

NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, DC 20594

March 17, 2022

Onboard Image Recorder

**Group Chairman's Factual Report
By Gerald Kawamoto**

1. EVENT

Location:	Joplin, Montana
Date:	September 25, 2021
Vehicle:	Freight Train
Registration:	AMTK 74
Operator:	Amtrak
NTSB Number:	RRD21MR017

2. GROUP

On February 1, 2022, a video group was convened virtually via Microsoft Teams.

Chairman:	Gerald Kawamoto NTSB, Electrical Engineer
Member:	James Allen Southworth NTSB, Investigator-in-Charge (IIC)
Member:	Troy Lloyd NTSB, Track Group Chairman
Member:	Richard A. Hipkind NTSB, Railroad Accident Investigator
Member:	Alice Park NTSB, Visual Accident Reconstruction Specialist
Member:	Brian Marquis USDOT Volpe Center, Chief, Structures and Dynamics Division
Member:	Brian Fransen BLET, Safety Task Force Investigator
Member:	Robert Nagel Amtrak, Deputy Division Engineer
Member:	Justin Meko Amtrak

Member: Anthony Emory
FRA, IIC

Member: Blain Luck
FRA

Member: Quinn Ligon
FRA

Member: Jim Chase
Smart Transportation Division Investigator

Member: Roy Morrison
BMW

Member: Ryan Ringelman
BNSF Railway, General Director System Safety

3. DETAILS OF INVESTIGATION

On September 30, 2021, the National Transportation Safety Board (NTSB) Vehicle Recorder Division received a forward-facing video file from the following locomotive:

Locomotive ID: **AMTK 74**
File Type: **Image file in .avi format**

3.1. Recorder Description

The video file received contained both video and audio data for 10 minutes of operation. The video started at 12:45:16 and ended at 12:55:17 embedded video time. The forward-facing video camera was mounted inside of the lead locomotive, as shown in the red circle in Figure 1. The video was sampled at 15 frames per second with a resolution of 704 x 480 pixels.



Figure 1. Location of forward-facing video camera as seen from the exterior. The camera is shown in a red circle.

3.2. Timing and Correlation

Embedded video time did not align with a standard time. Correlation to Universal Coordinated Time (UTC) was determined by comparing GPS location data embedded in the front-facing video to GPS location data from the Positive Train Control (PTC) recorded data from AMTK 74. GPS data in the video updated approximately once every 12 seconds and GPS data from the PTC recorded data updated approximately once every 5 seconds. Additional information on the PTC recorded data can be found in the Signal and Train Control Group Factual Report in the public docket. Figure 2 is a Google Earth overlay that illustrates two points, shown in red rectangles on the left and right sides of the image, where the GPS locations from the video and the PTC recorded data aligned. Video locations are depicted with a blue bubble and PTC locations are depicted with a white and black circle. The weather and lighting conditions in Google Earth are not necessarily the weather and lighting conditions at the time the data were recorded.

From 12:50:28 through 12:50:40 embedded video time, the GPS location recorded static values for latitude and longitude of 48.5582 degrees N and 110.7537 degrees W, respectively. This position corresponded to the position recorded on the PTC at 21:53:55.785 UTC, which had latitude and longitude values of 48.55824 degrees N and 110.75372 degrees W, respectively. These points are shown in the red rectangle on the right side of the image.

From 12:50:40 through 12:50:51 embedded video time, the GPS location recorded static values for latitude and longitude of 48.5582 degrees N and 110.7585 degrees W, respectively. This position corresponded to the position recorded on the PTC at 21:54:05.779 UTC, which had latitude and longitude values of 48.55817 degrees N and 110.75849 degrees W, respectively. These points are shown in the red rectangle on the left side of the image.

12:50:40 embedded video time is shown at both the data points in the red rectangles because the first 11 frames of this second correlated to the point on the right side of the image and the last four frames correlated to the point on the left side of the image. The locations indicate the locomotive was traveling from east to west.

The additional PTC data point seen in the image, which was slightly east of a North/South crossing, is shown in a red circle in Figure 2 and had a timestamp of 21:54:00.766 UTC. This point was correlated to the video by stepping through the video sequence frame-by-frame to observe when the crossing was in the camera's field-of-view (FOV) and subsequently when it was no longer in the camera's FOV. This sequence occurred during 12:50:35 embedded video time. The first frame of 12:50:35 shows the entire crossing in the center of the FOV, the fifth frame shows the crossing in the bottom half of the FOV, the ninth frame shows a portion of the crossing in the bottom of the FOV and is the last frame with the crossing in the FOV, and the tenth frame shows an image void of the crossing in the FOV. These four frames from 12:50:35 embedded video time are depicted in Figure 3. The FOV of the front-facing camera was westwardly facing.

