National Transportation Safety Board
Office of Research and Engineering
Washington, DC 20594

RRD22MR010

LOCOMOTIVE EVENT RECORDERS

Specialist's Factual Report

December 15, 2022

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A. ACCIDENT

Location: Mendon, Missouri
Date: June 27, 2022
Time: 12:42 p.m. central daylight time (CDT)
Train: Amtrak 4

B. LOCOMOTIVE EVENT RECORDERS SPECIALIST

Specialist: Cassandra Johnson
Mechanical Engineer
National Transportation Safety Board (NTSB)

C. DETAILS OF THE INVESTIGATION

A locomotive event recorders group was not convened. The NTSB Vehicle Recorder Division received locomotive event recorder files from the following locomotives:

Locomotive ID (consist location): Amtrak 133 (lead)

Locomotive ID (consist location): Amtrak 166 (rear) [1]

1.0 Recording Description

Using the wheel sizes of 38.75 inches for ATK133 and 38.87 inches for ATK166 as embedded by the operator, both locomotive event recorders' data were extracted using the Wabtec Railway Electronics Event Recorder – Data Analysis Software III (referred to as DAS III). The software outputted the locomotive event recorder parameters including distance and speed. The exported data have a sampling rate of one hertz (one data sample per second); therefore, the data have an accuracy of +/- 1 second. Only data relevant to this event are provided in this report.

1.1 Parameters

Tables 1 and 2 list the locomotive event recorder parameters verified and provided in this report for ATK133 and ATK166, respectively. Additionally, table 3 contains the unit and discrete state abbreviations for the parameters.

[1] In this report, locomotives Amtrak 133 and Amtrak 166 are referenced as ATK133 and ATK166, respectively.

1.1.1 Horn

The horn data from ATK133 is sampled ten times a second but as stated earlier, is exported with a sampling rate of one sample per second. When exported, horn is on if active at any time during the second and off if not active during the entire second.

However, the higher resolution can be viewed in the DAS III software as a combination of 1's and spaces. For example, with 0s representing the spaces, 0100111100 means the horn was active in the following tenths of a second: 0.1, 0.4, 0.5, 0.6, and 0.7. Additionally, 1111111111 means the horn was active the entire second and 000000000 means the horn was not active the entire second.

To provide the horn data for ATK133 at its higher resolution between 12:42:36 CDT to 12:42:45 CDT, the tenths of a second were incorporated into the exported data. After 12:42:45 CDT, the horn remained off until the end of the recording.

1.1.2 Interpolated Distance Traveled

The default output for distance is distance decreasing in time, therefore, the distance traveled began with a very large value and continually decreased.

To correlate the distance traveled to the horn data from ATK133 with the higher resolution, the distance traveled for both locomotives were interpolated to 0.1 samples per second. The interpolated parameters are Feet Traveled Interp_ATK133 and Feet Traveled Interp_ATK166.

1.2 Recorded Time

The recorded time from both event recorder data files is independently time stamped, thus the recorded times may not reflect the actual time of day. However, the times were adjusted by subtracting an hour to align the time to the event time as provided by the investigative team and are expressed as CDT.

D. FIGURES AND TABULAR DATA

Figures 1 and 2 contain locomotive event recorder data from ATK133 and ATK166 recorded during the event on June 27, 2022. All the parameters listed in tables 1 and 2 are plotted.

Figure 1 covers the data from 12:42:30 CDT to 12:43:04 CDT and figure 2 covers data from 12:42:35 CDT to 12:42:48 CDT.

The event recorder data from ATK133 between 12:42:36 CDT and 12:42:46 CDT indicated in table 1.

