NATIONAL TRANSPORTATION SAFETY BOARD

Office of Railroad, Pipeline, and Hazardous Materials Investigations
Washington, D.C. 20594

Vehicle Performance and Engineering Group Factual Report

Collision Between two Trolley Cars
Massachusetts Bay Transportation Authority (MBTA)
Green Line B-Branch
Boston, Massachusetts
July 30, 2021

RRD21FR013

Contents

A. ACCIDENT

NTSB Accident Number:	RRD21FR013
Accident Type:	Collision
Date and Time:	July 30, 2021
Location:	Boston, MA
Track Owner:	MBTA
Train Operator:	MBTA
Train Numbers:	Green Line Trolley 3894-3697 / Trolley 3862-3705
Fatalities:	0
Injuries:	24 Passengers and 3 Employees

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C. ACCIDENT SUMMARY

On July 30, 2021, at 6:04 pm EST a Massachusetts Bay Transportation Authority (MBTA) trolley collided into the rear of another MBTA trolley. The collision occurred on the B- Branch of the MBTA Green Line that runs on a curb separated guideway in the middle of Commonwealth Avenue in Boston Massachusetts. Following the accident, 24 passengers and 3 crew members were transported to the hospital.

Figure 1. Trolley 3894 and 3705 at the accident scene

D. RAILROAD EQUIPMENT INVOLVED IN THE ACCIDENT

Green Line Consist Makeup

Train consists on the MBTA Green Line are partially governed by a lawsuit settlement regarding limited mobility accessibility dated April 10, 2006. Item No. 28 of the settlement states, "The MBTA shall include one low-floor Type 8 Breda car in each train set or consist on the Green Line".

Based on this agreement, it is permissible to run consists of Type 8 only, but not Type 7 only. There are not enough Type 8 vehicles to run them exclusively while meeting service demand. The agreement has the effect of requiring MBTA to run two-car consists of mixed Type 8 and Type 7 cars to meet the service demand.

The consists in the accident each contained one Type 8 and one Type 7 trolley for this reason.

Train Consist

Struck Train

	No.	Type.	Condition	Capacity
1.	Trolley 3862	Type 8 Built 1998 (477,667 miles)	Axle No. 4 Derailed B-End Leading in Direction of Travel	Seated: 44 Standing: 144
2.	Trolley 3705	Type 7 Built 1996 (725,897 Miles)	Axle Nos. 5 and 6 Derailed A-End Leading in Direction of Travel	Seated: 50 Standing:219

Striking Train

	No.	Type.	Condition	Capacity
1.	Trolley 3894	Type 8 Built 1998 (376,542 miles)	Axle Nos. 3, 5, 6 Derailed (Rear two axles and Front axle of middle truck) A-End Leading in Direction of Travel	Seated: 44 Standing: 144
2.	Trolley 3697	Type 7 Built 1987 (1,089,887 Miles)	Did not derail A-End Leading in Direction of Travel	Seated: 50 Standing:219

Note: The trolley ends are determined by the location of the pantograph. The "A-end" has the pantograph while the opposite end is the "B-end" Axles are numbered starting at the "A-end" with Axle No. 1, and run sequentially to Axle No. 6 at the end of the "B-end".

MBTA Type 7 Trolleys

The Type 7 Trolleys were built by Kinki Sharyo. The first order was completed between 1986-1988 and the second group was completed in 1997. The struck train contained a Type 7 built in the second group. The striking train contained a Type 7 built in the first group. Type 7 vehicles are 72 feet long and 8.5 feet wide. The Type 7 vehicle does not have an event recorder.

MBTA Type 8 Trolleys

The Type 8 Trolleys were built between 1998-2007 by Ansaldo Breda and have the same dimensions as the Type 7. The event recorder data from the Type 8 vehicles was captured by the operations working group.

