



RRD21FR015
Massachusetts Bay Transportation Authority
Green Line Trolley Collision
July 30, 2021
Boston,
Massachusetts

National Transportation Safety Board

Operations Group Factual Report

Accident

NTSB Accident Number: RRD21FR013
Date of Accident: July 30, 2021
Time of Accident: 6:04 p.m. (EST)
Type of Trains and No: Green Line Trolley #s 3862, 3705, 3894 Striking, 3697
Striking)
Crew Members: Striking Trolley, Lead Car Operator, 2nd Car Operator
Struck Trolley, Lead Car Operator, 2nd Car Operator
Location of Accident: Boston, MA

Working Group

Ryan Frigo
Operations Group Chairperson
National Transportation Safety Board

Philip Herbert
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Federal Transit Administration

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Chief, Transit Services
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Massachusetts Bay Transportation Authority

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Delegate
ATU-Boston Carmen's Union

Summary

On July 30, 2021, at approximately 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.



Accident

Preliminary evidence indicates that the operator of the striking train placed the master controller in a full power position after the last station stop, accelerating the equipment up a 3% grade at 31 mph for approximately ¼ mile before striking a moving trolley ahead on the same line. It appears that the operator did not attempt to stop the trolley before striking the train in front, the emergency brake was not activated until impact and the operator released the master controller. Estimated impact speed is 31 mph. The struck train was moving at approximately 10

mph at the time of the collision. The operator told responding investigators from MBTA transit police and System Safety that he did not recall what had happened and could not remember if there was another train in front of him. There was no indication from the operator that there was a mechanical failure. Investigators on sight observed that there is approximately ½ mile sight distance from the center of the bridge on Commonwealth Ave. to the accident location.

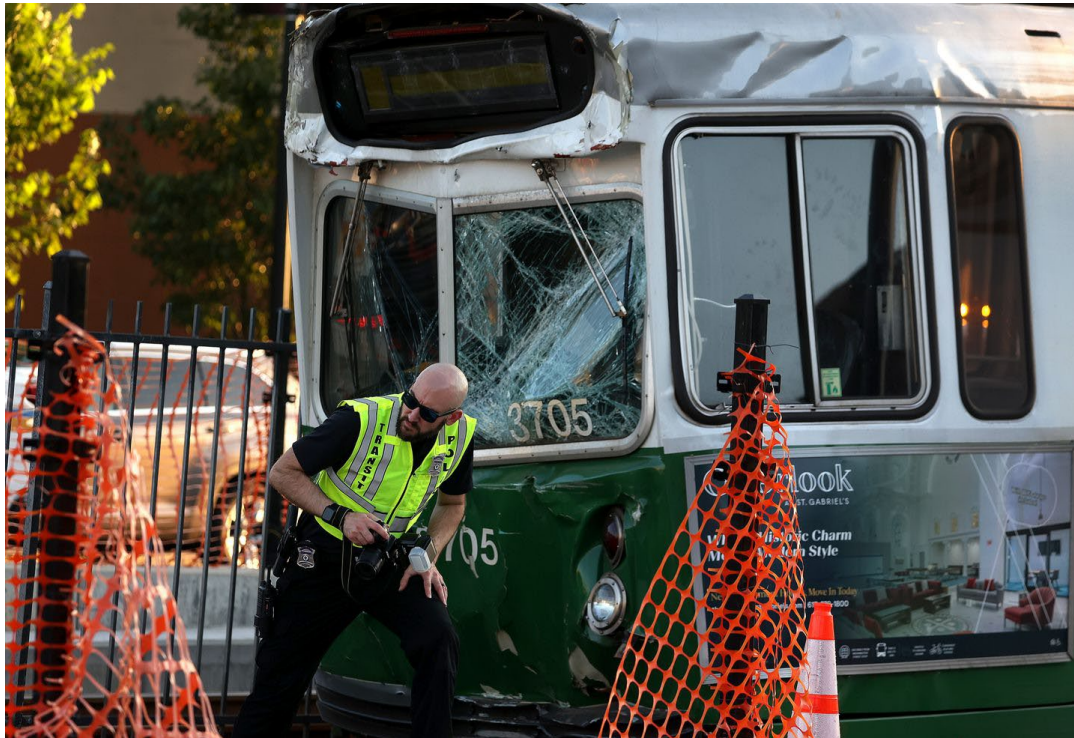


Figure 2: Image of struck trolley car. Deformation to the car is present. Source: Boston Globe