The difference in time between embedded video time and UTC was calculated at 12:50:35 embedded video time and was 9:03:25.766 or 32,605.766 seconds. The

difference between UTC and Mountain Daylight Time (MDT) is 6 hours or 21,600 seconds. Thus, the embedded video time lags MDT (local time) by 3:03:25.766 or 11,005.766 seconds.

The time correlation between embedded video time and the event recorder was determined by observing audible sounds of the horn recorded in the audio of the .avi file and aligning those times when the “Horn” parameter read “On” in the event recorder data. This yielded an offset of 4:04:57 or 14,697 seconds. Therefore, the event recorder is ahead of MDT by 3,691.234 seconds. From this point forward, times are referenced to MDT and are rounded to the nearest second. Figure 4 is a plot of parameters from the event recorder starting at 15:55:30 MDT and ending at 15:57:00 MDT. Detailed information on the parameters from the event recorder can be found in the Locomotive Event Recorder Specialist’s Factual Report in the public docket.



Figure 2. Google Earth overlay showing aligned coordinates from video GPS and PTC GPS.

DVR Video Snapshot

V:\2021\RRD21MR017_Amtrak\10.45.16_10.55.16.avi : Locomotive AMTK 74
Sat, Sep 25, 2021, 12:50:35 PM (Eastern Daylight Time) (48.5582° N, 110.7537° W @ 78.1 mph)
Event: No event selected



Video Capture Size: 704 x 480 pixels
Video Frame Time: 9/25/2021 12:50:35 PM (Eastern Daylight Time)
Media Input Name: CAM 1
DVR Location: AMTK 74
Locomotive: AMTK 74
DVR Serial #: KB0844A093-LDVR
DVR Station ID: 0

DVR Video Snapshot

V:\2021\RRD21MR017_Amtrak\10.45.16_10.55.16.avi : Locomotive AMTK 74
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DVR Video Snapshot

V:\2021\RRD21MR017_Amtrak\10.45.16_10.55.16.avi : Locomotive AMTK 74
Sat, Sep 25, 2021, 12:50:35 PM (Eastern Daylight Time) (48.5582° N, 110.7537° W @ 78.1 mph)
Event: No event selected



Video Capture Size: 704 x 480 pixels
Video Frame Time: 9/25/2021 12:50:35 PM (Eastern Daylight Time)
Media Input Name: CAM 1
DVR Location: AMTK 74
Locomotive: AMTK 74
DVR Serial #: KB0844A093-LDVR
DVR Station ID: 0

Figure 3. First (top left), fifth (top right), ninth (bottom left), and tenth (bottom right) frames of 15:54:01 MDT (12:50:35 embedded video time) showing the FOV of the camera as it traverses a crossing.