Employee Positions

MBTA operations require that the leading cab of each trolley be occupied by an operator. The operator in the leading cab of the leading trolley in a consist is responsible for train operation, door operation, fare collection at surface stations, and passenger safety. The operator in the trailing trolley of each consist is responsible for door operation, fare collection at surface stations, and passenger safety. There is no pass-through vestibule or door between trolleys in a consist.

Emergency Access and Egress

Green line trolleys facilitate emergency egress through the six bi-parting side-doors. There are no windows designed for, or designated as, emergency egress or access routes. Photoluminescent signage posted near the operating cab instructs passengers to notify the train operator of any emergency using the intercom, to follow all instructions provided by an official, to stay in the car unless instructed to leave or in the case of immediate danger, and to exit the vehicle using the doors when necessary. A sketch of the trolley is included on the sign showing the location of the doors, but not the passenger intercom. Additional photoluminescent signage at the doors indicate “EXIT”, emergency brake and door release operation instructions (with diagrams), and the location of fire extinguishers. The passenger intercom is located mid-trolley and includes retroreflective instructions and lighted ADA markings. Exclusions

E. ACCIDENT SEQUENCE

The struck train was operating outbound at 10 m.p.h. on the B-Branch of the MBTA Green Line. In this area the track is tangent and the grade is uphill at a 3% grade. The striking train was operating at approximately 31 m.p.h. when it impacted the train ahead on the same track. The struck train was accelerated to 24 m.p.h. by the impact before derailing and coming to rest.

F. AREAS OF INVESTIGATION

Track and Engineering

On August 1, 2021 investigators gathered at the accident location to make observations of the track structure. Traveling on the westbound track, the trains traversed an ascending grade of 2.77% from the St. Paul Station stop near chain marker 60+00 feet and crested at chain marker 65+00 feet. The collision occurred at 67+15 feet on a slight descending grade of 0.26%. The trackage of the MBTA Greenline has a maximum authorized speed of 25 MPH. Trains speeds are limited by rule to 10 MPH through highway/rail grade crossing as well as the limits of the station platforms. There was only superficial damage to the track structure.

Mechanical

On August 2 -4, 2021 investigators conducted inspections of the trolleys involved in the accident at the Newton, MA trolley yard. Investigators conducted a brake test on the striking trolley. Investigators inspected the running gear, wheels, couplers, and other mechanical components. Investigators noted that the trolley is equipped with an overspeed prevention system. This system adjustable between 30-50 m.p.h. and is set to activate at 42 m.p.h. in coordination with the maximum speed on the Green Line which is 40 m.ph. on the D-Branch.

Crashworthiness and Survival Factors

Investigators conducted crashworthiness inspections of the trolleys simultaneously with the mechanical inspections. What follows below is primarily a factual description of these activities.

G. POST-ACCIDENT EQUIPMENT DESCRIPTION

None of the trolleys lost any passenger occupied volume, however a description of lost operator cab survivable space is outlined below. Interior fittings, including seats, handholds, and handrails remained attached and secured to the vehicles.

Emergency signage was noted to be white photoluminescent material with green text depicting exit pathways, door exit locator signs, emergency instructions, door release instructions, and emergency communication device instructions. Speakers were noted on the interior and exterior of the car. All signage was secure, clean, and undamaged. The photoluminescent materials responded to charging from a flashlight.

Trolley 3862

Trolley 3862 is a Type 8 vehicle and was the leading trolley in the struck consist. The No. 3 axle was derailed. The B-end was leading in the direction of travel. The B-end cab was occupied by a motorperson.

The exterior of the vehicle showed evidence consistent with the trailing trolley impacting the A-end after that vehicle was struck from behind. The A-end anticlimber showed witness marks, paint transfer, and nearby Fiber Reinforced Plastic (FRP) was torn, approximately 14-inches

long. There were witness marks from the anticlimber on the A-end coupler. The A1 door was deformed approximately 1/8-inch, but did operate. The AL corner was observed to have crached FRP. There was exterior skin and roof deformation noted approximately 8-feet from the nose on the AR side. The A-end anticlimber was noted to be 27-inches ATOR at the top and 22-inches ATOR at the bottom. The A coupler was fully compressed during the accident. The L3 dog bone showed witness marks from riding on the rail, consistent with the axle derailing post-impact. The A-end coupler guide plate was broken, with all bolts sheared off.

