

NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division

Washington, D.C. 20594

June 3, 2021

Cockpit Display – Recorded Flight Data

Specialist's Factual Report

By W. Deven Chen

1. EVENT SUMMARY

Location: Conifer, Colorado
Date: April 3, 2021
Aircraft: Magnus Fusion 212
Registration: N434MA
Operator: Private
NTSB Number: CEN21FA177

2. RECORDED FLIGHT DATA GROUP

A recorded flight data group was not convened.

3. DETAILS OF INVESTIGATION

On April 15, 2021, the National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following electronic devices:

Device 1 Manufacturer/Model: **Dynon SV-D1000**
Serial Number: **8311**

Device 2 Manufacturer/Model: **Dynon SV-D1000**
Serial Number: **8349**

Device 3 Manufacturer/Model: **Dynon USB thumb-drive**
Serial Number: **N/A**

3.1. Devices Description

The Dynon SV-D1000 has an 11" screen with both a touchscreen and softkey interface. The device can serve as either a Primary Flight Display (PFD) or a Multifunction Display (MFD) depending on installation. The unit has a solid-state Air Data and Attitude Heading Reference System (ADAHRS) and displays aircraft parameter data including altitude, airspeed, attitude, vertical speed, and heading. The unit also has external pitot/static inputs for altitude, airspeed, and vertical speed information. The device contains an internal flash memory device. The flash memory stores information sampled every 60 milliseconds for the last two hours of flight in a file called a "Black_Box_Log," detailed alert logs that show both caution, warning and aural alerts generated by the display in a file called "Alert_Data," as well as a flight history log which is sampled at a lower rate that can record many more hours

of operation. The flight history is recorded as a file called “User_Log” and is sampled about every 250 milliseconds.

3.2. Devices Data Recovery

Figures 1 and 2 show the condition of the two Dynon SV-D1000s upon arrival at the Vehicle Recorder Division. One of the devices served as a PFD and the other device served as an MFD on the accident aircraft. The device with serial number 8311 (on the left side of Figure 1) powered on normally, and its data were downloaded using the manufacturer’s procedure. Based on past experience, the data stored on the other device (on the right side of Figure 1) would be identical, thus no download was attempted. Figure 3 shows the Dynon USB thumb-drive. This USB thumb-drive stored system and configuration data for the Dynon devices and did not contain any flight data.



Figure 1: Front view of two Dynon SV-D1000s, as received.

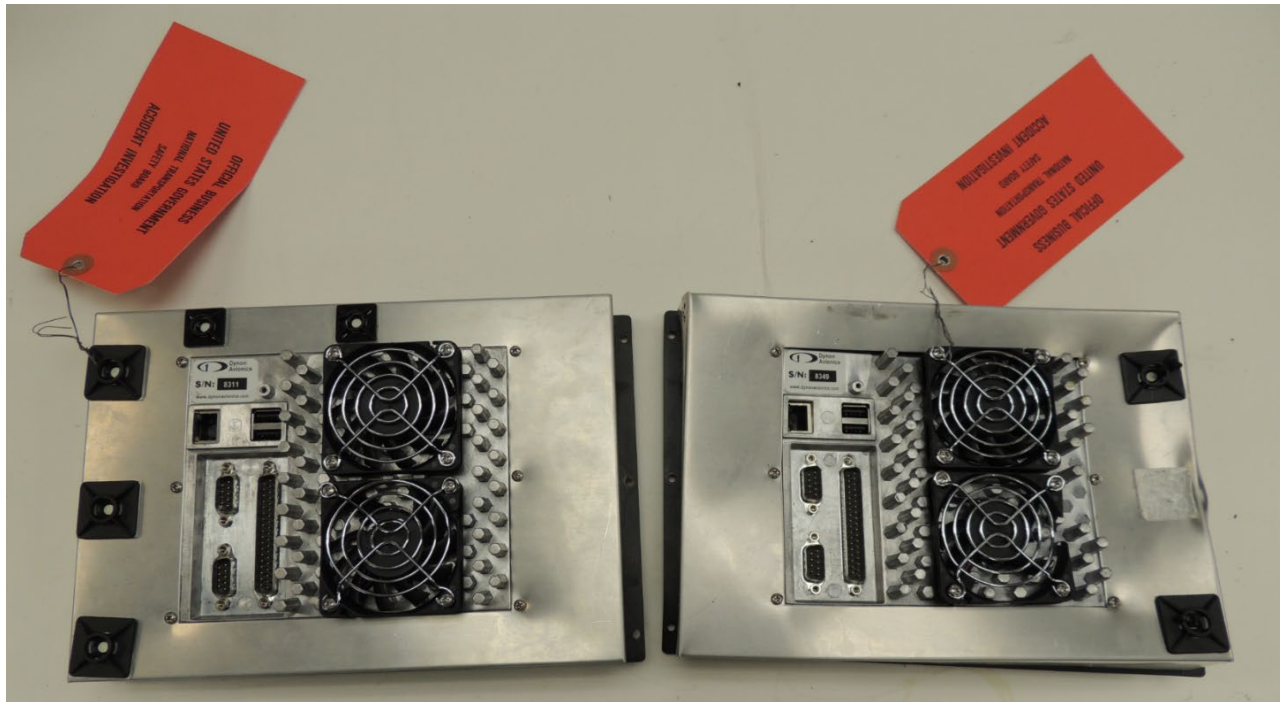


Figure 2: Back view of two Dynon SV-D1000s, as received.



