36c.	HAZMA	T	36d. Evac	uation	36e. Peoj	ple	0	37. Pc	oint of De	railmen	1t 38. N	/lechan	ism of I	Derailm	ent
	0	Derailed	<sup>i</sup> 0	Rele	asing	0	Select:				C	71.	0		Ca	tastro	ophic	Failu	re
39. First Equipment NS145387	Derail	ailed 39a. Load/Empty			40.Position 41. Weight (tor 80 170			s)	42. AAR <b>H35(</b>	R Car Type 4		43. L	43. Leading End		44. First Wheel Derailed <b>R4</b>				
45a. Employee 1 Cr 617	ployee 1 Craft 45b. Injured Not Injured		ed ured		45c. Tim 3/4/202	e on Du 22 20:4	у 5	45d. R Yes	legular As	ssignment 45		5e. Drug & Alcoho Yes		hol Tes	Tested 45f. In Yes		a cab @ time of Accident		
46a. Emplovee 2 Cr 608	e 2 Craft 46b. Injured			46c. Time on Duty			46d. Regular Ass			signment 46e. Dru Yes		ug & Alcohol Tested 46 S		sted 46f.	6f. In cab @ time of Accident				
47a. Employee 3 Cr	aft 47	47b. Injured			47c. Time on Duty			47d. Regular Ass			ignment 47e. Drus		g & Alco	& Alcohol Tested 47f.		f. In cab @ time of Accident			
48a. Employee 4 Cra	aft 48	48b. Injured			3/4/2022 20:45 48c. Time on Duty			48d. Regular Ass			ignment 48e. Dru		g & Alco	cohol Tested 48f.		es f. In cab @ time of Accident			
Select:	S	Select:			40- Time - Dutu			Select:				Select:			Select:				
Select:	S S	Select:			49c. Time on Duty			49d. Regular Assignment Select:			nment <sup>2</sup>	Select:			sted 49f. Se	Select:			
50a. Contractors	50 S	50b. Injured Select:			50c. Time on Duty			50f.In cab @ time of a Select:			of accide	accident Empty							
51a. Trespassers	a. Trespassers 51b. Injured Select:				51f.In cab @ time of acciden Select:			52a. Others				52b. Injured Select:			52f.In cab @ time of accident Select:				
$\checkmark$		$\checkmark$	]	ſ	$\checkmark$		$\checkmark$			]		<b>√</b>	7						
Operating Practices		Track	-	M	P&E		Signal		Grade Cros	ssing		Drug &	Alcohol		Fatigue			HazMat	
The pages will appear i	in the ord	ler selecte	ed, you can sel	ect as m	nany as you	need.													

53. Executive Summary and FRA Investigation Findings:

On March 5, 2022, at 1:58. a.m., EST, a Norfolk Southern (NS) freight train, Y92H202 (Train 1), derailed at Milepost (MP) 71 on the Northeast Corridor in Perryman, Maryland, resulting in \$2,665,277 of damage to rail equipment and track. There were no injuries reported.

Train 1 was traveling South (timetable direction) when the train went into emergency. NS determined that freight car NS 145387 had a broken R4 wheel rim that resulted in a 20-car derailment.

Train 1 was operated by a 3-member crew and was comprised of 2 locomotives and 130 loaded freight cars. Train 1 was 6,767 feet long and had a trailing tonnage of 18,438 tons. The method of operation was Signal Indication with positive train control (PTC) overlay that was operable at the time of the derailment. The maximum authorized speed for this territory is 50 mph.

At the time of the derailment, Train 1 was operating at 30 mph with 130 cars when the R4 wheel rim broke apart on freight car NS 145387, causing a derailment of 20 cars total, lines 80 to 99.

The Federal Railroad Administration (FRA) Motive Power & Equipment Division reviewed mechanical inspection records for Train 1. FRA took no exceptions to the mechanical records of the locomotives and cars in Train 1 that were germane to the cause of the derailment. The FRA investigation determined the probable cause of the accident was E61C – broken R4 rim on NS 145387.