The BL roof was deformed behind the cab windows and there were witness marks and paint transfer consistent with wayside structure contact on the BL skirt.

Inside the B-car, on the right-side forward facing wall just prior to the C-Car connection, there was an impact mark, including broken fascia about 10-inches in diameter, centered approximately 18-inches above the floor. This is consistent with a person or luggage impacting the wall at this location during the accident. Additionally, some limited signs of injury were noted on the floor in the single seat facing door B3.

Figure 2. Trolley 3862 in the maintenance facility.

Figure 3. Trolley 3862 inside facia with hole.

Trolley 3705

Trolley 3705 is a Type 7 vehicle and was the trailing trolley in the struck consist. The trolley derailed axle nos. 5 and 6. The A-end was leading in the direction of travel.

The exterior of the vehicle contained evidence consistent with being both struck from behind (B-end) by the striking train and colliding with the trolley it was coupled to in the consist. The B-end anticlimber was crushed inboard longitudinally. The top of the anticlimber was 22.5-inches ATOR and the bottom of the anticlimber was 17-inches ATOR. An exemplar anticlimber was noted to be 30-inches ATOR at the top and 24-inches ATOR at the bottom. The anticlimber outer edge to the first axle was noted to be 89.5-inches. An exemplar trolley distance was 117-inches for this measurement. Therefore, the anticlimber was crushed approximately 27-inches.

The B1 door was removed during the recovery operations. The stairway at this location was buckled and crushed approximately 4-inches. The right side roof rail buckled at the first window. The B-end destination sign was crushed. The glazing was shattered, but not penetrated. There was sheet metal buckling on the right side from the nose to a location 9-feet inboard.

The B-end cab had it's occupied volume reduced by approximately 15%. The operator's space was observed to be 36"x28"x55" in post accident measurements, this is 55,440 cubic inches. An exemplar space 40"x28"x58" or 64,960 cubic inches. This cab was unoccupied at the time of the accident. Additionally, the floor was buckled between doors B2 and B3.

The A-car had a floor buckle at the A1 door/ first seat location.

Under the car, the B-end coupler showed evidence consistent with impact damage failure. The anticlimber was separated from the front end frame, with the bolts torn through the mounting plate. The coupler mounting/ center sill area was twisted approximately 1.5-inches. From the nose to the plow area, about 5-feet of sheet metal underside was torn, deformed, and separated from the center sill. The underframe/ center sill shows signs of elastic strain in the curved gooseneck areas.

Figure 4. Trolley 3705 in the maintenance facility.

Trolley 3894

Trolley 3894 is a Type 8 vehicle and was the leading trolley in the striking consist. The trolley derailed axle nos. 3, 5, and 6. The A end was leading in the direction of travel. Therefore, the rear two axles derailed and the leading axle of the middle truck derailed.

The exterior of the A-end showed signs of paint transfer and witness marks on the FRP along it's entire height. Relatively, there is less structural damage than the end of the trolley which was struck. The A1 door will not cycle normally, nor manually open. It is bent out of alignment approximately 1-inch. There is approximately 1-inch of deformation visible approximately 22-inches from the nose above the top corner of the A1 door.

The underside of the B-end has witness marks on the coupler consistent with a lifting motion. The B-end anticlimber bolts are secure. The A-end High Voltage junction box, plow, and support tray show signs of impact damage from debris on the right-of-way. The A-end couple height adjustment bolts are bent.