Figure 3: Dynon USB thumb-drive, as received.

3.3. Devices Data Description

The recovered data contained 5 data files: one User_Log file, three Alert_Data files (Alert_Data part_01 – part_03) and one Black_Box_Log file. These 3 types of files had the first session of data recorded at different times, but all had last session recorded on April 3, 2021, which was later identified as the accident flight. The User_Log file contained data at a sampling frequency of approximately 4 data points per second, while the Black_Box_Log file contained data at a sampling frequency of approximately 16 data points per second. The Alert_Data file only contained data recorded whenever a system alert event occurred. Table 1 is a summary of the data recovered. The User_Log file contained the recording of the entire accident flight, from the takeoff to the crash, which had a duration of 49 minutes and 3 seconds. The Black_Box_Log file had the last 27 minutes and 39 seconds of the recording with the same parameters but recorded at a higher sampling frequency, as described above. The data used in this report were combined from those two data files to yield a data set recording with the entire accident flight record and with the highest sampling frequency. The Alert_Data file showed there were 3 alerts given during the accident flight. Those 3 alerts were all “TFC” and were given as audio at 16:58:51, 17:05:59 and 17:06:00. TFC stands for traffic alerts.

Table 1: Summary of recovered data.

Data File Type	First Session	Last Session timeframe on April 3, 2021	Sample Frequency
User_Log	March 17, 2021	16:46:41 – 17:35:44 MDT	~ 4 Hz
Alert_Data	January 27, 2017	16:58:51 – 17:06:00 MDT	Whenever events occurred
Black_Box_Log	April 3, 2021	17:08:05 – 17:35:44 MDT	~16 Hz

3.3.1. Time Correlation

Data were recorded in Universal Coordinated Time (UTC). All time were converted to mountain daylight time (MDT), the local time of the accident, for the rest of this report. The difference between UTC and MDT is 6 hours.

3.3.2. Parameters Provided

Table 2 shows the data parameters recovered from the devices. There was a parameter named ELEV POSITION (%), which was Elevator Trim Position in percentage with respect to the neutral or take-off position. After consulting with the manufacturer, it was determined that the measurement of this parameter was not reliable since it was a user calibrated item and the take-off position was set by the user during the calibration procedure, thus this parameter is not included in this report.

Table 2: Data Parameters.

Parameter Name	Parameter Description
Time (HH:MM:SS)	MDT for recorded data point (Hour:Minutes:Seconds)
EGT 1/2 (degF)	Exhaust Gas Temperature Location # (degrees Fahrenheit)
CHT L/R (degF)	Cylinder Head Temperature Left/right (degrees Fahrenheit)

Parameter Name	Parameter Description
OAT (degF)	Outside Air Temperature (degrees Fahrenheit)
MAP (inHg)	Manifold Pressure (inches of mercury)
RPM (rpm)	Engine Rotational Speed (revolutions per minute)
OIL T (degF)	Oil Temperature (degrees Fahrenheit)
OIL P (PSI)	Oil Pressure (pounds per square inch)
Volts (V)	Bus Voltage (Volts)
Amps(A)	Bus Load Current (amperes)
Lateral Accel (g)	Lateral Acceleration (g)
Vertical Accel (g)	Vertical Acceleration (g)
Pitch (deg)	Pitch (degrees)
Roll (deg)	Roll (degrees)
Ground Speed (kt)	Average groundspeed between current and previous data point (knots)
Indicated Airspeed (kt)	Airspeed read from airspeed indicator onboard (knots)
True Airspeed (kt)	Airspeed corrected for temperature and pressure altitude (knots)
Vertical Speed (ft/min)	Aircraft vertical speed (feet per minute)
Ground Track (deg)	Path on the surface of the Earth directly below aircraft (degrees)
Magnetic Heading (deg)	Direction relative to magnetic north (degrees)
GPS Altitude (ft)	Geometric altitude above Mean Sea Level (feet)
Pressure Altitude (ft)	Altitude recorded at a 29.92 inHg pressure setting (feet)
Density Altitude (ft)	Altitude corrected for nonstandard temperature variations (feet)
Turn Rate (deg/s)	Aircraft turn rate (degree per second)
Wind Direction (deg)	Measured wind direction (degrees)
Wind Speed (kt)	Measured wind speed (knots)

3.3.3. Plots and Corresponding Tabular Data

The following ten figures contain data recorded on the Dynon devices on April 3, 2021. Figures 4 through 9 show parameters plots and figures 10 through 13 show Google Earth overlays of the accident flight.