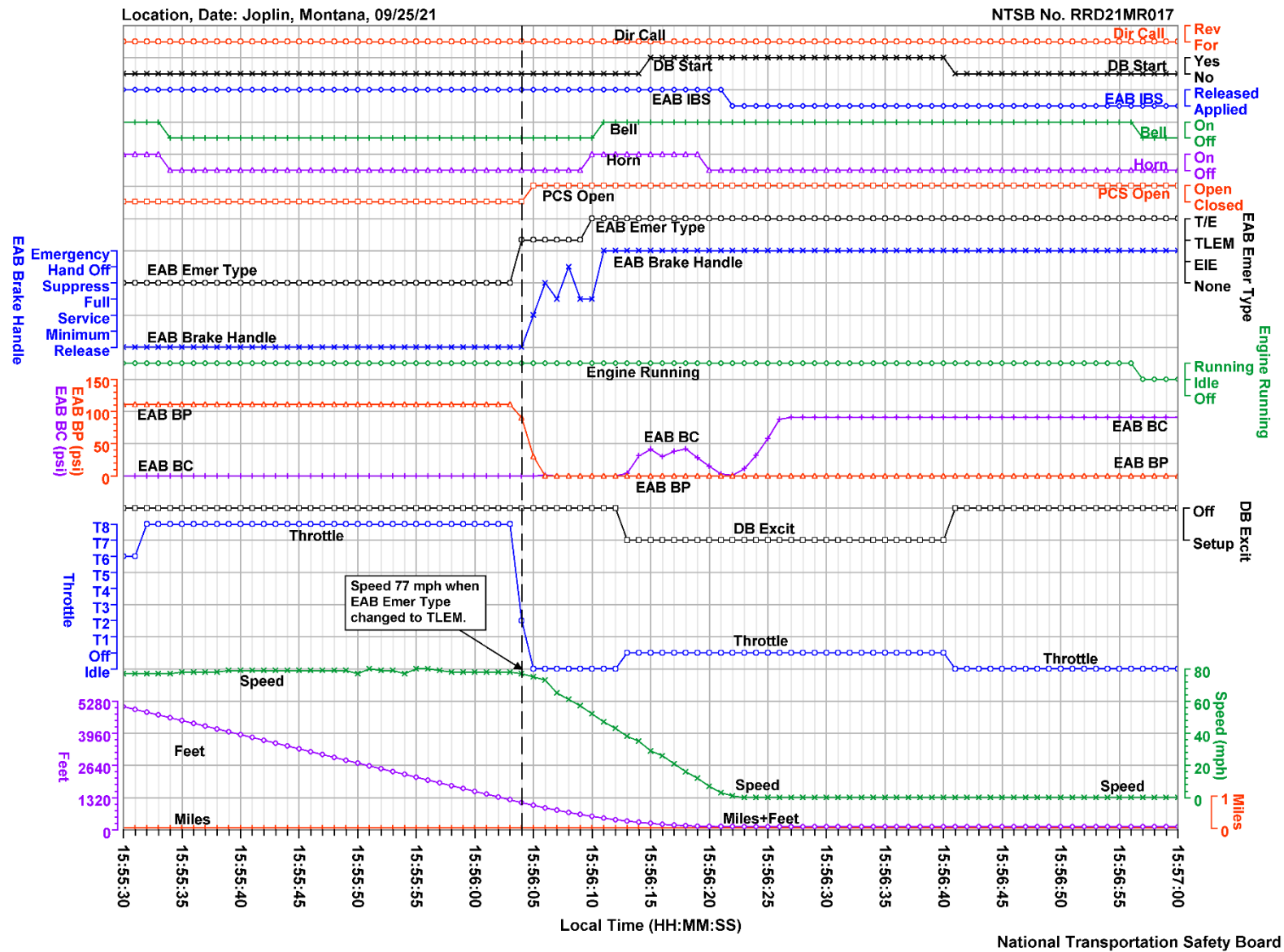


Figure 4. Plot of parameters from the event recorder.

Table 1 summarizes GPS data embedded in the video and Table 2 summarizes GPS data from the PTC recorded data associated with Figure 2. There are two data points associated with each time in Table 2 because the locomotive was equipped with two Navigation Sensor Modules to provide cross-checking and redundancy for the system. It should be noted that due to the update rate of the GPS in the video, the embedded speed values do not necessarily represent the speed and location at their corresponding time stamp.

Table 1. Video GPS data

Video GPS			
Embedded Video Time	Lat (deg)	Long (deg)	Speed (mph)
12:50:28	48.5582	-110.7537	78.1
12:50:29	48.5582	-110.7537	78.1
12:50:30	48.5582	-110.7537	78.1
12:50:31	48.5582	-110.7537	78.1
12:50:32	48.5582	-110.7537	78.1
12:50:33	48.5582	-110.7537	78.1
12:50:34	48.5582	-110.7537	78.1
12:50:35	48.5582	-110.7537	78.1
12:50:36	48.5582	-110.7537	78.1
12:50:37	48.5582	-110.7537	78.1
12:50:38	48.5582	-110.7537	78.1
12:50:39	48.5582	-110.7537	78.1
12:50:40	48.5582	-110.7537	78.1
12:50:40	48.5582	-110.7585	79.6
12:50:41	48.5582	-110.7585	79.6
12:50:42	48.5582	-110.7585	79.6
12:50:43	48.5582	-110.7585	79.6
12:50:44	48.5582	-110.7585	79.6
12:50:45	48.5582	-110.7585	79.6
12:50:46	48.5582	-110.7585	79.6
12:50:47	48.5582	-110.7585	79.6
12:50:48	48.5582	-110.7585	79.6
12:50:49	48.5582	-110.7585	79.6
12:50:50	48.5582	-110.7585	79.6
12:50:51	48.5582	-110.7585	79.6

Table 2. PTC GPS data.

PTC GPS		
Time (UTC)	Lat (deg)	Long (deg)
21:53:55.785	48.558243	-110.753718
21:53:55.785	48.558258	-110.753695
21:54:00.766	48.558208	-110.756090
21:54:00.766	48.558222	-110.756068
21:54:05.779	48.558173	-110.758485
21:54:05.780	48.558185	-110.758465

3.3. Summary of Recording Contents

The following five figures are still images exported from the video using the manufacturer's software.

3.3.1. Sequence of Events

Figure 5 is a still image of the first frame recorded at 15:55:54 MDT (12:52:28 embedded video time). The image shows the locomotive heading west into a curved portion of the track.