NS and FRA did not agree on the same primary cause code. Per the F 6180.54 submitted by the railroad, NS believes E69C "other wheel defects" is the most appropriate cause code. FRA contends that E61C "broken rim" is the most appropriate cause code due to the obvious fracturing of the R4 wheel on NS 145387.

The weather at the time of the incident was 26 °F, dark and clear.

This accident was not PTC-preventable.

Click here if you need additional room for Executive Summary and FRA Investigation Findings

Click Here to add Sign Page after ALL Discipline and Summary pages have been added

61. Operating Practices Analysis:

Analysis – Operating Practices: FRA reviewed the rules compliance of the Train 1 crew, the historical operational testing conducted on the Harrisburg Subdivision by NS Supervisors, and the train handling. FRA found that frequent and adequate operational testing was performed on the Harrisburg Subdivision by multiple supervisors over the six-month period reviewed. Per the download of the lead locomotive, FRA did not identify any exception with the train handling or rules compliance of the crew operating the derailed train.

Conclusion: FRA determined train handling, rules compliance, and operational testing did not contribute to the cause or severity of the accident.

61a. Evidence Collected

Train crew discipline and training histories, train crew hours of service histories, NS and ATK timetables, dispatchers record of movement, written crew accident statements, crew reports of interviews, event recorder records, and Fatigue Analysis Reporting Form.

## 55. Track Analysis:

Analysis – Track: The Amtrak Philadelphia to Washington Line Main Subdivision consists of multiple track mains. The Subdivision extends timetable North and South between Philadelphia, Pennsylvania, to Washington, D.C. Train 1 was operating on Track 2 at the time of the derailment.

Track 2 at the point of derailment (POD) is a .21-degree curved continuous welded rail track with a full ballast section consisting of concrete crossties spaced 24 inches in good condition that are fastened by Pandrol clips. The rail on the high and low side of the curve is 140 RE CC Steelton rail year 1962. There are no joint bars or gage rods on Track 2. The mainline ballast consisted of standard of 1-1/2 inch to 2-inch diameter rock with more than sufficient ballast coverage around the structure. The sub grade showed no evidence of moisture, and drainage and ditching showed no collapses or blockages. Track geometry measurements were taken and were found to be within Class 7 track standards.

Track 2 had last been tested when Sperry Rail services conducted an Ultra-Sonic Rail test from September 7, 202 to September 8, 2021. This test recorded no exceptions within one mile of the POD.

Amtrak provided Track 2 Disturbance reports for the month of January 2022. The report showed no track disturbances on Track 2.

A review of Amtrak Track Inspection Maintenance reports indicated the presence of engine burns on Track 2 at MP 66 prior to the derailment of Train 1. FRA verified the engine burns in the field but did not record any exceptions to the Track Safety Standards as the presence of the engine burns were not examples of non-compliance.

The first mark of the broken wheel was located at MP 70.4 (GPS 39.45007 -76.21746). The following anomalies were noted South of MP 70.4 at the stated distances from the first broken wheel mark (reference Map 1 and Sketch 1):

The first broken rail was 1,845.6'.

The second broken rail was 2,343.7'.

The general pile up was 2,820.8', located at MP 71 (39.44518, -76.22516).

Conclusion – Track: Track conditions did not cause or contribute to this accident.

55a. Evidence Collected

Track geometry test records, ATK track chart, daily track inspection records, track diagrams, track disturbance reports, and Y92 track authority.

# FEDERAL RAILROAD ADMINISTRATION BASIC ACCIDENT INVESTIGATION

### 56. MP&E Analysis:

Train 593H027 originated in Baltimore, Maryland, on February 26, 2022. The train was inspected on February 26, 2022 by Road and Rail Services at the Consol Energy terminal.

The train made an unremarkable trip to Bailey Mine in Graysville, Pennsylvania on or around February 27, 2022.

On March 2, 2022, the train was re-identified as Y92H202 (i.e., Train 1) and departed Bailey Mine bound for Baltimore.

Analysis – Mechanical Condition of Freight Cars:

FRA MP&E inspectors arrived at the accident scene at approximately 4 a.m. on March 5, 2022. Twenty loaded hopper cars had derailed in the Train 1; lines 80 – 99 on the consist list.