Figure 4 is a plot of the engine parameters for the entire accident flight. The time interval displayed is 16:45:00 to 17:40:00 MDT.

Figures 5 and 6 show the plots of the engine parameters for the last 5 minutes and last 90 seconds of the accident flight.

Figure 7 is a plot of the operational parameters for the entire accident flight. The time interval displayed is 16:45:00 to 17:40:00 MDT.

Figures 8 and 9 show the plots of the operational parameters for the last 5 minutes and last 90 seconds of the accident flight.

Figure 10 is a Google Earth overlay of the entire accident flight recorded on April 3, 2021. It shows the aircraft entered mountainous terrain around 17:19:44 MDT. The weather and lighting conditions in Google Earth are not necessarily the weather and lighting conditions present at the time of the recording.

Figure 11 is a Google Earth overlay of the beginning of the accident flight. It shows the aircraft took off the Runway 8 at Colorado Air and Space Port around 16:58:07 MDT, then it turned to the right and headed south around 16:58:44 MDT.

Figure 12 is a Google Earth overlay of the final portion of the accident flight. It shows the aircraft was maneuvering over mountain terrain. The reported wreckage location is shown with a red pin.

Figure 13 is a Google Earth overlay of the final portion of the accident flight viewed at a different angle. It shows the aircraft was flying along the valley, then at around 17:35:25 MDT, it turned to the right toward the higher terrain.

The corresponding tabular data used to create figures 4 through 13 are provided in electronic comma-delimited (.csv) format as Attachment 1 to this report. The Alert_Data file is provided in (.csv) format as Attachment 2 to this report. Not every additional parameter in the attachments have been validated by the specialist.

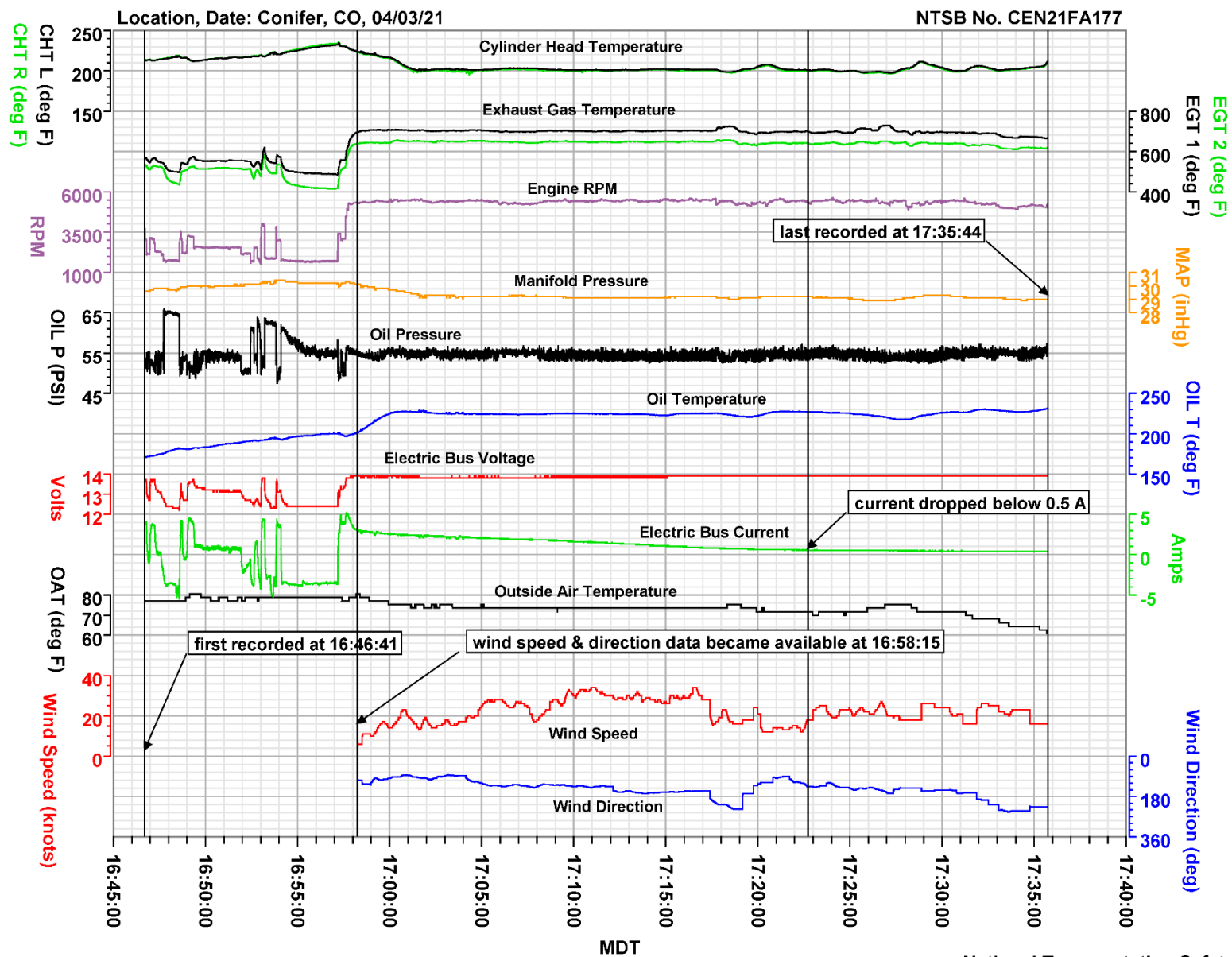


Figure 4: Plot of engine parameters for the entire accident flight recorded on April 3, 2021.

