

**NATIONAL TRANSPORTATION SAFETY BOARD**  
Vehicle Recorder Division  
Washington, D.C. 20594

April 5, 2016

## **Event and On-Board Image Recorders**

### **Group Chairman's Factual Report By Bill Tuccio, Ph.D.**

#### **1. EVENT SUMMARY**

Location: Cimarron, Kansas  
Date: March 14, 2016  
Vehicle: Train Amtrak 4: Locomotive AMTK 153 and 152  
Operator: Amtrak  
NTSB Number: DCA16MR004

On March 14, 2016, at 12:02am central standard time (CST), Amtrak train #4 (Southwest Chief) derailed near milepost 372.9 in the vicinity of Cimarron, Kansas. This LA to Chicago train consisted of two locomotives and 10 cars. Four cars were derailed on their sides. Two other cars derailed upright. There were approximately 130 passengers and 14 crew members on board. This event occurred on the BNSF, La Junta Division.

#### **2. GROUP**

A train recorders group was formed at the accident location on March 14, 2016.

Chairman:	Dr. Bill Tuccio Aerospace Engineer National Transportation Safety Board (NTSB)
Member:	Arnoldo Gonzalez Operating Practices Inspector Federal Railroad Administration
Member:	John Hines System General Road Foreman Amtrak
Member:	Charlie Rash Senior Manager Train Handling BNSF

### **3. DETAILS OF RECORDER INVESTIGATION**

Amtrak 4 was operating with two locomotives: Amtrak 153 (AMTK153) was the lead locomotive and Amtrak 152 (AMTK152) was the second locomotive. Amtrak 4 was operating from west to east on the single rail and derailed. Both locomotives had a Wabtec forward facing track image recorder and a Wabtec event recorder installed and operating.

About 16 hours before the Amtrak derailment, a BNSF cargo train operated east to west on the same section of track as the derailment. The lead locomotive of the BNSF train was BNSF3917. BNSF3917 had a GE Lococam forward facing track image recorder and a Wabtec event recorder installed and operating.

#### **3.1. Event and On-Board Image Recorder Data Recovery**

When the derailment occurred, AMTK153 and AMTK152 transmitted 58 seconds of forward facing video. Additionally, two hours of event recorder data were wirelessly transmitted from these locomotives. On-scene, under the supervision of the NTSB, Amtrak personnel downloaded one hour of on-board track image recorder video from AMTK153 and downloaded the entire event recorders from AMTK153 and AMTK152.

Under the supervision of NTSB personnel, BNSF personnel downloaded the pertinent part of the on-board track image recorder video from BNSF3917 and downloaded the entire event recorder.

Only pertinent data from AMTK153 and BNSF3917 were used in this report.

#### **3.2. Event Recorder Recording Description and Wheel Sizes**

Under the supervision of NTSB personnel, Amtrak and BNSF personnel measured the wheel size of AMTK153, AMTK152, and BNSF3917 as 38.5, 39.0, and 41.0 inches, respectively. Using these wheel sizes, the event recorder data were extracted using the Wabtec Railway Electronics Event Recorder Data Analysis Software. The data exported has a sampling rate of one second. Therefore, the data has an accuracy of +/- 1 second.

##### **3.2.1. Parameters and Tabular Data**

Table A-1 in Appendix A of this report lists the parameters from the AMTK153 event recorder verified and provided in this report. Table A-2 contains the unit and discrete state abbreviations for the parameters. Attachment 1 contains tabular data of all the parameters listed in table A-1 for AMTK153 in comma separated value (CSV) format for one hour and fifteen minutes of AMTK's event recorder data related to the derailment.

##### **3.2.1.1. Distance Traveled and Speed**

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

1,112 feet for AMTK153.<sup>1</sup> For this report, 1,112 feet were subtracted from AMTK153's distance traveled parameter so distance traveled ended at 0 feet.