The NS 145387 was the first (lead) derailed car (reference Picture 1). It was the 80th piece of rolling equipment (the 78th car) from the head end in Train 1. The A-end truck was photographed before any wrecking or clearing operations commenced. It was apparent that the R4 wheel on the NS 145387 had suffered a catastrophic failure (reference Pictures 2 and 3) as the wheel had broken apart while the train was in motion. A large portion of the break (approximately 50 percent) was determined to be old by assessing the amount of rust discoloration at the break.

The A-end truck from NS 145387 was eventually pulled from its resting location and set aside away from wrecking operations. The following R4 wheel characteristics were determined after reading the stamps on the back plate of the wheel:

• AAR Class "C";

• CJ36 design;

· Manufactured by Griffin Wheel Company in Columbus, Ohio;

Manufactured in November 1998;

Serialized as 02238.

Several large fragments of broken wheel were recovered from the Main 2 track right-of-way between MP 70.4 and MP 71.0. The fragments were collected by NS and set aside to be assessed by NS's research and test department. FRA photographed the wheel fragments (reference Picture 4).

FRA observed a Class I brake test of the portions of the train that were not derailed. No defects were noted during the Class I brake test of the forward portion of the train (lines 3 – 79 of the consist). During the Class I brake test of the rear portion of the train (lines 100 – 132), the air brakes on CR 507817 (line 131) failed to remain applied until commanded to release.

On March 9, 2022, FRA re-inspected the R4 wheel from NS 145387. The wheel set had been moved to NS' Enola car shop in Enola, Pennsylvania.

Approximately one-third of the wheel had been broken. Most of the damage was to the wheel tread surface.

The head-end camera footage from the lead locomotive of Train 1 was viewed. The video footage did not show any indication of a shudder or other anomaly at the time the train experienced an undesired emergency (UDE) application of the air brakes at 1:58 a.m. on March 5, 2022.

On March 22, 2022, the manufacturer of the broken wheel provided specifications and notes. The wheel was:

• Poured on November 2, 1998, at 11:15 p.m., in heat (group) H6323.

• The 9th wheel poured in the heat and cast in cope mold No. 591 and drag mold No. 540.

· Free of any record of process deviations or re-work.

· Manufactured to AAR class C steel specifications.

On March 23, 2022, during a review of mechanical records obtained during this accident investigation, it was noted that the single car air brake test (SCABT) for NS 52369 (line 110 of the consist) was overdue under 49 CFR § 232.305(c). A defect was documented as a result.

(MP&E Analysis continued below)

## 56a. Evidence Collected

Road and Rail contractor inspector list, EOTD event log, Y92 block consist, Y92 outbound consist from Shire Oaks, NS 7629 and NS 9590 maintenance and trouble histories, 593 consist, 593/Y92 Class I air brake test slip, EOT inspection slip, NS MF90 (intercept) report for cars in Y92 train, Y92 movement history, movement and repair history for NS 145387, and repair history for all cars in Y92 train.

57. Signal Analysis:

Analysis - S&TC:

Signal inspections were performed at Oak Interlocking, Automatic Signal Location 651/652, Automatic Signal Location 672/673, Automatic Signal Location 695/696, and Bush Interlocking. The inspections included reviewing signal plans, performing ground tests, performing shunt tests, testing all signal aspects for the route that was lined at the time of the derailment, and testing 19 Switch at Oak Interlocking (19 Switch is the only switch the train traversed at Oak Interlocking prior to the derailment). The inspections found the signal system to be working as intended with defects noted for plans not legible (49 CFR § 236.1), only one fouling wire in the tow of the frog on 19 Switch's turnout (49 CFR § 236.57(a)), and the normal switch point on 19 Switch indicated switch point closure with the point obstructed with a one-quarter inch obstruction (49 CFR § 236.334). These defects did not cause or contribute to the derailment.

Signal test records and data recorder downloads from the above locations were reviewed. The test records were found to be in compliance with federal regulations with no defects noted. A download was also reviewed from the Poplar Hot Box Detector at MP 67.4. The download showed no anomalies for the NS Train 1 move.