Table 1. Timeline for event recorder data from ATK133

Time (CDT)	ATK133 Parameter	Event	Speed (mph)	Throttle	Distance (ft)
12:42:36.1	Horn	Changed from Off to On	89	T1	1,289
12:42:38.8	Horn	Changed to Off	89	T1	936
12:42:39.3	Horn	Changed to On	89	T1	871
12:42:42.3	Horn	Changed to Off	88	T1	480
12:42:42.9	Horn	Changed to On	88	T1	402
12:42:43.1	Horn	Changed to Off	88	T1	376
12:42:43.4	Horn	Changed to On	88	T1	336
12:42:43.9	Horn	Changed to Off	89	T1	271
12:42:44	Electronic Air Brake – Emergency Type (EAB Emer Type)	Changed from None to Engineer Initiated Emergency (EIE)	89	T1	258
12:42:44.6	Horn	Changed to On	89	T1	183
12:42:44.8	Horn	Changed to Off and remained Off for the rest of the data.	89	T1	156
12:42:45	Pneumatic Control Switch (PCS)	Changed from Closed to Open	88	Idle	128
12:42:46	Electronic Air Brake – Brake Handle (EAB Brake Handle)	Changed from Release to Emergency	87	Idle	0

At 12:42:47, due to impact, the speed from ATK133 was 0 mph. At 12:43:02, fifteen seconds later, the speed from ATK166 was 0 mph indicating the train came to a complete stop.

The corresponding tabular data used to create figures 1 and 2 are provided in electronic comma separated value (CSV) format as attachment 1 to this report.

Submitted by:

Cassandra Johnson
Sr. Mechanical Engineer

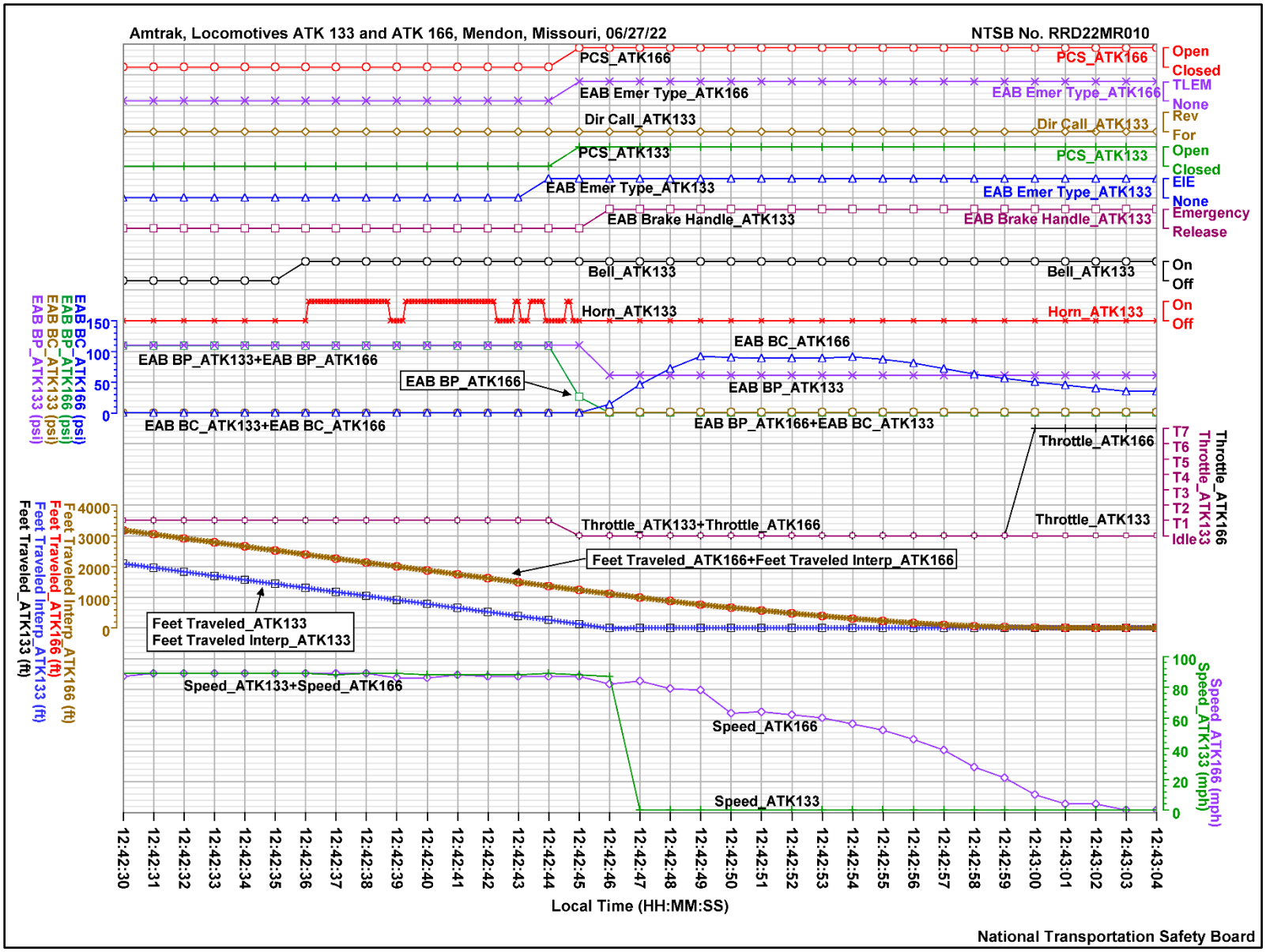

Figure 1. Select event recorder parameters from 12:42:30 CDT to 12:43:04 CDT

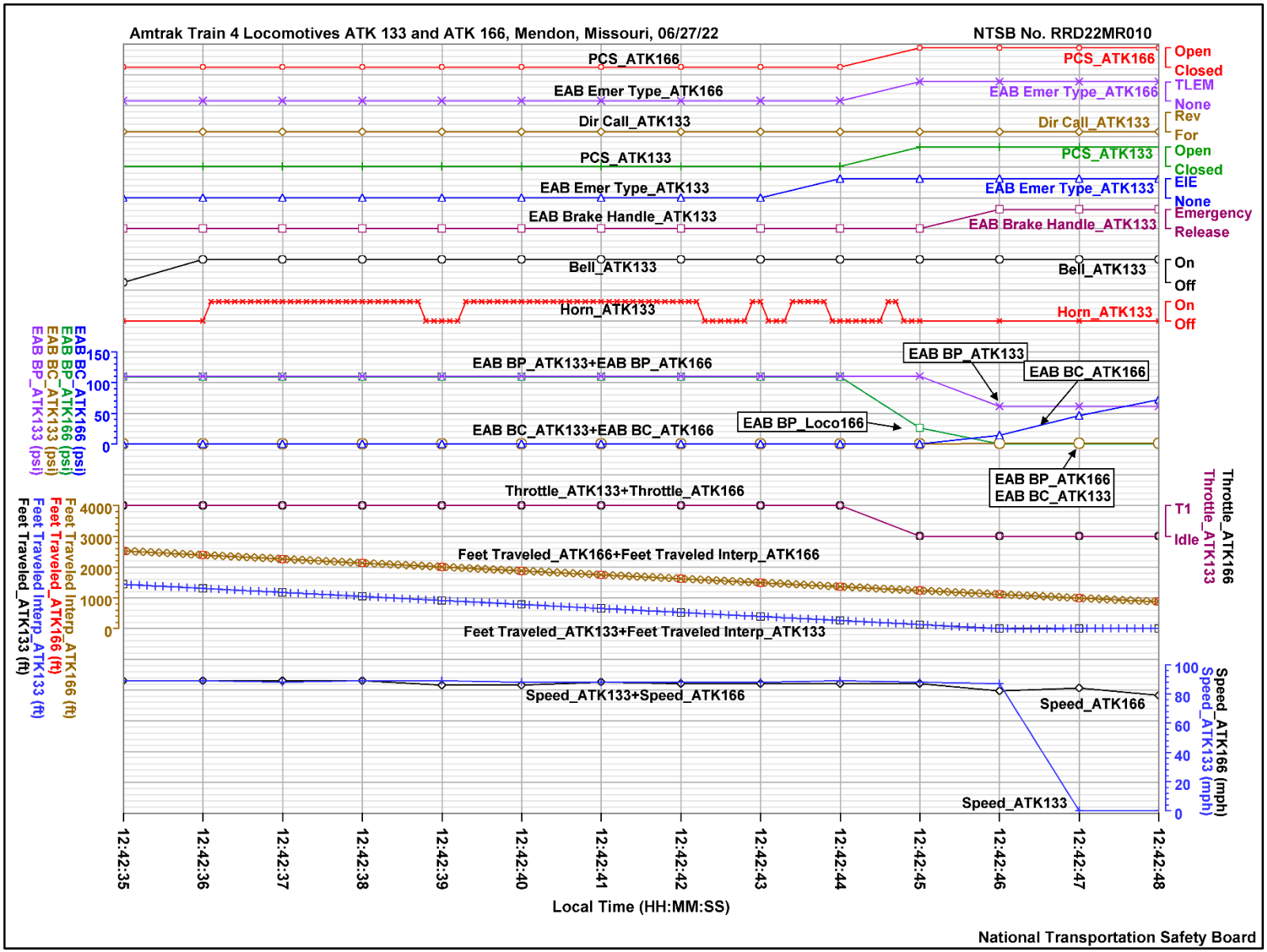

Figure 2. Select event recorder parameters from 12:42:35 CDT to 12:42:48 CDT

APPENDIX A. VERIFIED AND PROVIDED PARAMETERS

This appendix describes the locomotive event recorder parameters provided and verified in this report for ATK133 and ATK166. Tables 1 and 2 list the plot labels, parameter descriptions, and units for ATK133 and ATK166, respectively. Parameters with a blank unit description are discretes. A discrete is typically a 1-bit parameter that is either a 0 state or a 1 state where each state is uniquely defined for each parameter. Table 3 contains the unit and discrete state abbreviations for the parameters.

Table 2. Verified and provided locomotive event recorder parameters for AKT133

Plot Label	Parameter Description	Unit
Bell_ATK133	Bell Activation	
Dir Call_ATK133	Dir of Travel	
EAB BC_ATK133	Electronic Air Brake – Brake Cylinder	psi
EAB BP_ATK133	Electronic Air Brake – Brake Pressure	psi
EAB Brake Handle_ATK133	Electronic Air Brake – Brake Handle	