Equipment

Each train involved in this accident consisted of two trolley pairs. According to MBTA officials, the lead trolley of each pair was a newer Type 8 (20yr old) car paired to a trailing older Type 7 (30yr old) car. The Type 8 trolleys do have event data recorders, but neither the Type 8 nor the Type 7 trolleys have inward or forward-facing cameras.

Striking Trolley Leading Car, # 3894

Striking Trolley 2nd Car, #3697

Struck Trolley Leading Car, #3862

Train Control

There are no wayside signals in the accident location, train operations are governed by operational rules, timetable speed, special instructions, and line of sight. Roadway intersections on this line include traffic signal dedicated movement authorization signals for trolleys. It should be noted that wayside signals that govern train movement are present on other sections of the Green Line. Trolleys on this line are operated as single and double cars. In single car configurations a single operator controls both train movement and the operation of the doors. In multiple car configurations, a 2nd operator is located in the 2nd car with the primary responsibility to operate doors on the second trolley. In a multiple car configuration, the operator at the leading end of the 1st car has the same responsibilities as they do in a single car configuration.

Trolleys are operated from a control console located on both ends of the car (A end and B end), an operator must insert a key to energize the control console. Type 8 Trolleys are equipped with a master control device that controls both power and braking efforts. The master controller also functions as the car's "dead man" switch requiring an operator to apply pressure to the controller. In the event that this is not applied by the operator then an emergency brake application occurs. Type 7 Trolleys are equipped with 2 foot pedal controls for power and braking and a 3rd "dead man" switch pedal.

Trolleys do not have a forward collision avoidance feature. Positive Train Control (PTC), is not installed on the Green Line. According to a presentation by the MBTA to investigators, the Green Line Train Protection System that is under development by the MBTA will reduce the risk of red signal violations, reduce the risk of train-to-train collisions, and enforce train speed. The project is currently on schedule for completion in July 2024. The project is funded by the Federal Transit Administration.



Figure 3: Photo of operator console. Source: NTSB



Figure 4: Photo of master controller inactive, “deadman” switch not engaged. Source: NTSB



Figure 5: Master Controller in operating position, power and brake can be engaged, “deadman” switch engaged. Source: NTSB



Figure 6: Exemplar operator engaging the master controller. Source: NTSB

Method of Operation

The B-Branch of the MBTA Green Line runs for 4.2 miles between downtown Boston and the surrounding municipalities. This operation includes a mix of street running, street running in an

exclusive right of way, and tunnel operations. There are 18 stations stops on the B-Branch, although at the time of the event one station stop was closed due to construction. Service is governed by an operating schedule and timetable. Trolleys are dispatched by the pull-out official at a terminus, according to the times in the timetable.

Striking Trolley Operator

The operator of the striking trolley was hired on 9/22/14 and has 7 years experience. The operator has worked on this line since 8/30/20. The operator's most recent certification as a trolley operator occurred on 1/21/21. The operator started their shift at 3pm on the day of the accident and was making their 2nd run when the accident occurred. The operator was off Tuesday and worked Wednesday and Thursday on this same shift, this was the operators normal shift time.

Striking Trolley 2nd Car Operator

The operator located in the 2nd car of the striking trolley was hired on 2/4/18 and has 3 years experience. The operator's most recent certification as a trolley operator occurred on 5/26/21. The operator started their shift at 3:07 pm on the day of the accident and was making their 2nd run when the accident occurred. The operator was off Wednesday and Thursday and this was the operators normal shift time.