DVR Video Snapshot

V:\2021\RRD21MR017_Amtrak\10.45.16_10.55.16.avi : Locomotive AMTK 74

Sat, Sep 25, 2021, 12:52:28 PM (Eastern Daylight Time) (48.5575° N, 110.8090° W @ 78.4 mph)

Event: No event selected



Video Capture Size: 704 x 480 pixels

Video Frame Time: 9/25/2021 12:52:28 PM (Eastern Daylight Time)

Media Input Name: CAM 1

DVR Location: AMTK 74

Locomotive: AMTK 74

DVR Serial #: KB0844A093-LDVR

DVR Station ID: 0

Figure 5. The first frame of 15:55:54 MDT (12:52:28 embedded video time).

Figure 6 is a still image of the first frame recorded at 15:55:56 MDT (12:52:30 embedded video time). The image shows a rightward deflection in the track as shown in the red rectangle

DVR Video Snapshot

V:\2021\RRD21MR017_Amtrak\10.45.16_10.55.16.avi : Locomotive AMTK 74

Sat, Sep 25, 2021, 12:52:30 PM (Eastern Daylight Time) (48.5580° N, 110.8142° W @ 77.8 mph)

Event: No event selected



Video Capture Size: 704 x 480 pixels

Video Frame Time: 9/25/2021 12:52:30 PM (Eastern Daylight Time)

Media Input Name: CAM 1

DVR Location: AMTK 74

Locomotive: AMTK 74

DVR Serial #: KB0844A093-LDVR

DVR Station ID: 0

Figure 6. The first frame of 15:55:56 MDT (12:52:30 embedded video time).

Figure 7 is a still image of the tenth frame recorded at 15:55:56 MDT (12:52:30 embedded video time). The deflection in the track was no longer visible and the locomotive was passing over the deflected portion of the track seen in Figure 6.

DVR Video Snapshot

V:\2021\RRD21MR017_Amtrak\10.45.16_10.55.16.avi : Locomotive AMTK 74

Sat, Sep 25, 2021, 12:52:30 PM (Eastern Daylight Time) (48.5580° N, 110.8142° W @ 77.8 mph)

Event: No event selected



Video Capture Size: 704 x 480 pixels

Video Frame Time: 9/25/2021 12:52:30 PM (Eastern Daylight Time)

Media Input Name: CAM 1

DVR Location: AMTK 74

Locomotive: AMTK 74

DVR Serial #: KB0844A093-LDVR

DVR Station ID: 0

Figure 7. The tenth frame 15:55:56 MDT (12:52:30 embedded video time).

Figure 8 is a still image of the first frame recorded at 15:56:10 MDT (12:52:44 embedded video time). At this time, the horn became audible and remained audible for approximately 9 seconds. The “Horn” parameter in the event recorder data was “On” and simultaneously the “EAB Brake Handle” parameter indicated “Full.” One second later, at 15:56:11 MDT (12:52:45 embedded video time) the “EAB Brake Handle” parameter from the event recorder indicated “Emergency.”

DVR Video Snapshot

V:\2021\RRD21MR017_Amtrak\10.45.16_10.55.16.avi : Locomotive AMTK 74

Sat, Sep 25, 2021, 12:52:44 PM (Eastern Daylight Time) (48.5587° N, 110.8178° W @ 42.1 mph)

Event: No event selected



Video Capture Size: 704 x 480 pixels

Video Frame Time: 9/25/2021 12:52:44 PM (Eastern Daylight Time)

Media Input Name: CAM 1

DVR Location: AMTK 74

Locomotive: AMTK 74

DVR Serial #: KB0844A093-LDVR

DVR Station ID: 0

Figure 8. The first frame of 15:56:10 MDT (12:52:44 embedded video time).

Figure 9 is a still image of the first frame recorded at 15:56:25 MDT (12:52:59 embedded video time). At this time, the locomotive had come to rest. The value of the speed parameter from the event recorder was 0 mph.

DVR Video Snapshot

V:\2021\RRD21MR017_Amtrak\10.45.16_10.55.16.avi : Locomotive AMTK 74

Sat, Sep 25, 2021, 12:52:59 PM (Eastern Daylight Time) (48.5588° N, 110.8190° W @ 0.0 mph)

Event: No event selected



Video Capture Size: 704 x 480 pixels

Video Frame Time: 9/25/2021 12:52:59 PM (Eastern Daylight Time)

Media Input Name: CAM 1

DVR Location: AMTK 74

Locomotive: AMTK 74

DVR Serial #: KB0844A093-LDVR

DVR Station ID: 0

Figure 9. The first frame of 15:56:25 MDT (12:52:59 embedded video time).

The video file ended at 15:58:43 MDT (12:55:17 embedded video time). No further information was transcribed.