EAB Emer Type_ATK133	Electronic Air Brake – Emergency Type	
Feet Traveled Interp_ATK133	Interpolated Feet Traveled	ft
Feet Traveled_ATK133	Feet Traveled	ft
Horn_ATK133	Horn Activated	
PCS_ATK133	Pneumatic Control Switch	
Speed_ATK133	Speed	mph
Throttle_ATK133	Throttle Position	

Table 3. Verified and provided locomotive event recorder parameters for AKT166

Plot Label	Parameter Description	Unit
EAB BC_ATK166	Electronic Air Brake – Brake Cylinder	psi
EAB BP_ATK166	Electronic Air Brake – Brake Pressure	psi
EAB Emer Type_ATK166	Electronic Air Brake – Emergency Type	
Feet Traveled Interp_ATK166	Interpolated Feet Traveled	ft
Feet Traveled_ATK166	Feet Traveled	ft
PCS_ATK166	Pneumatic Control Switch	
Speed_ATK166	Speed	mph
Throttle_ATK166	Throttle Position	

Table 4. Unit and discrete state abbreviations

Unit and Discrete State Abbreviation	Description
EIE	Engineer Initiated Emergency
For	Forward
ft	feet
mph	miles per hour
psi	pounds per square inch
Rev	Reverse
T1	Throttle Position 1
T2	Throttle Position 2
T3	Throttle Position 3
T4	Throttle Position 4
T5	Throttle Position 5
T6	Throttle Position 6
T7	Throttle Position 7
TLEM	Trainline Emergency