Struck Trolley Operator

The operator of the struck trolley was hired on 6/23/14 and has 7 years experience. The operator's most recent certification as a trolley operator occurred on 12/31/20. The operator started their shift at 7:20 am on the day of the accident and was making their 6th run when the accident occurred. The operator was off Thursday and worked Monday through Wednesday on this same shift, this was the operators normal shift time.

Struck Trolley 2nd Car Operator

The operator located in the 2nd car of the struck trolley was hired on 7/1/02 and has 19 years experience. The operator's most recent certification as a trolley operator occurred on 4/21/21. The operator started their shift at 7:20 am on the day of the accident and was making

their 6th run when the accident occurred. The operator was off Monday and worked Tuesday through Thursday on this same shift, this was the operators normal shift time.

Pull-Out Official

Pull-out officials work at Terminus locations and are responsible for conducting Fitness for Duty observations of operators and dispatching trains according to the timetable.

Chief Inspector

A Chief Inspector is assigned to each surface branch of the Green Line throughout all operating hours. There are also mobile Chief Inspectors that are located throughout the system during operating times. Their role is to assist in the event of any service disruptions.

Central Dispatcher

Two Dispatchers are on duty assigned to the Green Line at the Operations Control Center located in Downtown Boston 24/7.

Internal Oversight

Safety Rules Compliance Program (SRCP)

The MBTA Audit Program was implemented in 2009 and includes 36 Audits/Observations that are conducted across Operations & Maintenance. For Light Rail there are 10 audits, 8 conducted by Operations, 1 conducted by training and 1 by the Operations Control Center. The audits are not advertised to employees. Audits are performed by all Operations departments as well as MBTA Safety Department, Training Department and observed by the State Safety Oversight (DPU). There is also a program for Supervisory Oversight Audits. All audit results are entered into an internal database. Currently results are entered into internal database, however the MBTA is working on a pilot program to fully digitize this system. The SRCP Steering Committee meets monthly to review data and go through a full agenda.

Light Rail Operations Radar Observations

Radar observations of Light Rail Operations are conducted in accordance with MBTA Safety Form RCP-001. The form outlines the methodology to conduct audits of operators to determine compliance with proper rules and procedures of operations posted speed limits. See Appendix: A

Automated Overspeed Notification System

A review of downloads on the accident trip and the striking operator's previous trip indicates multiple occurrences of over speeding. Reports from the GL Overspeed Notification (Geofence) and All Traffic digital Speed sign did not capture any of the speeding events.

Since its implementation in September 2019, the MBTA has relied on an automated GPS and fixed speed sign system to monitor speed compliance of Green Line Trains. This system is only active on approximately 5% of the Boston College line. The only area on the Boston College line with the GL Overspeed Notification (Geofence) and All Traffic digital Speed sign is the Blandford siding. There is a sign at Copley westbound and Boylston EB &WB. Prior to the introduction of the automated system, MBTA relied solely on LIDAR speed monitoring conducted by Operations and Safety personnel.

MBTA Safety Management

The MBTA uses a Transit Safety Plan (required by 49 CFR 673) to describe its safety policy, programs and processes. Currently MBTA is working towards implementing a Safety Management System.

External Oversight

Massachusetts Department of Public Utilities – State Safety Oversight

The Department of Public Utilities (DPU) Transportation Oversight Division is responsible for the oversight of equipment safety and operations for the Rail Fixed Guideway Public Transportation Systems (RFGPTS) in the state. The Rail Oversight Team is the federally designated state safety oversight (SSO) agency of the MBTA, designated by the Federal Transit Administration (FTA). The MBTA is the only Massachusetts transit authority which operates a RFGPTS. The Division annually reviews, tests, and approves the Agency Safety Plan created by the MBTA, along with monitoring of the MBTA's compliance with the Division's System Safety Program Standard. The Division also performs random inspections of MBTA light and heavy rail subway cars and operation facilities which include all carhouses. Division staff review and participate in internal safety audits to further enhance compliance and safety plans. The Division also conducts external safety audits which are designed to monitor compliance with program requirements. The Rail Team is made up of nine full time employees, three Engineers and three Compliance Officers and two Auditors and a Program Manager. Additionally, a Program Manager oversees the office and reports to the Transportation Division Director.

