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

RRD24MR002

TRACK AND ENGINEERING FACTUAL REPORT

Group Chair's Factual Report

January 28, 2024

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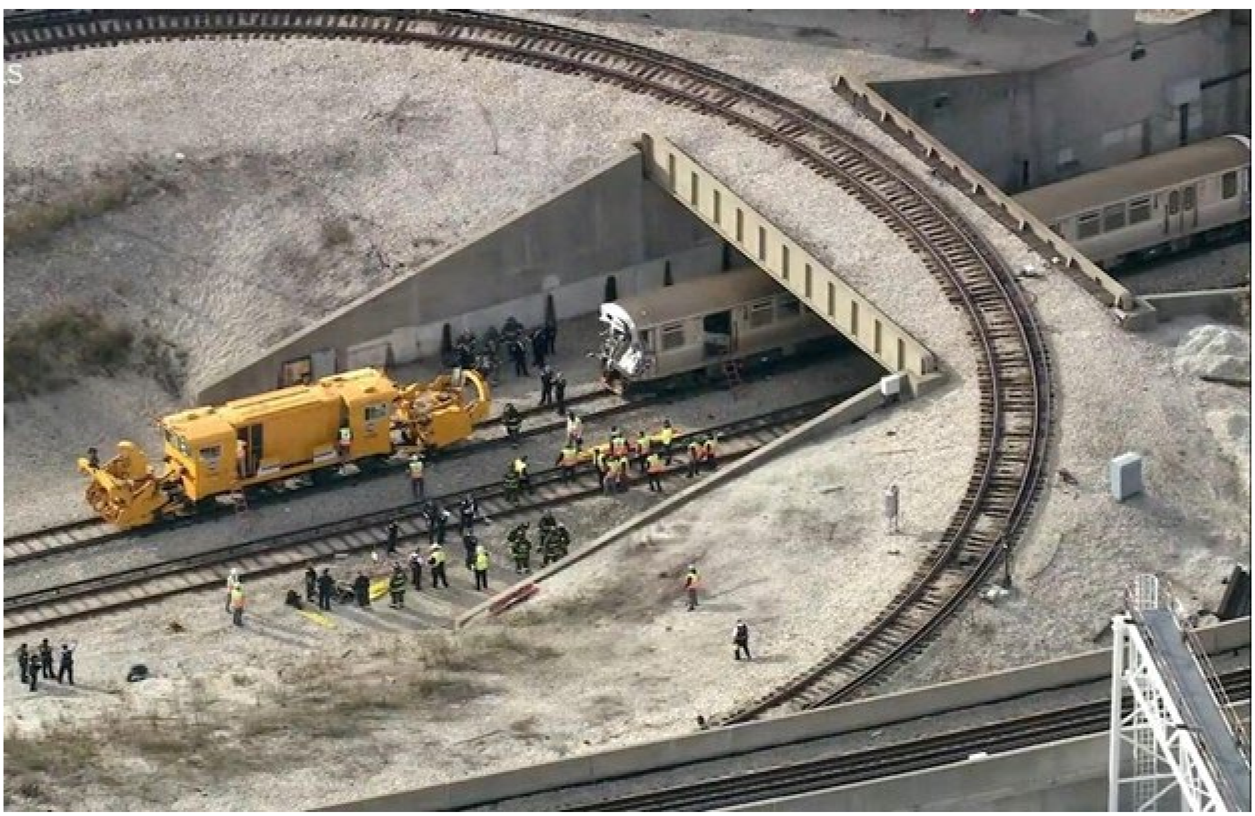

Figure 1: Aerial view of accident location. (Source: Local Media)

A. ACCIDENT ID

Location: Chicago, IL
Date: November 16, 2023
Time: 1031 (local)
Train 1: Yellow Line Train 593
Equip 1: S 500
Railroad: Chicago Transit Authority
Line: Yellow Line

B. TRACK AND ENGINEERING FACTUAL REPORT GROUP

Group Chair	Darius Mack NTSB Rail Accident Investigator
Party Spokesman	Bill Mooney Chicago Transit Authority Chief Infrastructure Officer
Party Spokesman	Ryan Kelly IAM Local 126 Investigative Team Member

C. ACCIDENT SUMMARY

See *Accident Summary* in the docket.

