

CSX Transportation Freight Train and Southeastern Pennsylvania Transportation Authority Trolley Collision

Darby, Pennsylvania
December 9, 2021

1 Factual Information

1.1 Accident Description

On December 9, 2021, about 8:25 a.m. local time, Southeastern Pennsylvania Transportation Authority (SEPTA) trolley 9070 was struck by CSX Transportation (CSX) freight train I03309 at the Darby Diamond highway-railroad grade crossing near Main Street and 6th Street in Darby, Pennsylvania.¹ The SEPTA trolley was stopped on the eastbound track of trolley route 11 and fouling the CSX mainline track when it was struck by the westbound CSX freight train.² (See figure 1.) There were 10 passengers and 1 operator on board the trolley and 2 CSX employees on the train at the time of the accident. Five passengers on the trolley, the trolley operator, and the CSX train engineer were transported to local medical facilities with non-life-threatening injuries. SEPTA estimated damages to its trolley to be \$125,000, and CSX estimated damages to its train to be \$5,500. Visibility conditions at the time of the collision were daylight and clear; the weather was 33°F with no precipitation.

¹ (a) All times in this report are local time unless otherwise noted. (b) Visit [nts.gov](https://www.nts.gov) to find additional information in the public docket for this National Transportation Safety Board (NTSB) accident investigation (case number RRD22LR004). Use the CAROL Query to search safety recommendations and investigations.

² *Fouling* is the placement of an object or an individual in such a position that the object or individual could be struck by a passing train.

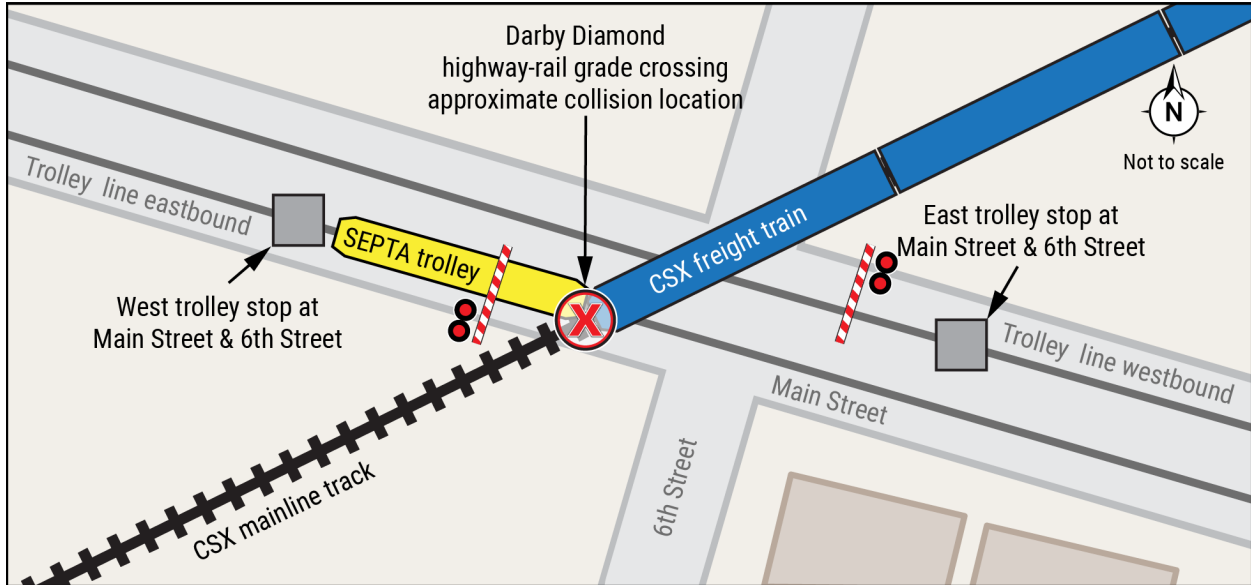


Figure 1. Illustration of the accident location.