FTA

Federal oversight of the Department of Public Utilities (DPU) Transportation Oversight Division is provided by the Federal Transit Administration (FTA), which is part of the Federal Department of Transportation (DOT). The FTA has an Office of Safety in Washington D.C. that conducts triennial audits of a State Safety Oversight (SS) Organization's compliance with Federal requirements. The FTA Regional Office attends SSO quarterly meetings and site visits at MBTA as appropriate.

Interviews Conducted

- **Struck Train Lead Car Operator**
- **Struck Train 2nd Car Operator**
- **Striking Train 2nd Car Operator**
- **Striking Train Lead Car Operator**

- **Chief Inspector B Branch**
- **Chief Inspector C Branch**
- **Pull-Out Official**
- **Chief Safety Officer**
- **Green Line Dispatcher**
- **Green Line Dispatcher**

Presentations by MBTA

- **Safety Rules Compliance Program**
 - See data in Appendix B and C.
- **Green Line Train Protection System**
 - Developed in response to previous NTSB Recommendations to prevent collisions, overspeed events, and signal violations. See Appendix D.

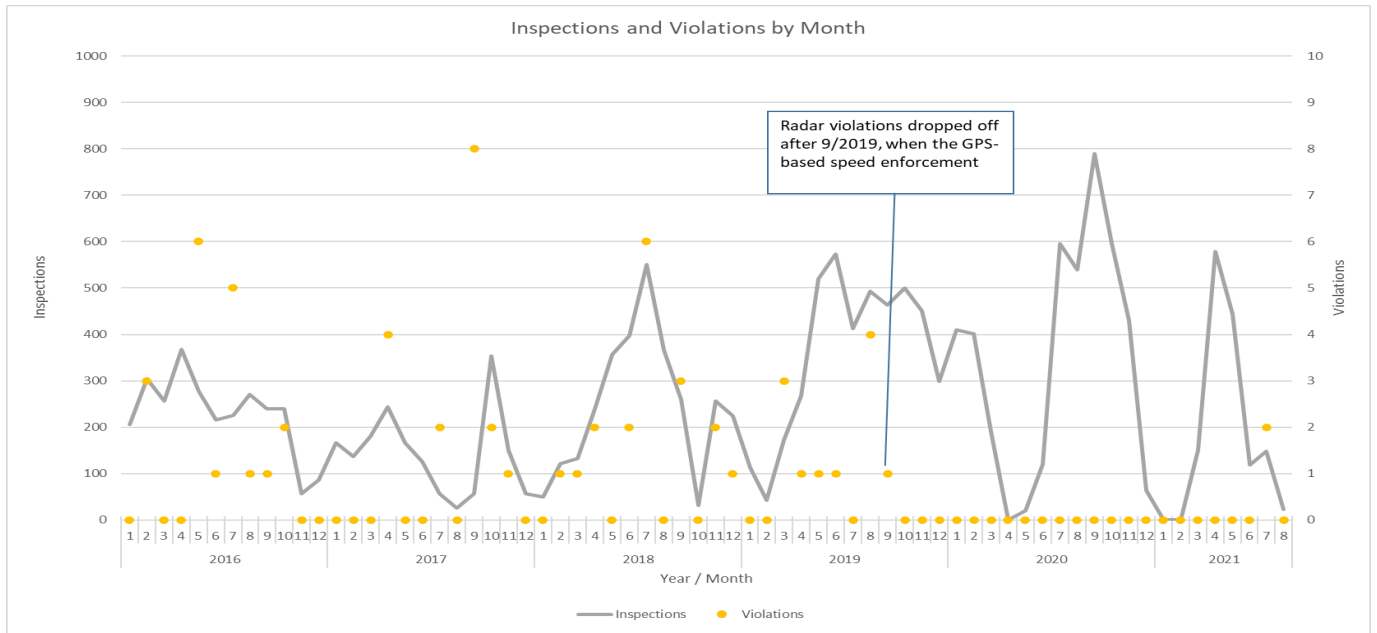
Appendix A:

MBTA SAFETY RULES COMPLIANCE PROGRAM INSPECTION PROCEDURE AND FORM

Department(s): Light Rail (LR) Operations	Persons notified when there is a violation: Light Rail Dispatcher On duty Light Rail Supervisor Light Rail Superintendent Superintendent of Subway Training	Rules Compliance Staff: One LR Supervisors, LR Instructors, or LR Officials. Optional: A Safety or DPU Representative
Element 14.1–Rules Compliance: Radar Observation	MBTA Safety	RCP-001 11/18/15 Rev. 5
Reference Criteria: <ul style="list-style-type: none"> SSPP – 4.5 Operators/Maintenance Personnel – Obey established Authority rules and “standard operating procedures.” SSPP – 8.0 Subway Operations employees are governed by specific rules and procedures so they may safely perform their duties in a manner consistent with MBTA Policy. 		
Element/Characteristics and Method of Verification: This observation verifies that the Motorperson follows the rules and proper procedures for compliance with Subway Operations posted speed limits. <ul style="list-style-type: none"> One Rules Compliance Staff stands in a safe location where the speed of the vehicle can be observed and recorded by radar. In order to perform the test, the Rules Compliance Staff must have the required PPE and/or equipment needed to perform the RCP Observation at the scheduled starting time. Examples of PPE and/or equipment needed: testing compliance form; Radar Gun; Fitness for Duty form; statement form; pen; working portable radio, etc. <p><u>IMPORTANT:</u> Radar gun must be tested prior to each observation session.</p> Testing and Observations: The Rules Compliance Staff observes train operations looking for the following violation: — Operating more than 5 mph over the posted speed limit <ul style="list-style-type: none"> Test Rules Compliance Staff have no latitude in recording rules violations. What is observed is what is recorded. Written in ink, fully complete the form for the observation. Write data in neatly and do not abbreviate the words Yes/ No in the Compliant columns. If any violation is observed, the employee(s) must be re-instructed immediately and checked “fit for duty” before allowing the move to continue. Test Rules Compliance Staff must personally ensure that the original form is received by the Area’s Supervisory Staff and/or Superintendent. If other rule violations are observed, the Rules Compliance Staff must immediately take action to stop or otherwise appropriately address the violation. The other violation should be documented and followed up on as required by rules and procedures. Do not document on this Inspection Form. Original forms are to be kept at the Area Superintendent’s office. Comments/Corrective Action: <ul style="list-style-type: none"> If the employee is observed operating faster than five (5) miles per hour above the posted speed, the employee must be re-instructed and checked for Fitness for Duty by Supervisory Personnel. Status: <ul style="list-style-type: none"> Two locations for ½ hour each. Observations must be done on different forms. 		

Appendix B:

Number of Radar/LIDAR Inspections and Violation by Month and Year



Year	Month	Inspections	Violations
2016	1	206	0
	2	305	3
	3	257	0
	4	367	0
	5	277	6
	6	216	1
	7	225	5
	8	271	1
	9	239	1
	10	239	2
	11	57	0
	12	86	0
2017	1	166	0
	2	137	0
	3	180	0
	4	244	4
	5	166	0
	6	126	0
	7	57	2
	8	26	0
	9	57	8
	10	354	2

	11	149	1
	12	57	0
2018	1	50	0
	2	121	1
	3	133	1
	4	240	2
	5	356	0
	6	397	2
	7	551	6
	8	366	0
	9	259	3
	10	31	0
	11	256	2
	12	224	1
2019	1	113	0
	2	42	0
	3	172	3
	4	268	1
	5	519	1
	6	573	1
	7	412	0
	8	493	4
	9	463	1
	10	500	0
	11	450	0
	12	299	0
2020	1	410	0
	2	402	0
	3	190	0
	4	1	0
	5	20	0
	6	120	0
	7	595	0
	8	539	0
	9	790	0
	10	596	0
	11	429	0
	12	64	0
2021	1	0	0
	2	0	0
	3	151	0
	4	579	0
	5	444	0