Investigators observed the presence of dust and fine debris inside the trolley. The dust/debris was concentrated in the c-car area. There was none in the A-end and a little located in the B-end. This is consistent with witness statements describing "smoke" inside the B/C-end areas. There was no evidence of fire, melting, or burning at any location on, under or in the car. It was noted that the connection between car ends is not airtight to the exterior. The baffles connecting the ends accumulate dirt and debris over time. Finally, there are two air conditioning vents blowing into the short C-car. The air is 75% recirculated and 25% outside fresh air from the roof area. Dust and debris from the accident would possibly by-pass the filters. The evidence inside the car is consistent with the accumulated dust and debris, mixed with exterior airborne particles kicked up by the derailment combining inside the car to reduced visibility. This was described by passengers as "smoke".

Door A2 was found to be operating normally. There are two emergency release handles. One, above the door, has a little/no resistance to a point where the handle begins to engage. Additional force is required to pull the handle and engage the door release. There is an additional handle on the right side of the door, about halfway off the floor.

No A-end cab damage was observed.

Figure 5. Trolley 3894 in the maintenance facility.

Trolley 3697

Trolley 3697 is a Type 7 vehicle and was the trailing trolley in the striking consist. The vehicle sustained significant structural damage to the leading end (A-end) including separation of the coupler. The trolley did not derail. A motorperson was located in the cab of the A-end.

Damage to the front skin of the trolley is consistent with the anticlimber from the 3894 overriding the 3697. There are clear witness marks from an anticlimber in the front skin/nose area of 3697. The front skin is deformed over most of its surface area, the penetration is about 8-inches. The structural members behind the skin are vertical posts which crumpled to 'pinch' the 3894 anticlimbers as evidenced by matching witness marks. There are additional witness marks inside the anticlimber on 3697. There is paint transfer and paint removal on several anticlimber connection bolts.

The area behind the A1 door shows skin deformation, buckling and extends the entire vertical height of the trolley.

The underside of the trolley shows plastic deformation. The center sill began to fold in a type of U-shape with the peaks at the front/nose and first horizontal structural member above the plow area. The evidence is consistent with all four coupler shear pins failing by design at 70,000 pounds of force. The coupler itself failed and left pieces on the right of way. The anticlimber was bent 2-inches upward directly in the center of the device, corresponding to a broken tippet valve on the coupler head. The welds connecting the center sill to the sheet metal on the exterior bottom of the car were failed along the longitudinal axis. The center sill showed signs of elastic strain at the gooseneck above the plow.

Inside the car, the right side of the operator's cab floor was bent down 1.5-inches as measured at the corner post of the operator's door.

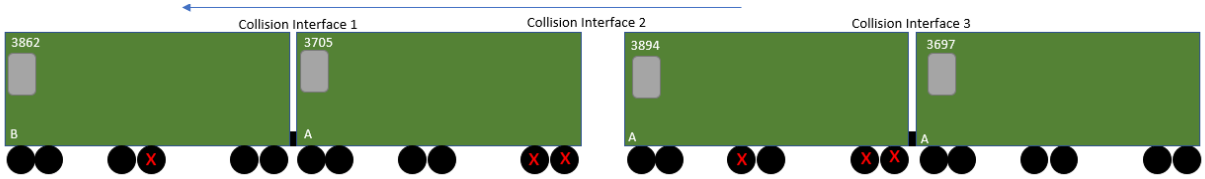
Figure 6. Trolley 3697 in the maintenance facility.

Anticlimbers of Striking Train

	3894 B-end (leading)	3697 A-end (Trailing, occupied cab)	
Depth of anticlimber	2 5/8”	2 5/8”	
Space between Top and Middle plate	2 3/8”	2 7/16”	
Space between Middle Plate and Bottom Plate	2 3/8”	2 7/16”	
Top of Rail (TOR) to bottom of anticlimber	24 1/8”	26”	*top of rail measurements are affected by air bag inflation, ADA leveling, structural damage, and load weight.
TOR to top of anticlimber	30	31 3/4	Cars are inspected and adjusted for leveling every 90-days.
Anticlimber top rail thickness	5/16	3/16	

Middle rail thickness	3/8”	3/8”	
Bottom rail thickness	5/16”	3/16”	
	Anticlimber “indents” that were “Sandwiched” 25.5 distance between marks	Vertical “collision-post” style structural members with anticlimber impact damage and deformity = 25.5” apart	