### 3.3. On-Board Image Recorders

#### 3.3.1. On-Board Image Recorders: Amtrak

The Wabtec VideoTrax On-Board Image recorder is a forward facing video camera that records to external storage. It records video at a resolution of 704x480 pixels at 15 frames per second (fps) with external audio.

#### 3.3.2. On-Board Image Recorders: BNSF

The GE Lococam On-Board Image recorder is a forward facing video camera that records to external storage. It records video at a resolution of 720x480 pixels at 15 fps with external audio.

### 3.4. Recorder Timing

The times used in this report are expressed as local time of the accident (CDT).

#### 3.4.1. AMTK153 On-Board Event Recorder

In agreement with the Investigator-in-Charge, the time recorded by AMTK153's event recorder was considered authoritative for this accident. At the time of download, the time was verified to be accurate to +/-1 minute relative to the time reported by a cell phone network.

#### 3.4.2. AMTK153 On-Board Image Recorder

Events recorded by AMTK153's on-board image recorder and transmitted via wi-fi to Amtrak were aligned with common events on AMTK153's event recorder. Table 1 shows the alignment events considered. A best fit adjustment of the 1 Hertz event recorder sampling and video/audio review resulted in the following relationship:

$$\text{AMTK153 On-Board Image Recorder CDT} = \text{AMTK153 Event Recorder Time} - 2000:12.^2$$

**Table 1. Image and event recorder time alignment.**

Event	AMTK153 Image Recorder	AMTK153 Event Recorder (CDT)
Horn Start	2002:26	0202:13
Horn End	2002:27	0202:14
Horn Start	2002:38	0002:26
Horn End	2002:40	0002:28
Train Stop	2002:47	0002:34

<sup>1</sup> Before the event recorder download was performed, AMTK153 was moved for operational reasons to re-couple the train and move it into the Cimarron siding.

<sup>2</sup> Expressed as HHMM:SS (HH is hours, MM is minutes, SS is seconds).

### 3.4.3. BNSF3917 On-Board Image Recorder

Time recorded by BNSF3917's on-board image recorder was verified accurate (sufficient for the purposes of this report).