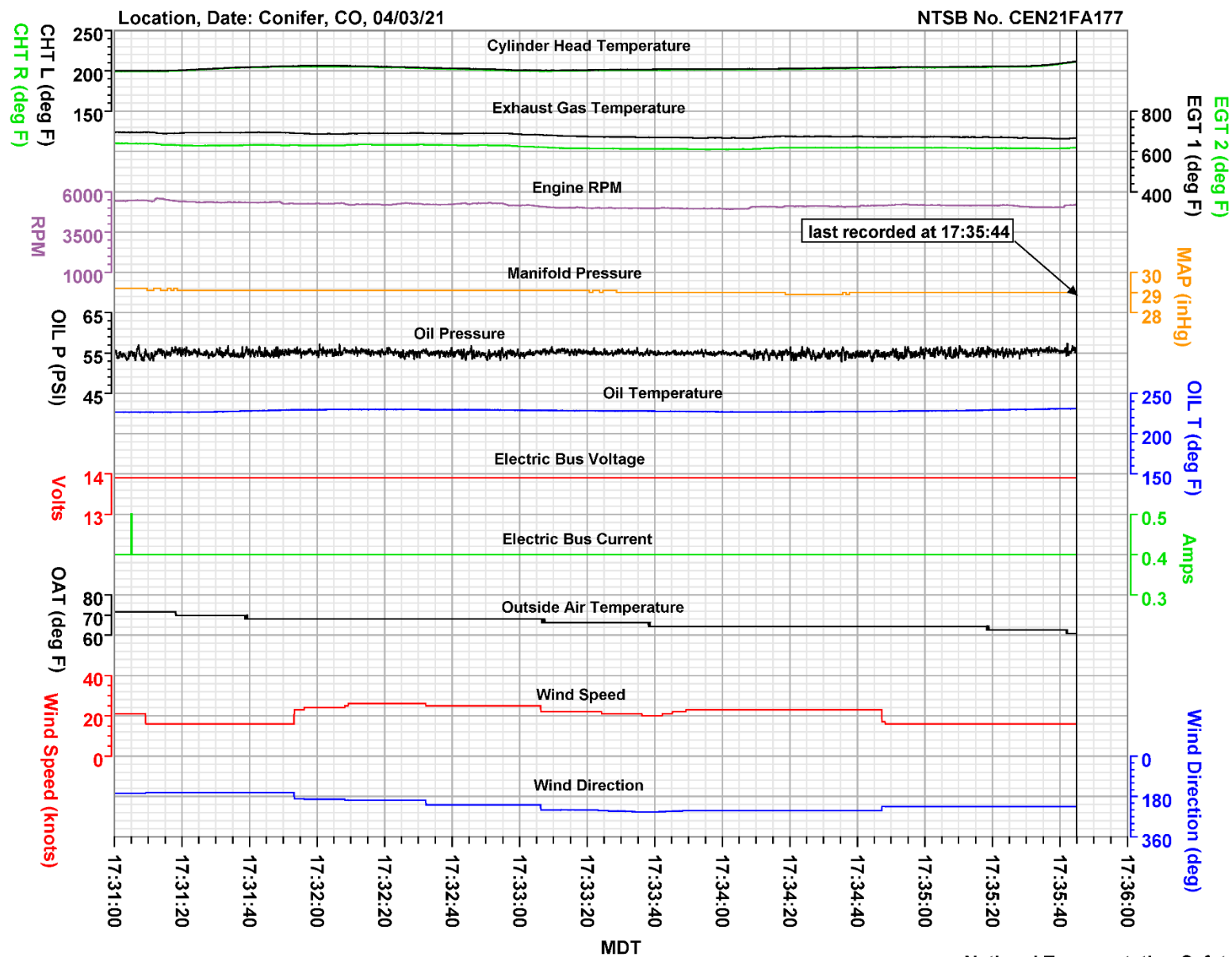
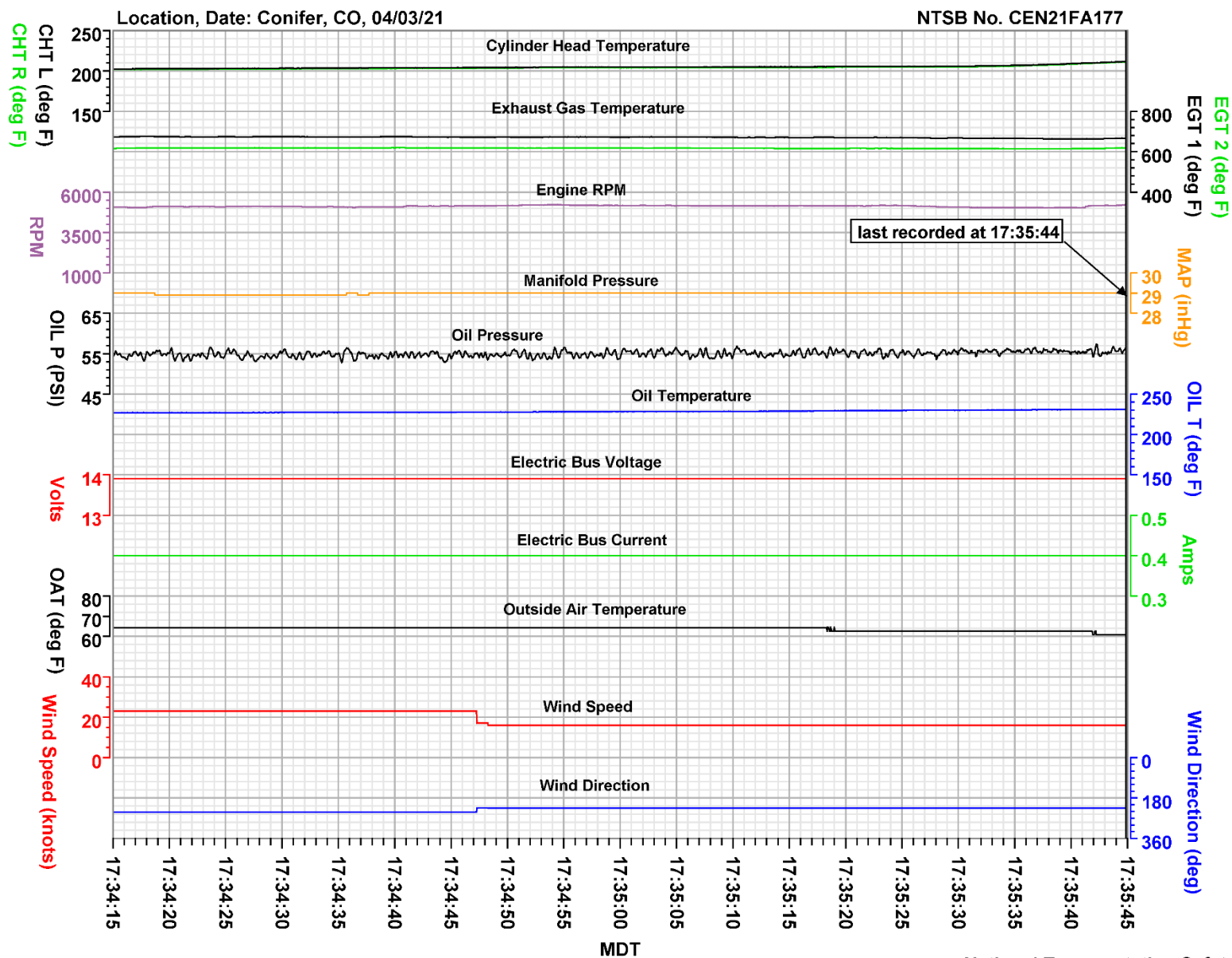