Collision Interfaces



1. Struck Train, Interface between lead trolley (3862/A) and trailing trolley (3705/A)

Figure 7. Collision interface 1

2. Between Struck Train (3705/B) and Striking Train (3894/A)

Figure 8. Collision interface 2

3. Striking Train, Interface between lead trolley (3894/B) and trailing trolley (3697/A)

Figure 9. Collision interface 3

H. POST-ACCIDENT INSPECTIONS AND TESTING

Friction Brake Test

On August 3, 2021, investigators observed MBTA car shop employees conduct a full brake diagnostic on Trolley 3894 from the A-end cab. Employees used Bombardier PTU software Version 2.0.8, REV 6 from a company laptop computer connected to diagnostic modules of the trolley. The procedure used was BOVS-17, GL8-TP0003, "Friction Brake Functionality". All three High Pressure Control Units (HPCU), one per truck, were tested. The functionality of the brake system was verified without exception. There was no physical damage noted to the brake system.

The vehicles are equipped with magnetically actuated track brakes which are not used under normal operating conditions. The operator has an option to activate the track brake using a button on the control panel or the master controller. Additionally, the track brake is activated in an emergency brake application.

"Deadman" Feature Test

Investigators tested the functionality of the "Deadman" feature, which is built into the master controller handle. To engage propulsion the operator must rotate the master controller 90-

degrees and hold it in that rotated position. If the controller handle is released, for example due to operator incapacitation, the handle rotates freely back to the original position and the emergency brake features are activated automatically. The handle must be placed into the full service brake position to recover the system. These features worked as intended during the inspection.

I. DOCUMENTATION

The Group reviewed the following documents.

- Daily mechanical inspection and brake test records for striking train and struck train
- Post-accident mechanical inspection records for striking train and struck train
- Copy of the following sections from "Contract Provisions & Bid Documents for No. 7 Surface Rail Cars, dated 4/25/1983"; Section 2, Section 3, and Section 4
- *Similar document for type 8 vehicle
- Crashworthy Analysis for MBTA No. 7 SRC, dated 8/1985
- *Similar document for type 8 vehicle
- Vehicle Description for type 7 and 8 vehicles
  - Manufacturer
  - Year Built
  - Mileage
  - Rehabilitation date(s)
  - Seats and standing room
  - Alerter/Deadman system descriptions
- Monetary damage estimates

J. SPECIFICATIONS AND STANDARDS

UMTA

In the 1970's the Urban Mass Transportation Administration(UMTA) promoted a Standard Light Rail Vehicle (SLRV) for U.S. cities. This standard set the basic design and configuration for light rail vehicles until the adoption of the standard below.

American Society of Mechanical Engineers

In 1998 the American Society of Mechanical Engineers (ASME) formed the Standards Committee on Rail Transit Vehicles. The committee develops and maintains standards that cover safety, functionality, performance, and operability requirements as well as mechanical systems, components and structural requirements for rail transit vehicles. This includes what the ASME calls heavy rail and light rail, but excludes freight, commuter, high-speed, or any other rail operations under the jurisdiction of the Federal Railroad Administration (FRA).

The ASME standard, RT-1 "Safety Standard for Structural Requirements for Light Rail Vehicles and Streetcars", was first approved in 2015 and most recently revised in 2020. Therefore, it did not exist and was not applicable when the MBTA Type 7 and Type 8 were designed and built.

The current standard draws from existing requirements and best practices for the design of the carbody of light rail vehicles. It considers recent developments in the design of rail carbody structures intended to optimize the performance of the structure under the conditions of an overload, as may occur during a collision. This is known as Crash Energy Management (CEM). The intent of CEM is to better manage the dissipation of the energy of a collision that can reasonably be expected to be absorbed by the deformation of the carbody and other components. The CEM design may reduce risk of injury due to secondary impacts and loss of occupied volume.