Conclusion:

FRA's investigation determined that the signal system was working as intended and did not cause or contribute to the derailment.

57a. Evidence Collected

Signal Test Records for Oak Interlocking, Signal Test Records for Automatic Signal Location 651/652, Signal Test Records Automatic Signal Location 672/673, Signal Test Records Automatic Signal Location 695/696, Signal Test Records Bush Interlocking, Data Recorder and Dispatcher Downloads from Oak Interlocking to Bush Interlocking, Poplar Hot Box Detector Download, and Locomotive Daily Cab Signal Test Records.

59. Drug and Alcohol Analysis:

FRA post-accident toxicological testing was performed on all crew members of Train 1.

All test results were negative.

Conclusion: Intoxication from drug or alcohol usage did not cause or contribute to the derailment.

59a. Evidence Collected

PATT results memo.

## 60. Fatigue Analysis:

FRA conducted a fatigue analysis using the Fatigue Audit InterDyne (FAID) program. When conducting this analysis, FRA uses an overall effectiveness rate of 63 as the FAID score baseline for biomathematical 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 is not considered as probable for an employee. The higher the FAID score, the higher fatigue exposure. Any schedule that violates the overall effectiveness rate, violates the fatigue threshold on the date of the accident, or violates the fatigue contributing to the accident. The fatigue questionnaires and other evidence collected are also considered when making a fatigue determination. 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 employees involved in this accident. Based on the evidence collected during the accident investigation, excessive fatigue risk was present; however, given the actions and/or position of the crew members involved, there is not a strong likelihood that fatigue may have contributed to the cause or severity of the accident.

60a. Evidence Collected

Fatigue Analysis Reporting Form

## FEDERAL RAILROAD ADMINISTRATION BASIC ACCIDENT INVESTIGATION

### 53. Executive Summary and FRA Investigation Findings Continued:

MP&E Analysis (continued):

On April 7, 2022, a follow-up records inspection of CR 507817 was performed. The CR 507817 was identified as having ineffective or improperly functioning air brakes during the post-accident Class I air brake test that was performed on March 5, 2022. The records that were reviewed indicated that NS had never repaired or performed a single car air brake test (SCABT) on the car since being made aware of the improperly functioning air brake system. The car was then moved past the nearest available location where necessary repairs could have been performed in non-compliance with Title 49 Code of Federal Regulations (CFR) § 232.15(a).

A copy of the NS "MF90" intercept report was reviewed for Train 1. No intercepts were noted regarding high impact wheels.

On May 9, 2022, the NS research and test department issued a report summarizing conclusions reached after assessment of the broken R4 wheel from NS 145387 (reference Pictures 5 and 6). The report concluded that heat checks were present on the wheel tread surface and that the wheel failed as result of a "shattered rim". The heat checks were determined to be non-detrimental.

Conclusion - Mechanical Condition of Freight Cars:

The derailment of Train 1 was caused by the broken R4 wheel on the NS 145387. Although defects pertaining to 49 CFR part 232 were noted on other cars in the train, they did not cause or contribute to the derailment.

Analysis – Mechanical Condition of Locomotives:

NS 7629 was the lead locomotive of Train 1. The front right inboard vertical handhold on the NS 7629 was found to have less than required clearance and was not in compliance with Title 49 CFR § 231.30(e).

NS 9590 was the trailing locomotive in the Train 1 consist. The daily (calendar day) inspection was found to be overdue and was not in compliance with Title 49 CFR § 229.21(a). The dynamic brakes were cut out and found to have been cut out for more than 30 days, which was not in compliance with Title 49 CFR § 232.109(b), which requires all inoperative dynamic brakes to be repaired within 30 days of becoming inoperative or at the locomotive's next periodic inspection (whichever occurs first). The No. 2 traction motor was cutout due to flashover and grounding faults, which was not in compliance with Title 49 CFR § 229.91(a), which states that a motor may not be shorted or grounded.

#### Conclusion - Locomotives:

The mechanical condition of the locomotives used in Train 1 did not cause or contribute to the derailment.

Several instances of non-compliance with 49 CFR parts 229, 231, and 232 were documented, but these also did not cause or contribute to the derailment.