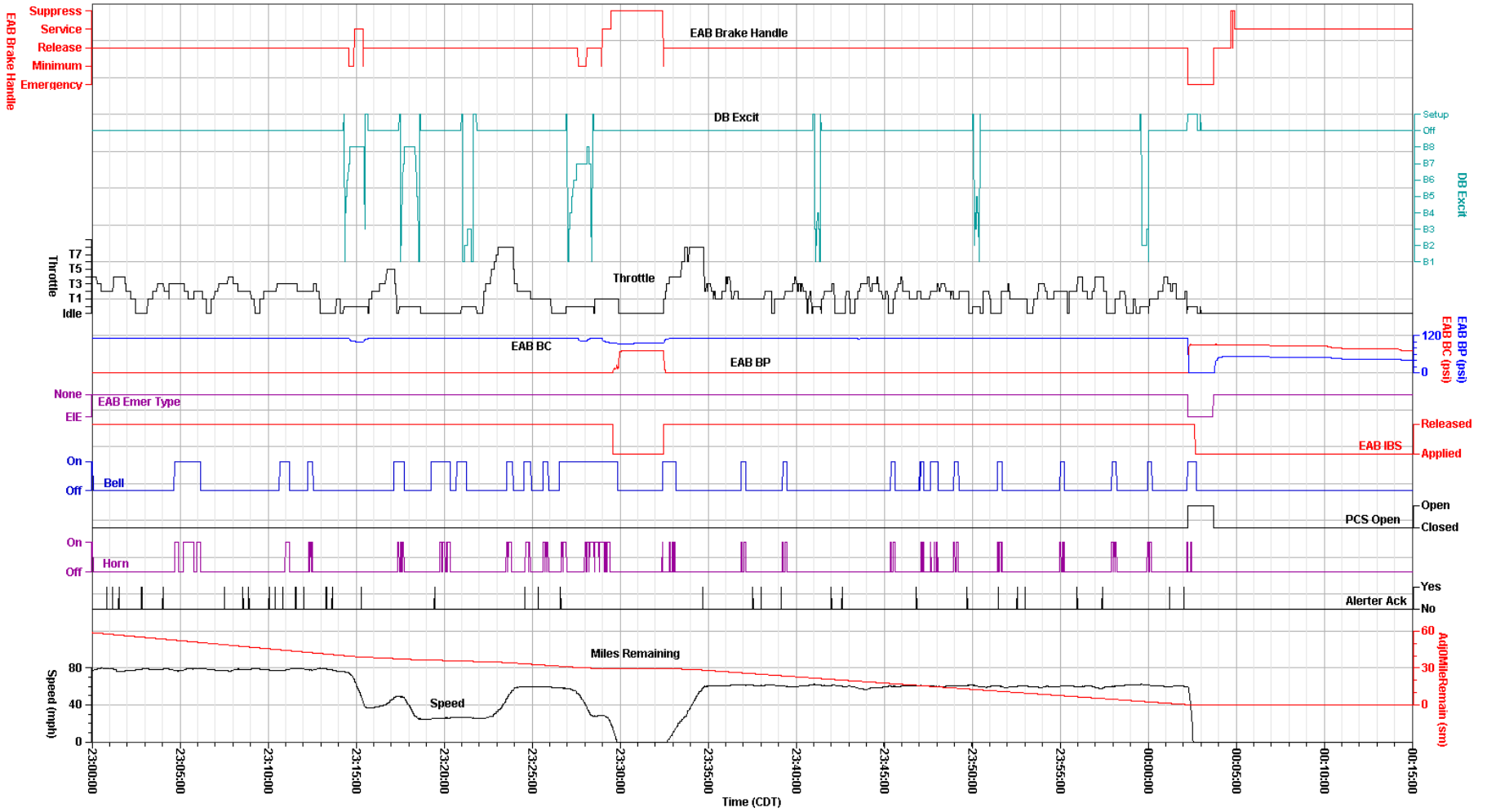
### 3.5. Plots of Event Recorder Data

Figures 1 and 2 contain event recorder data as described in table 1. All parameters listed in table A-1 were plotted.

**Table 2. Locomotive event recorder plot summary.**

<b>Locomotive</b>	<b>Start Time (CDT)</b>	<b>End Time (CDT)</b>
AMTK153	2300:00 March 13, 2016	0015:00 March 14, 2016
AMTK153	0001:30 March 14, 2016	0002:35 March 14, 2016

Figure 1: Select parameters from AMTK153 event recorder (from 2300:00 to 0015:00 CDT).