After making a scheduled stop at the west trolley stop at Main Street and 6th Street, the trolley operator began to move the trolley forward and east into the Darby Diamond highway-railroad grade crossing. At 8:25:02 a.m., the automatic grade crossing protection red warning lights, maintained by CSX, began to flash, and the gate arms began to lower. National Transportation Safety Board (NTSB) investigators reviewed data from the trolley's outward-facing image recorder and observed that the trolley operator quickly glanced out the left window at 8:25:03 a.m., while the trolley continued to move forward toward the crossing. The automatic warning devices were active during this part of the movement. The trolley operator then looked forward again, put both hands on the console grab bar, and initiated braking with the foot brake, pushing the pedal past the detent.³ This action activated the trolley air brake system's emergency brake function. The emergency brake brought the trolley to a stop at 8:25:06 a.m. with the front end of the trolley fouling the CSX track within the highway-railroad grade crossing. The south gate arm then closed on the roof of the trolley. The trolley could not be moved, and the air brakes would not release until reset.⁴ In interviews with NTSB investigators, the trolley operator reported attempting to reset the trolley's air brake system unsuccessfully and then evacuated the trolley. The CSX freight train

³ A *detent* is a mechanical means to resist or arrest the movement of a mechanical device, in this case a brake pedal. Pressing the brake pedal past the detent (which can be felt) puts the trolley's brakes into an emergency application with more braking force than if the pedal was only pushed to the detent.

⁴ Resetting the brakes after the emergency application requires removing foot pressure from the brake pedal. The air compressor is then able to recharge reservoirs, brake pipe, air hoses, and other components of the brake system in about 20 seconds, releasing the brakes.

collided with the trolley at 8:25:38 a.m. at a speed of 22 mph. The train struck the right front and side of the trolley, pushing it backwards (west) but not derailing it.⁵ (See figure 2.)



Figure 2. Damaged trolley and CSX track.

1.2 Before the Accident

On December 9, 2021, the trolley operator reported for duty about 5:05 a.m. at Darby Transportation Center (DTC). The operator completed one round trip from DTC to the 13th Street Station. The trolley operator then departed DTC eastbound about 8:21 a.m. for the second round trip to the 13th Street Station and made a stop at 8:25 a.m. at Main Street and 6th Street to let passengers on and off before the accident.

⁵ The CSX freight train approached the highway-railroad grade crossing at 30 mph and struck the trolley at 22 mph.

1.3 Darby Diamond Highway-Railroad Grade Crossing

At the Darby Diamond highway-railroad grade crossing, a Class I freight railroad intersects a highway and two light rail vehicle tracks.⁶ The trolley tracks have one track designated for eastbound travel and another designated for westbound travel. The CSX railroad track crosses the roadway and the SEPTA trolley tracks at the intersection of Main Street and 6th Street. CSX trains have the right-of-way at all highway-railroad grade crossings.

NTSB investigators inspected the accident location and found there were no advance railroad warning signs or pavement markings on Main Street, and there were no stop line markings on the pavement; stop line markings are required about 8 feet before the gate as described by the Manual on Uniform Traffic Control Devices.⁷ There was a trolley stop street sign at the curb marking the area for passenger pick-up and drop-off.

1.4 Trolley Operator

1.4.1 Employment and Training

The trolley operator began working for SEPTA as a bus operator on July 23, 2018, and obtained about 3 years of training and experience in this position.

The trolley operator began rail operator training in September 2021 and became a certified trolley operator on October 15, 2021. The training included operating sign compliance, speed compliance, braking, and emergency evacuation.

1.4.2 Work/Rest History

The NTSB's review of training records showed the trolley operator did not work the 2 days before the accident and maintained a consistent wake and sleep schedule over the 3 days preceding the accident.

⁶ (a) *Class I* railroads are railroads with annual revenues of more than about \$500 million. (b) *Light rail* typically operates small, frequent trains (such as trolleys) in urban areas.

⁷ This manual requires a stop line to be installed at grade crossings with active control devices. Guidance indicates the stop line should be placed approximately 8 feet in advance of the gate but no closer than 15 feet in advance of the nearest rail. Manual on Uniform Traffic Control Device, section 8B.28. 2009 edition.

1.4.3 Cellular Phone Usage

The NTSB's review of data from the onboard surveillance video image recorder showed that the trolley operator used a personal cell phone while operating the trolley about 3 minutes before the accident.

1.4.4 Postaccident Toxicology Testing

The SEPTA trolley operator underwent postaccident toxicology tests for alcohol and other drugs. The results were negative for all tested-for substances, including ethanol.