### Analysis - Inspection Procedures of Freight Cars:

On March 8, 2022, FRA interviewed the engineer and the conductor of Train 1. The conductor trainee that was assigned to Train 1 was not interviewed. Neither the engineer nor the conductor indicated that anything remarkable occurred during the operation of the train other than the undesired emergency (UDE) of the air brakes at 1:58 a.m. on March 5, 2022.

The engineer mentioned that a Class I air brake test had been performed before he had taken control of the train. He also remarked that after the UDE and after the train had been inspected by the conductor, he was surprised to learn that the train had derailed. The engineer said that the train stopped so smoothly that there was no indication of a train separation.

On March 9, 2022, two carmen were interviewed. Both carmen were employees of Road and Rail Services and had inspected Train 593H027 in Baltimore on February 26, 2022. The train was later re-identified as the Y92H202 (i.e., Train 1). Neither of the Road and Rail Services employees mentioned anything remarkable regarding the inspection of the train. They both mentioned that they inspected several trains every day; they could not recall anything particular about the 593H027/Y92H202 train.

Both carmen were asked questions to assess their level of awareness of general rail car inspection procedures and tools used during inspections. During the interviews, both carmen demonstrated a moderate level of knowledge and skill regarding car inspections.

Train 1 received no additional inspections or Class I air brake tests after February 26, 2022. When the train departed Bailey Mine in Graysville, Pennsylvania, on March 2, 2022, it was still running on the same brake slip and test that had been written and performed on February 26, 2022, in Baltimore.

#### Conclusion - Inspection Procedures of Freight Cars:

The equipment inspection procedures used regarding Train 1 did not directly cause or contribute to the derailment. However, as discussed below, increased inspections and inspection frequency may have prevented the derailment by identifying the wheel defect that caused the derailment sooner.

In February 2016, FRA's Office of Railroad Safety (RRS) and Office of Research, Development and Technology (RD&T) established a multi-phase research program to better understand vertical split rims and other wheel failure modes with a focus on failure causes, detection, and prevention, as well as an overall life cycle understanding to help mitigate the risk and minimize wheel failure- related derailments. A key element of this program is the involvement of a Stakeholders Working Group comprised of railroads, vendors, and other industry researchers as active participants. Initial efforts focused on gathering data regarding the industry's current understanding of critical wheel failure modes, as well as future efforts intended to eliminate them. Follow-on work continues to focus on laboratory testing of failed wheels and the evaluation of approaches to analyzing industry data to identify root causes of the failures.

The nature of the wheel defect that caused this accident can be very difficult to detect during traditional in-person "walking" inspections of rolling equipment. The MP&E team recommends the following potential countermeasures regarding this issue: • Inspect trains more frequently than required by FRA regulations -- Train 1 received no further inspections before it left Bailey Mine. Had the train been reinspected by designated inspectors (as defined in 49 CFR § 215.11) prior to it departing the mine, the defective R4 wheel on NS 145387 may have been detected thereby preventing this accident.

• X-ray railroad wheels (or conduct some other form of metallurgic testing) with the same frequency as required by SCABT regulations -- the defective R4 wheel on NS 145387 may have been detected by way of periodic X-ray or ultrasonic testing. All freight cars are required to receive SCABT no less than every 5 years per 49 CFR § 232.305(c). Metallurgic defect testing of in-service wheels could be performed while SCABTs are performed.

FRA File Number HQ-NS-2022-0305-1543

62. Primary Cause Code	63. Contributing Cause Code 1	64. Contributing Cause Code 2					
E61C	Select:	Select:					
65. Contributing Cause Code 3	66. Contributing Cause Code 4	67. Contributing Cause Code 5					
Select:	Select:	Select:					
68. Non-Compliance	69. Enforcement Recommended	70. Mitigation Recommended					
229 231 232	Yes	Yes					
71. Relevant Waiver	72. Waiver Number(s)	73. NRC Report Number					
No		1330289					

Sketch 1

HQ-NS-2022-0305-1543 NS Y92H202 Perryman, MD Derailment March 05, 2022

2















Sourced from NS Research & Test analysis



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