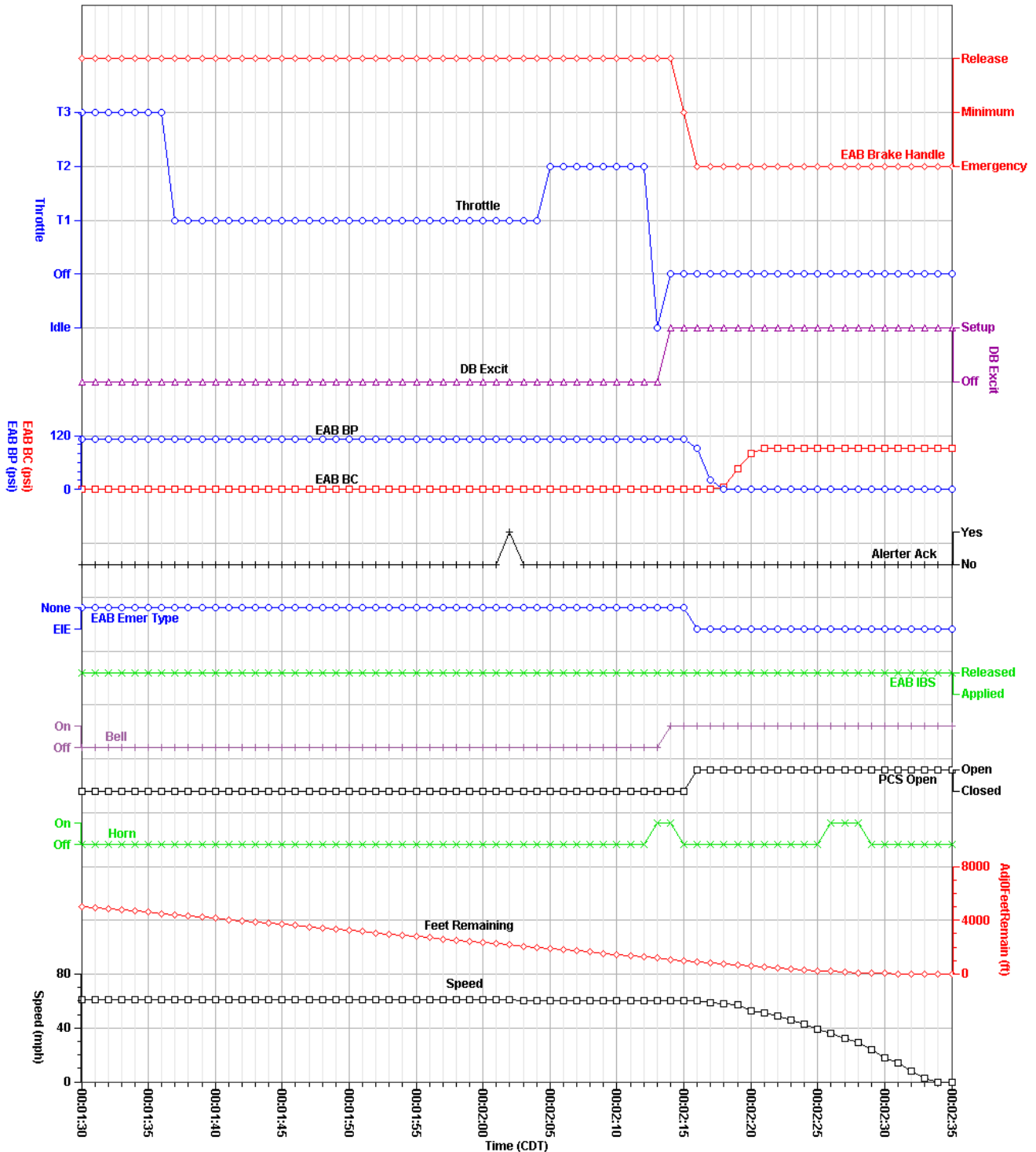


Revised: 24 March 2016

1-hour 15-minute View

National Transportation Safety Board

Figure 2: Select parameters from AMTK153 event recorder (from 0001:30 to 0002:35 CDT).



### 3.6. Description of Data from AMTK153

Data from the event and image recorders of AMTK153 provided investigators with the following chronological order of events.

From 2300 CDT until the derailment event, active changes of throttle, alerter, horn, and bell parameters occurred, as shown previously in figure 1.

At 0001:57 CDT, AMTK153 crossed over a small bridge, as shown in figure 3. At this time, AMTK153 was traveling 61 mph, and was about 1,697 feet from the Engineer Induced Emergency (EIE) event.

**Figure 3. AMTK153 at 0001:57 CDT.**



At about 0002:05 CDT, the reflective whistle board next to the track anomaly was first visible in the video recording, as shown by the annotation in figure 4.

**Figure 4. AMTK153 at 0002:05 CDT.**





At about 0002:10 CDT, a semitrailer truck passed in the opposite direction on the highway to the left, as shown in annotated figure 5.