Figure 5: Plot of engine parameters for the last 5 minutes portion of the accident flight.



National Transportation Safety Board

Figure 6: Plot of engine parameters for the last 90 seconds portion of the accident flight.

CEN21FA177

Cockpit Display Factual Report, Page 9 of 16

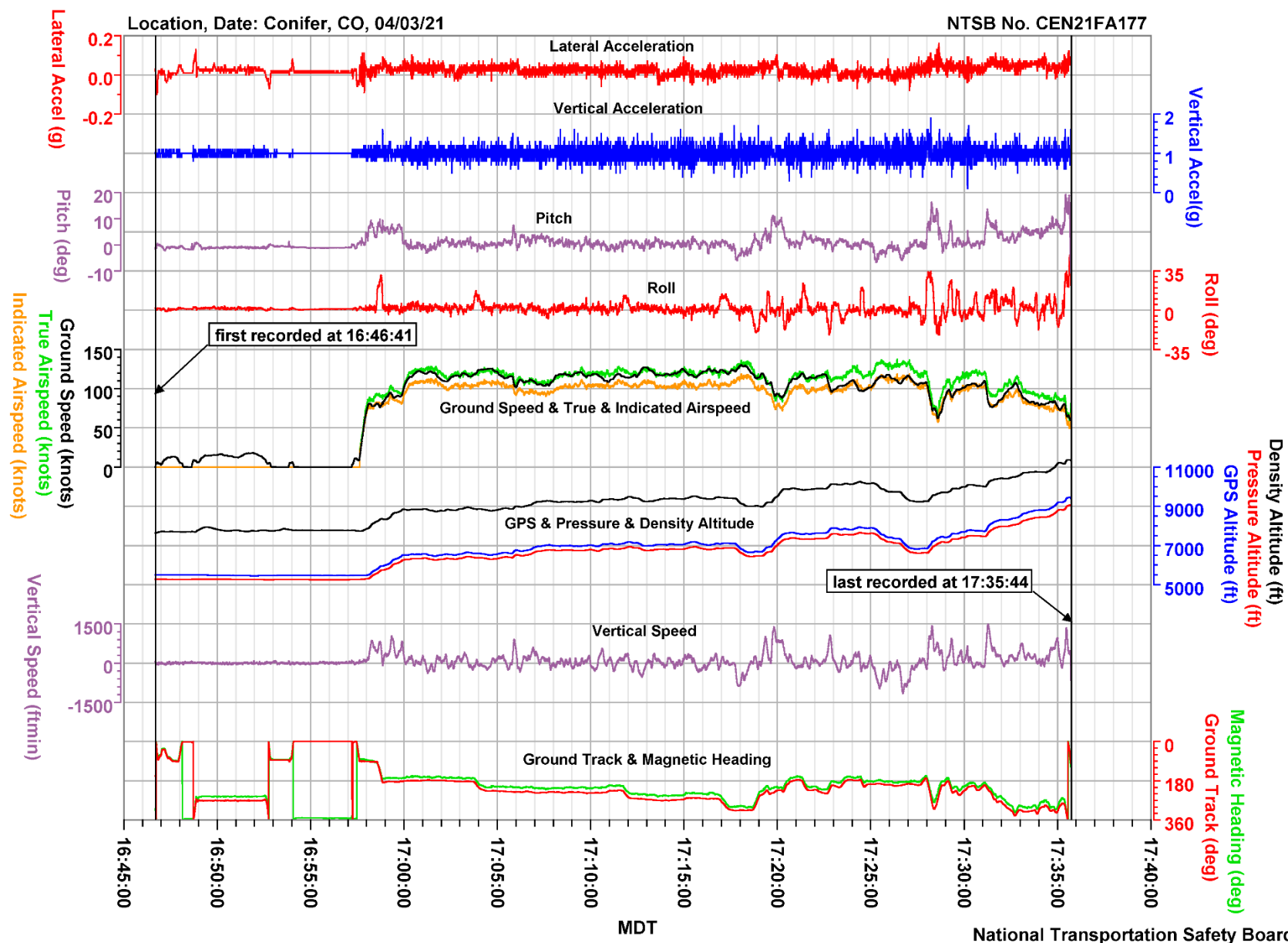


Figure 7: Plot of operational parameters for the entire accident flight recorded on April 3, 2021.