The standard includes a section on what the ASME calls interoperability, which considers collisions between different vehicles operating on the same route. The section on interoperability requires an anticlimber designed for engagement between vehicles to mitigate override, including failed or deflated suspension elements. The standard is not prescriptive with regards to what "designed for engagement" means, nor does it provide strength requirements or additional requirements beyond the anitclimber.

The section titled "crashworthiness" states three objectives. First, to minimize the possibility of injury to occupants during a collision from such causes as parts detaching from the carbody or equipment falling from the ceiling or roof. Second, to minimize the loss of occupant volume resulting from structural collapse or structural penetration. And finally, to provide for progressive controlled collapse of energy absorption zones of the carbody structure prior to crush of other carbody structures, while limiting the average collision acceleration. To this end, the standard provides four scenarios and acceptable outcomes of each. First, low-speed collision between two like vehicles. Second, a "safe-speed" collision between two like vehicles. Third, a structural stability collision between two like vehicles. And finally, a collision with a street (highway) vehicle.

American Public Transportation Association (APTA)

APTA develops and maintains a number of standards relating to public transportation in the U.S. The Standard for Modern Streetcar Vehicle Guidance (APTA RT-ST-GL-001-13) is the main set of guidelines to support the specification and procurement of modern streetcar vehicles. The main subjects are vehicle configuration, vehicle/platform interface, vehicle/track interface and power supply. Structural and crashworthiness design criteria are not addressed.

Agency Specifications

The overarching design requirements for LRV construction, especially at the time of Type 7 and 8 development, are the agencies own specifications.

Type 7

The technical provisions for No. 7 (Type 7) rail vehicles is RE-650 dated May 1983. This specification included section 2.1.2 – Crashworthy Design Requirements and stated, "the following guidelines are suggested to achieve crashworthy design goals for front end collisions of empty cars"

- Vehicle to withstand 3 mph coupler impact with solid object and sustain zero damage
- Vehicle to withstand 5 mph impact with solid object with damage confined to replaceable elements in the draft gear assembly, the anticlimber, anticlimber supports, and adjacent sheet metal.
- Vehicle ends to withstand 10 mph impact with solid object with permanent deformation confined to forward four feet and damage confined to forward six feet of vehicle.

These design goals were to be verified by structural and dynamic analysis performed to the satisfaction of the authority.

The structure of the car was to be designed to dissipate energy of collisions through minimum shock and maximum plastic deformation. Anticlimbers were to be designed to prevent understructure override or telescoping. The anticlimber must also be designed to absorb up to 10 mph of energy between vehicles without permanent deformation of car underframe and minimize injuries to passengers and operating personnel.

Section 3 of the specification required that anticlimbers be wide enough to engage the anticlimber of an opposing car under the tightest curves, be 6-inches high, with 3 ribs, and be at least 2.75-inches deep. Attachment bolts were allowed to be within the anticlimber ribs.

Section 3.4 of the specification required the following design calculations

- Compression load on centerline of anticlimber with no yielding, 144,000 lbs
- Compression load on center line of car body to coupler pivot, 100,000 lbs.
- Collision posts, load applied at underframe, 210,000 lbs.
- Anticlimber vertical load with no yield, 50,000 lbs
- Corner post, 55,000 lbs

The couplers were designed to withstand 100,000 lbs. in tension or compression without yield. They were designed with an automatic emergency release designed to activate when the buff load exceeded 75,000 lbs. The draft gear would then absorb another 75,000 ft. lbs. of energy. The total coupler travel is 13-inches.

Section 2.1.3 of the specification states that the vehicles are designed for a 30-year service life and an average mileage of 40,000 miles per year.

Type 8

The technical provisions for Type 8 vehicles are a part of Contract No. 621 – No. 8 Green Line Low Floor Cars.

The anticlimber was required to have the same height and profile as the existing Type 7 cars.

Section 3.13 required the car to sustain a compression load on the end sills of 144,000 lbs. without yielding. The coupler compression load without permanent deformation was 100,000 lbs. The collision post minimum ultimate shear strength was 135,000 lbs. The anticlimber was to withstand a 100,000 lb. compressive load applied at the centerline without permanent deformation.