	6	118	0
	7	148	2
	8	23	0

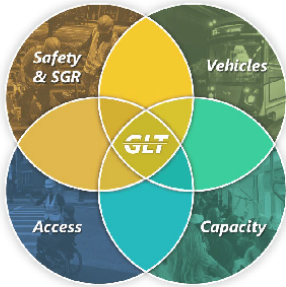
Appendix C:

Inspections by Speed Limit since 1/1/2019					
Posted Speed	Inspection	Violations	Max_Observed_Speed	Avg_Observed_Speed	
3	33	0	7	4	
6	460	0	11	6	
10	9188	14	19	8	
15	69	0	19	15	
20	99	0	24	17	
25	176	0	29	15	
30	9	0	25	20	
Total	10034				

Appendix D:

GLT Green Line Transformation (GLT) | Overview

Program Goal: Improve the Green Line quality of service for all riders through strategic investments in Safety & State of Good Repair, Accessible Stations, Legacy Car Replacement and Increased Capacity



GLT 2018-2021

- ✓ Replaced 12 miles of track (25% of System)
- ✓ Upgraded 45 Vehicle Intersections and Pedestrian Crossings
- ✓ Upgraded 29 Units of special trackwork

Level 0 Safety & State of Good Repair

- Minimize risk of service disruptions
- Reduce speed restrictions
- Bring assets to state of good repair

Level 1 Accessible Stations

- New or upgraded platforms
- Compliant height, width & slope
- Barrier-free pathways & wayfinding
- Detectable warning panels

Level 2 Legacy Car Replacement

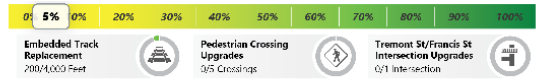
- Operate and maintain single Type 10s
- More **efficient** O&M
- 100% of Green Line trains **accessible**
- More **equitable** across the Green Line

Level 3 Increased Capacity

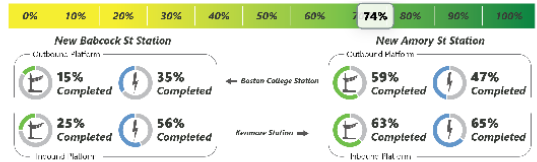
- Additional vehicles and infrastructure for two-car Type 10 operation
- Increase core capacity of subway
- Reduce headways and journey time
- Expand yards and facilities

Massachusetts Bay Transportation Authority (MBTA)

E Branch Track & Intersection Upgrades | Aug 2-29, 2021



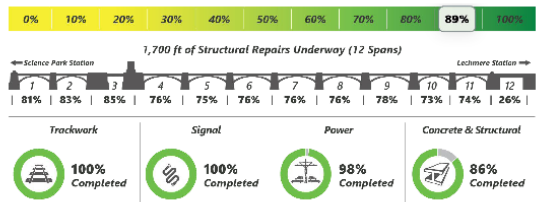
B Branch Station Consolidation



D Branch Track and Signal Replacement



Lechmere Viaduct Rehabilitation Project



Office of Green Line Transformation (GLT) | 1

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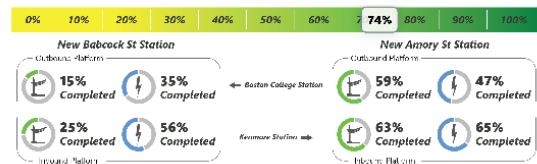
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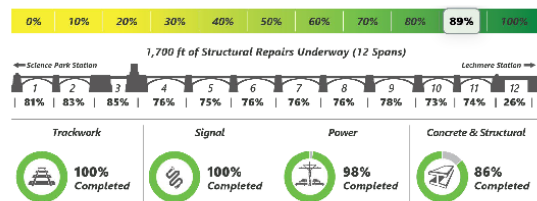
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