National Transportation Safety Board

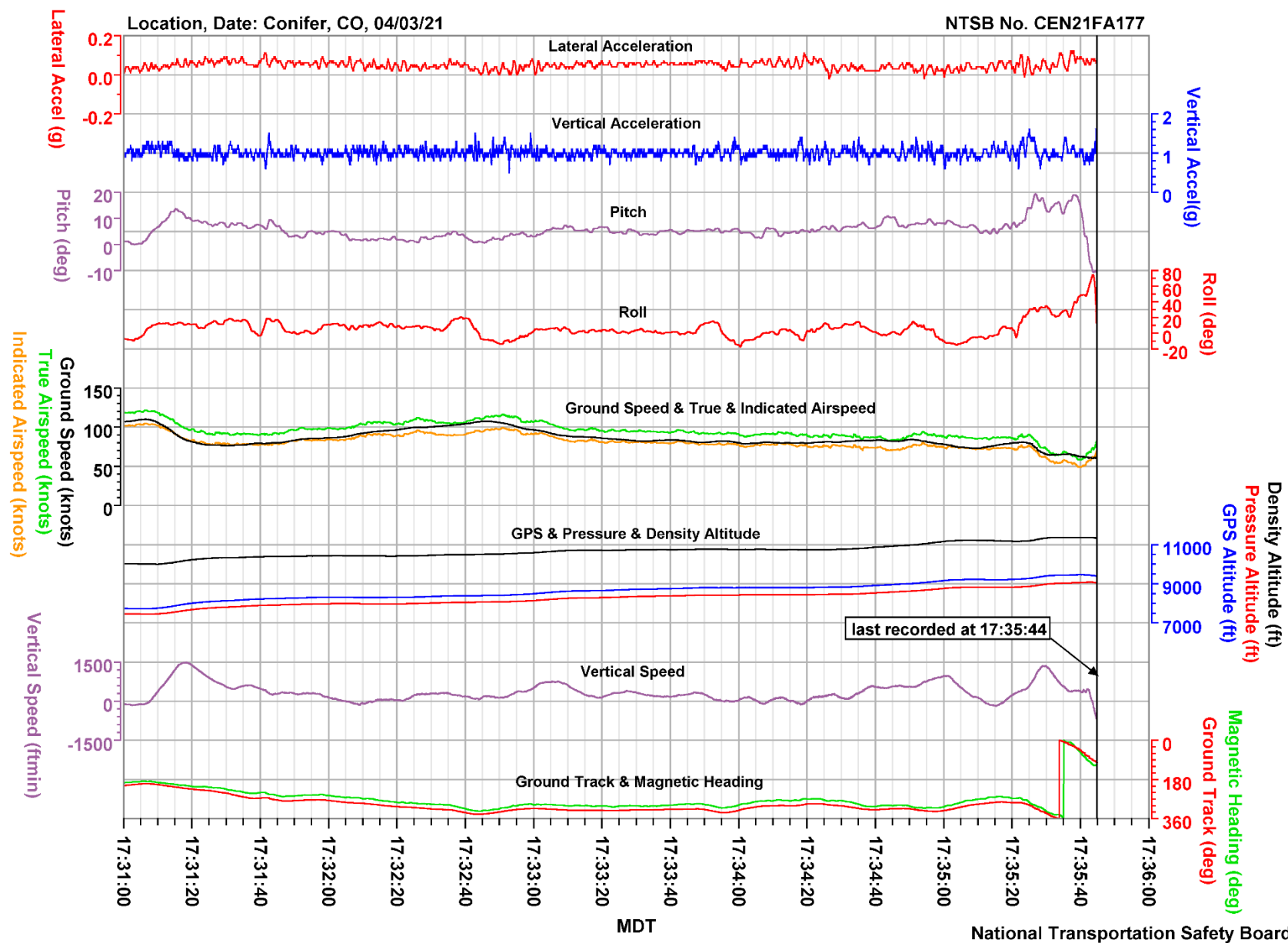


Figure 8: Plot of operational parameters for the last 5 minutes portion of the accident flight.