**Figure 5. AMTK153 at 0002:10 CDT.**



At 0002:12 CDT, the track anomaly was first visible in the recorded video, as shown by the annotation in figure 6. At this time, AMTK153 was traveling 60 mph, and was about 1,364 feet from the EIE event. The semitrailer truck from figure 5 is shown in the upper left hand corner of figure 6.

**Figure 6. AMTK153 at 0002:12 CDT.**



Figure 7 shows the track anomaly at 0002:13 CDT from AMTK153.

**Figure 7. AMTK153 at 0002:13 CDT.**



At 0002:13 CDT (about 0.2 seconds after the image in the figure 7), the horn sounded on the train. At the time the horn sounded, AMTK153's video recorded the image shown in figure 8.

**Figure 8. AMTK153 at 0002:13 (+.2) CDT.**



At 0002:14 CDT, AMTK153 swayed right, then left. Also, the bell began and continued until the end of the recording.

At 0002:15 CDT, the Electronic Air Brake (EAB) Handle changed state from "Release" to "Minimum." By 0002:16 CDT, the EAB Handle changed state to Emergency and remained so for the remainder of the derailment event. Coincident with the EAB Handle in Emergency, EAB Pressure began to reduce from a prior value of 111 pounds per square inch to 0 by 0002:18 CDT.

At 0002:26 CDT, the horn was activated for three seconds.

At 0002:34 CDT, AMTK153 came to a stop, as shown in Figure 9. A grade crossing was visible ahead of the locomotive.

From the time the EAB Handle was first taken out of "Release" until the train stopped, AMTK153 traveled 1,095 feet in 19 seconds.

Figure 9. AMTK153 at 0002:34 CDT.



### 3.7. Description of Data from BNSF3917

At about 0726 CDT on March 13, 2016, BNSF 3917 passed over the location of the track anomaly (shown previously in figure 7) in the opposite direction relative to AMTK153. No track anomaly was observed, as shown in figure 10.

Figure 10. BNSF3917 at 0726 CDT.



## APPENDIX A

This appendix describes the parameters provided and verified in this report. Table A-1 lists the parameters from AMTK153. Table A-2 describes the unit and discrete abbreviations.

**Table A-1. AMTK153 verified and provided event recorder parameters.**

<b>Parameter Name</b>	<b>Parameter Description</b>
1. Adj0FeetRemain (ft)	Feet Remaining
2. Adj0MileRemain (sm)	Miles Remaining
3. Alerter Ack (discrete)	Alerter Acknowledgement
4. Bell (discrete)	Bell
5. DB Excit (discrete)	Dynamic Brake Excit
6. EAB BC (psi)	Electronic Air Brake Cylinder
7. EAB BP (psi)	Electronic Air Brake Pressure
8. EAB Brake Handle (discrete)	Electronic Air Brake Handle
9. EAB Emer Type (discrete)	Electronic Air Brake Emergency Type
10. EAB IBS (discrete)	Electronic Air Brake Independent Brake System
11. Horn (discrete)	Horn
12. PCS Open (discrete)	Pneumatic Control Switch
13. Speed (mph)	Speed
14. Throttle (discrete)	Throttle Position

**Table A-2. Unit and discrete state abbreviations.**

<b>Unit and Discrete State Abbreviations</b>	<b>Description</b>
B1	Dynamic Brake 1
B2	Dynamic Brake 2
B3	Dynamic Brake 3
B4	Dynamic Brake 4
B5	Dynamic Brake 5
B6	Dynamic Brake 6
B7	Dynamic Brake 8
discrete	discrete
EIE	Engineer Induced Emergency
ft	feet
mph	miles per hour
psi	pounds per square inch
sm	statute miles
T1	Throttle 1
T2	Throttle 2
T3	Throttle 3
T4	Throttle 4
T5	Throttle 5
T6	Throttle 6
T7	Throttle 7
T8	Throttle 8

NOTE: For parameters with a unit description of discrete, 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.