D. FACTUAL INFORMATION

1.0 TRACK DESCRIPTION

CTA's Yellow line train travels from stations, Howard and ends at station Dempster-Skokie for a total of 9.9 track miles. 3% of this route is elevated open deck track, and the remainder is on ballasted track with wood cross ties. AREMA 115 RE rail is standard across the CTA's Yellow Line and the entire rail system. This line has 14 curves (including compound curves) with a curve radius ranging from 1718.88' to

8,399.88′ feet. On average daily commuter train counts over the Yellow Line are 80 (during week) / 60 (on weekend). The maximum authorized speed for CTA's yellow line is 55 mph (some areas have the geometry which permit 70mph civil speeds, but trains are restricted by cab signaling to 55mph). The yellow line uses standard 56-½" gage track and an electrified third rail system.

In a third rail system, an additional rail (known as a conductor rail) is added to the railway. This rail carries up to 750 volts in most systems. Electricity is sent from substations placed along the track at varying distances depending on various factors, including power requirements, headways, and allowable voltage drop. A collector or contact shoe contacts the third rail as the train moves along the track. This transmits the electricity that powers the train. The return current flows back through the main rails, completing the electrical circuit.

2.0 Track Structure

The collision occurred on the main track near Howard yard at marker 7+00. The accident occurred in a 1189.5 ft. long right-hand curve which had a radius of 2122.26′ (8 degree 46 minutes). This was also on an ascending grade of 3.88′, meaning the train was climbing from lower ground to higher ground. The segment CTA's Yellow Line consists of above ground ballasted single main track.

The rail at this location was 115 lb. RE (CF 1985). The rail was fastened to 6x8x8.5′ hardwood crossties using double-shoulder tie plates and cut spikes. The rail was box anchored every other crosstie throughout the track segment. The ballast was made of crush limestone with no evidence of insufficient or fouled ballast. The location of the accident was in a curve which had 3” of superelevation. The track gauge at this location was 56 ½”. The fasteners were holding effectively with no evidence of lateral movement on the crossties.

3.0 Track Inspections

CTA inspects the yellow line twice per week with at least a two-day interval between inspections. The last inspection conducted on this segment of track was completed on the day of the accident, November 16, 2023. No defective conditions were recorded during this inspection. The CTA also completes automated track geometry testing once a year on the yellow line. The last defective condition identified in this segment using the geometry car was on April 6, 2021. This condition was a “rail (wheel) burn” on both rails.

4.0 Track Equipment

The equipment struck in the accident was a diesel snow locomotive identified as S500. S500 is a specialized piece of maintenance equipment purchased by CTA from Mitsubishi International Corporation and built by Niigata Engineering Company Limited of Japan in 1981. The S500 weighs 89,500 and has a total length of 59’-3/8”. The S500 consists of two cabs, one on each end of the machine and can be operated in either direction. The machine has a total of 6 axles and is equipped with a spring applied, air released disc braking system. The machine is equipped with a plow on the South end and a brush assembly on the North end. There was one Instructor and one machinist on the north end of the machine where the impact occurred and one Instructor and three machinists on the south end of the machine training. The machine was traveling southbound approaching Howard Yard when the collision occurred. Prior to the accident the equipment had come to a stop while slowly traversing an ascending grade as it waited for a signal (X34) to enter the yard. S500 was not equipped with internal or external video cameras.