1.5 SEPTA Rules

Trolley operators are required to come to a full stop less than 50 feet, but not less than 15 feet, of the nearest rail when approaching an unfenced railroad crossing at grade as stated in Rail Division Rule (RDR) 62G.⁸ Under RDR 62G, operators must not proceed over the crossing unless there is sufficient room for the entire vehicle to clear the crossing, and before proceeding, the trolley operator must open the side window and front door to look and listen for approaching trains. Trolley windows and doors must then be closed before movement can commence.

SEPTA's Authority Standard Rule (ASR) 9B1, "Cell Phone and Other Electronic Devices, General Use of Electronic Devices," prohibits operators from using their personal cell phones while operating a trolley.⁹ SEPTA does not issue cell phones to trolley operators; communication occurs by radio. Trolley operators are allowed to have their personal cell phones with them on trolleys, but operators are prohibited from using their cell phones during trolley operation. Employees must have all personal electronic devices turned off and stored out of sight.

1.6 SEPTA Trolley and Braking System

An operator activates the emergency braking system either by pressing and holding the brake pedal past a detent at the end of the pedal's maximum range of travel or by pushing down the red emergency stop button on the operating console. In either case, the emergency application will result in combined air emergency disc braking and

⁸ SEPTA, Rail Division Rule (RDR) 62G, Railroad Crossings, General Order 19-01. Issued January 2019.

⁹ SEPTA, Authority Standard Rule (ASR) 9B1, "Cell Phone and Other Electronic Devices, General Use of Electronic Devices," Issued November 21, 2010.

track braking.¹⁰ When emergency brakes are activated, the trolley must come to a complete stop, and the air system must be recharged before the trolley can be moved. Recharging the air system takes about 20 seconds. If the console emergency stop button is used, the button on the console must be pulled up by the operator before air brake recharging can occur. The track brake stays applied if the pedal is held down past the detent in an emergency.

Before the accident occurred, SEPTA was in the process of replacing their trolley fleet. SEPTA proposed a new brake system as part of the new design. The new design includes a spring-applied, hydraulically released friction brake system that does not require a recharge of the air system to release brakes after an emergency application. In February 2023, SEPTA's Board of Directors approved the purchase of 130 new trolleys to replace their current fleet.

1.7 Postaccident Testing, Inspections, and Examinations

1.7.1 Traffic Control Signal System

The NTSB performed signal tests on December 9 and 10, 2021, and determined that the traffic control signal system displayed the proper signal sequence for train movements in either direction, and signal aspects were not in conflict with each other. The NTSB's review of signal data logs showed that westbound CSX freight train I03309 was operating on the proper signal indication.

1.7.2 Mainline Track, Crossing Gate, and Warning System

1.7.2.1 Mainline Track

The NTSB conducted a postaccident visual inspection of the CSX mainline track at the accident location on December 9, 2021. There were no indications of damage to the track structure, and mainline track inspections showed that all federal requirements had been met.¹¹

¹⁰ A *track brake* is an electromagnetically activated mechanism that slows or stops a trolley or rail transit vehicle by applying braking force to the running rail.

¹¹ Title 49 *Code of Federal Regulations* Part 213.

1.7.2.2 Crossing Gate

Railroad maintenance and inspection records for the highway-railroad grade crossing reviewed by the NTSB did not indicate a history of activation failures with the gate control circuit.

The NTSB conducted tests and examinations of the crossing gate on December 9 and 10, 2021, and found the gate arms were installed as specified by the signal circuit diagrams. Testing of the gate control circuit showed that the circuit functioned properly, and both crossing gates activated and lowered as designed. The eastbound gate arm on Main Street was not able to reach the full horizontal position, because it was blocked by the SEPTA trolley.