Section 14 – Crashworthiness, required that the car be designed to maximize enery-absorbing capabilities within the strength parameters. An analysis of the energy absorbing properties of the vehicle was made based upon the assumption that one vehicle impacts an identical vehicle on level grade.

K. PREVIOUS ACCIDENTS

PB2009-916302

On May 28, 2008, about 5:51 p.m., eastern daylight time, westbound Massachusetts Bay Transportation Authority Green Line train 3667, traveling about 38 mph, struck the rear of westbound Green Line train 3681, which had stopped for a red signal. The accident occurred in Newton, Massachusetts, a suburb of Boston. Each train consisted of two light rail trolley cars and carried two crewmembers—a train operator at the front of the lead car and a trail operator in the second car. The operator of the striking train was killed; the other three crewmembers sustained minor injuries. An estimated 185 to 200 passengers were on the two trains at the time of the collision. Of these, four sustained minor injuries, and one was seriously injured. Total damage was estimated to be about $8.6 million.

In the course of its investigation of this accident, the NTSB identified the following safety issues: lack of a positive train control system on the Massachusetts Bay Transportation Authority light rail system, lack of coordination between crewmembers on Massachusetts Bay Transportation Authority light rail trains with regard to signal indications, inadequate requirements for Massachusetts Bay Transportation Authority train operators to report possible signal malfunctions, and lack of screening of rail transit operators for possible obstructive sleep apnea. As a result of its investigation of this accident, the NTSB makes recommendations to the Federal Transit Administration, all U.S. rail transit agencies, and the Massachusetts Bay Transportation Authority. The National Transportation Safety Board also reiterates one safety recommendation to the Massachusetts Bay Transportation Authority.

DCA-09-MR-004

On Friday, May 8, 2009, about 7:14 p.m., westbound Massachusetts Bay Transportation Authority (MBTA) Green Line train 3612 struck the rear of standing westbound MBTA Green Line train 3808 near Government Center Station in Boston, Massachusetts. The accident occurred in the underground tunnel segment on the Green Line of the MBTA subway system. Each train consisted of two light-rail "married-pair" railcar sets[2]. One car from each train derailed upright as a result of the collision. Sixty-eight injured passengers and crewmembers were transported to local hospitals. Monetary damages were estimated to be about $9.6 million.

The National Transportation Safety Board determines that the probable cause of the May 8, 2009, collision of two Massachusetts Bay Transportation Authority Green Line Trains in Boston, Massachusetts, was the failure of the pilot operator of the striking train to observe and appropriately respond to the red signal aspect at 744A because he was engaged in the prohibited use of a wireless device, specifically text messaging, that distracted him from his duties. Contributing to the accident was the lack of a positive train control system that would have intervened to stop the train and prevent the collision.

L. PREVIOUS RECCOMENDATIONS

NTSB has acknowledged light rail vehicle crashworthiness recommendations during its investigation of the collision between MBTA Green Line Trains in Newton, Massachusetts on May 8, 2008. The reccomendation to the Federal Transit Administration during the investigation of a November 3, 2004 collision of two Washington Metropolitan Area Transit Authority trains in Washington, DC is as follows:

R-06-6

Develop minimum crashworthiness standards to prevent the telescoping of transit railcars in collisions and establish a timeline for removing equipment that cannot be modified to meet the new standards.

At the February 18, 2010 Board meeting addressing the NTSB's Most Wanted List of Transportation Safety Improvements (MWL), the board voted to place Safety Recommendations R-06-5 and R-06-6 on the MWL under the issue category "Improve Transit Railcar Design".

The FTA and NTSB have corresponded regularly regarding this reccomendation. The most recent correspondence, from the NTSB to the FTA and dated July 30, 2018 classifies the Safety Reccomendation as "Open – Unacceptable Response".

M. ACKNOWLEDGEMENT SIGNATURES

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