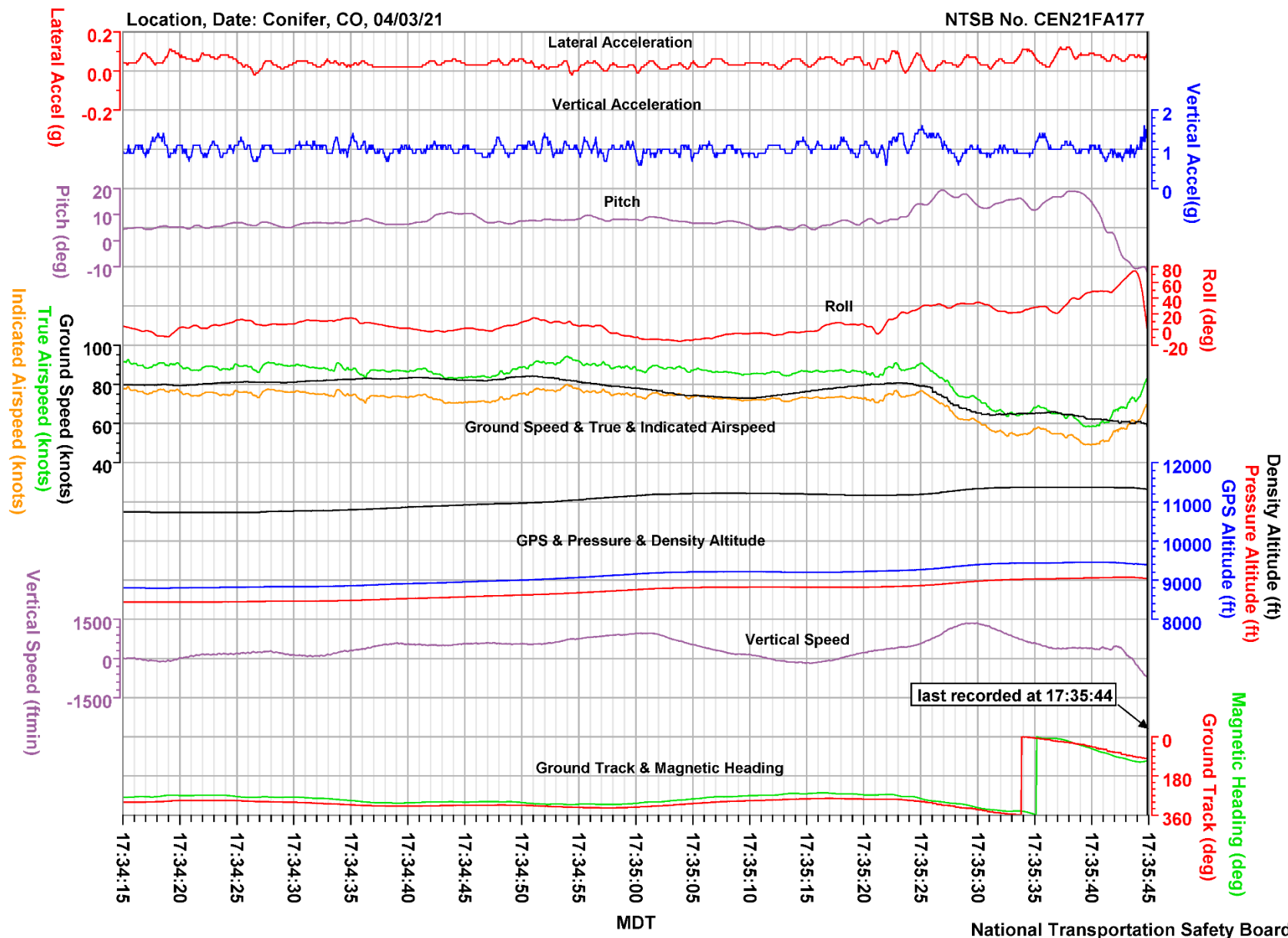


Figure 9: Plot of operational parameters for the last 90 seconds portion of the accident flight.