1.7.2.3 Warning System

Title 49, *Code of Federal Regulations* Part 234.225, Activation of Warning Systems, requires train-detection track systems to provide a minimum of 20 seconds of warning time for train traffic. The NTSB tested the warning system's light units at the Darby Diamond grade crossing on December 9, 2021, and reviewed the data logs for the day of the accident. According to the data logs, the grade crossing signal light units began flashing 27 seconds before the CSX freight train arrived at the crossing. The data logger was operating within equipment manufacturer specifications. The light units, circuit voltages, signal cantilever, and gate arm lights functioned as designed and were determined to be in accordance with federal regulations.¹²

1.8 Postaccident Actions

As a result of this accident, SEPTA partnered with the Pennsylvania Public Utility Commission, CSX, Delaware Valley Regional Planning Commission, and Darby Borough to secure \$1 million in funding to improve safety at the Darby Diamond crossing. A training campaign was conducted for trolley operators on RDR 62G, reminding operators about the protocols for making a safety stop at the location and what to do if emergency braking is applied. Information on RDR 62G was also included in a training bulletin issued to trolley operators in January 2022.

SEPTA has been working with Darby Borough, the Pennsylvania Public Utility Commission, the Delaware Valley Regional Planning Commission, and the Pennsylvania Department of Transportation to explore the possibility of doing a full grade separation or re-routing of the trolley line to remove the crossing. This evaluation will continue as

¹² Title 49 *Code of Federal Regulations* Part 234.217.

part of a SEPTA trolley modernization project. SEPTA emphasized ASR 9B1 in training bulletins released systemwide in July and November 2022 to all employees operating trains or vehicles; ASR 9B1 states that these employees must have their personal cell phones turned off and stored out of sight.

2 Analysis

Westbound CSX freight train I03309 struck a SEPTA trolley fouling the eastbound mainline tracks at the Darby Diamond highway-railroad grade crossing in Darby, Pennsylvania, resulting in injuries to passengers and crewmembers. SEPTA's RDR 62G states that a trolley operator is required to stop less than 50 feet, but not less than 15 feet, from the CSX mainline track to determine if the trolley is clear to cross, and that while at a full stop, the trolley operator must open the window and door to listen for oncoming trains. The NTSB's review of the trolley's outward facing video data showed that the trolley operator did not stop while performing the look and listen procedure. SEPTA has initiated a training campaign to remind trolley operators about RDR 62G, including the protocols for making a safe stop at highway-railroad grade crossings.

At the time of the accident, the trolley operator had about 3 years of training and experience as a bus operator and only about 3 months of experience operating a trolley. As the trolley operator observed the oncoming CSX train I03309, they applied (emergency) braking that brought the trolley to a stop in the foul of the track about 30 seconds before CSX train 103309's impact. Because of the design of the brake system, the trolley could not be moved until the system was reset. In February 2023, SEPTA's Board of Directors approved the purchase of 130 new trolleys to replace their current fleet. The new trolleys will include a different brake system design that will reduce the release time after emergency brakes are applied.

The trolley operator was carrying a personal cell phone and, according to the NTSB's review of data from the onboard image recorder, used the phone while operating the trolley about 3 minutes before the accident. Therefore, the NTSB could not exclude the possibility that the trolley operator was distracted while operating the trolley. In November 2022, SEPTA issued a training bulletin to all transit operating personnel emphasizing ASR 9B1, which stipulates that employees operating trains and vehicles must have their personal cell phones turned off and stored out of sight during operation.

3 Probable Cause

The National Transportation Safety Board determines that the probable cause of the December 9, 2021, collision between a Southeastern Pennsylvania Transportation Authority trolley and a CSX Transportation freight train was the trolley operator stopping the trolley within the foul of the CSX track using the emergency brake.

The NTSB is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant events in the other modes of transportation—railroad, transit, highway, marine, pipeline, and commercial space. We determine the probable causes of the accidents and events we investigate and issue safety recommendations aimed at preventing future occurrences. In addition, we conduct transportation safety research studies and offer information and other assistance to family members and survivors for each accident or event we investigate. We also serve as the appellate authority for enforcement actions involving aviation and mariner certificates issued by the Federal Aviation Administration (FAA) and US Coast Guard, and we adjudicate appeals of civil penalty actions taken by the FAA.

The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, “accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties ... and are not conducted for the purpose of determining the rights or liabilities of any person” (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB’s statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)).

For more detailed background information on this report, visit the [NTSB Case Analysis and Reporting Online \(CAROL\) website](#) and search for NTSB accident ID RRD22LR004. Recent publications are available in their entirety on the [NTSB website](#). Other information about available publications also may be obtained from the website or by contacting –

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