Figure 1: Photo of S-500 Diesel Snow Locomotive. (Source: rrpicturearchives.net)

5.0 S500 Planned Work

The equipment was being used to conduct training by 4 maintenance machinist (operators of the machine) and 2 Instructors (Pilots). The equipment was tasked with making multiple trips between station Dempster and Howard yard. The instructors' duties included obtaining authority to occupy the main track and line switches as needed. The four machinists were training to operate the equipment. The lead Instructor of S500 was granted a rail service bulletin to operate northbound and southbound between station Dempster and station Howard on Thursday, November 16, 2023, at 0900 hrs. until 1400 hrs. The accident occurred on the first return trip from Dempster to Howard.

6.0 Interviews

6.1 CTA Machinist

- The track and engineering group interviewed the CTA Machinist that was operating the S500 as part of the investigation.
- This operation was for the purpose of training two other machinists on how to operate the S500.
- The training was being conducted in the south cab at the time of the accident and was traveling southbound towards Howard yard.
- There were no issues with the machine at the beginning of the shift and no issues with the equipment at the time of the accident.
- Before impact the equipment stalled and stopped on an ascending grade, due to there low speed as they approached the signal.

7.0 Collected Samples

During the field investigation, NTSB noted that a black substance was on top of the rails. The substance was found to exist in various locations on this segment of track and at the location of the collision. Samples of this unknown black substance were collected for analysis. These samples were sent to NTSB’s materials laboratory in

Washington D.C. for testing and identification. The area also had high amounts of fallen leaves on the track and identifiable leaf matter on the rails.

7.1 Examination Results

Material removed from the rail surface at the accident scene was submitted to the Materials Laboratory. The sample was examined using an Agilent Fourier Transform Infrared (FTIR) Model 610 bench spectrometer with a diamond attenuated total reflectance (ATR) accessory in accordance with ASTM E1252-98 (American Society for Testing Materials E1252-98: *Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis and American Society for Testing Materials*). The spectrometer(s) were used to collect and process infrared wavelength absorbance spectra of the unknown material.

The spectrum for the unknown material contained spectral peaks that corresponded to particular functional groups found within molecular structure of the unknown material. The presence of a broad peak at ~3330 cm^{-1} indicative of an oxygen-hydrogen stretching bond. A doublet peak at ~2920 cm^{-1} and ~2850 cm^{-1} corresponds to a carbon-hydrogen stretching bond. Peaks at 2450 cm^{-1} and 2285 cm^{-1} are indicative of a carbon-carbon (elemental) bond. A single peak at ~1730 cm^{-1} is indicative of a carbonyl (C=O) bond (in phase and out of phase). A peak at and ~1600 cm^{-1} is indicative of a carbon-nitrogen (C=N) double bond. A single peak at ~1430 cm^{-1} is indicative of a carbon-hydrogen$_2$ ($C\text{-}H_2$) bond. A single peak at ~1380 cm^{-1} is indicative of a carbon-carbon aromatic double bond. Peaks at ~1065cm^{-1} is indicative of a carbon-oxygen-carbon (C-O-C) bond. A peak ~804 cm^{-1} is indicative of a nitrogen-hydrogen bond. The spectrum was consistent with an amino carbohydrate. A spectral library search was performed on the unknown spectrum. The spectral search found spectral similarities to cellulose. Cellulosic material is found in natural plant fibers and leaves. A mixture search was also performed. There were matches to several other natural nitrogen-containing material sources.

The combination of spectral patterns and similarities to several natural amino-carbohydrates and other materials, the unknown material was most likely plant material. Plant or leaf material consists of a combination of carbon, nitrogen, carbohydrates, organic acids, mineral substances, and water. Molecular bonds for these materials were all present within the unknown spectrum. The presence of the elemental carbon in the sample indicates that the material had sustained some type of thermal exposures carbonizing the material.

APPENDIX A – PHOTOS

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Figure 3: Photo of black substance found on top of the rail. (Source: NTSB)

Figure 3: Photo of inside south cab of S-500. (Source: NTSB)