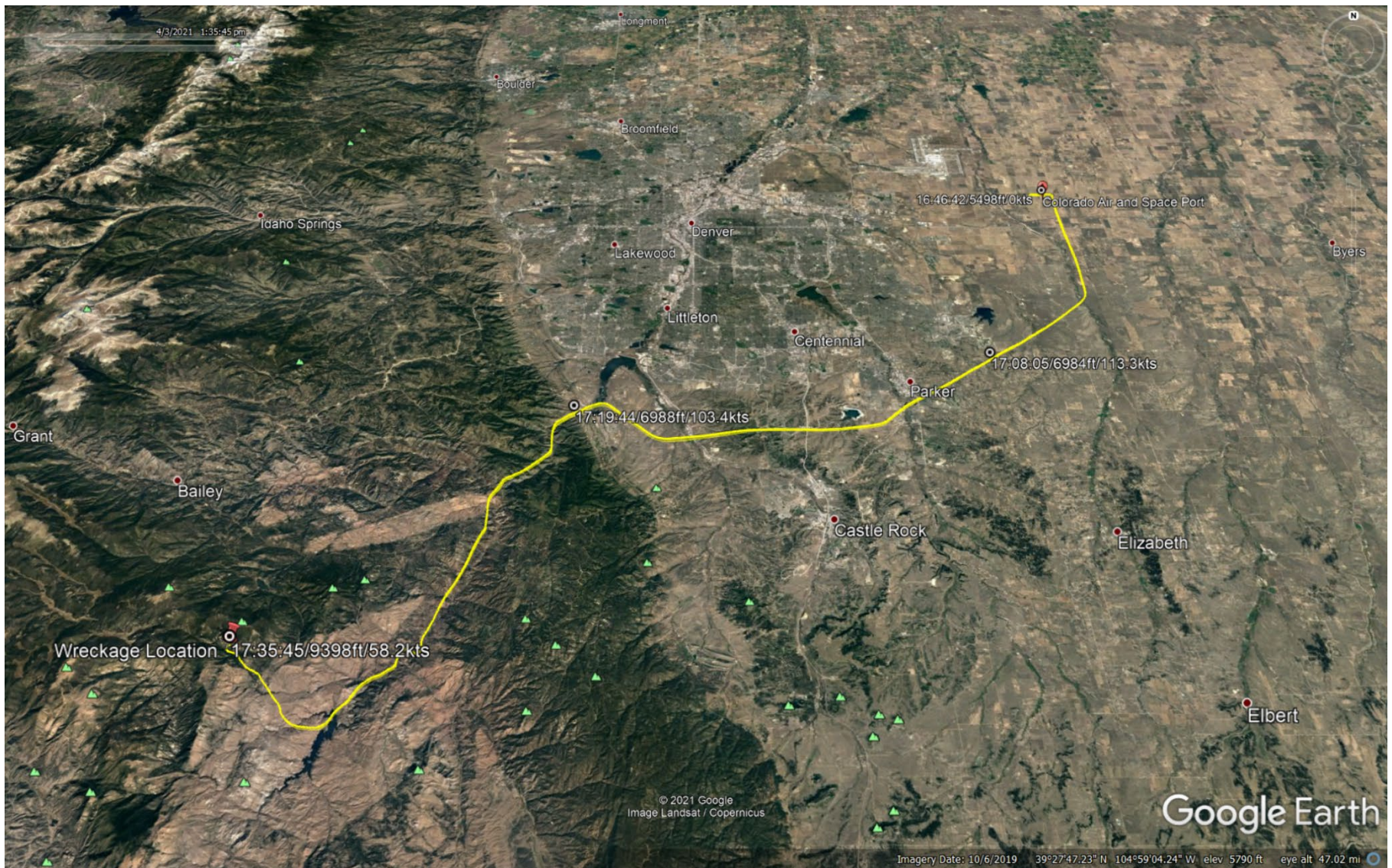


Figure 10: Google Earth overlay of the entire accident flight.



Figure 11: Google Earth overlay of the beginning of the accident flight.

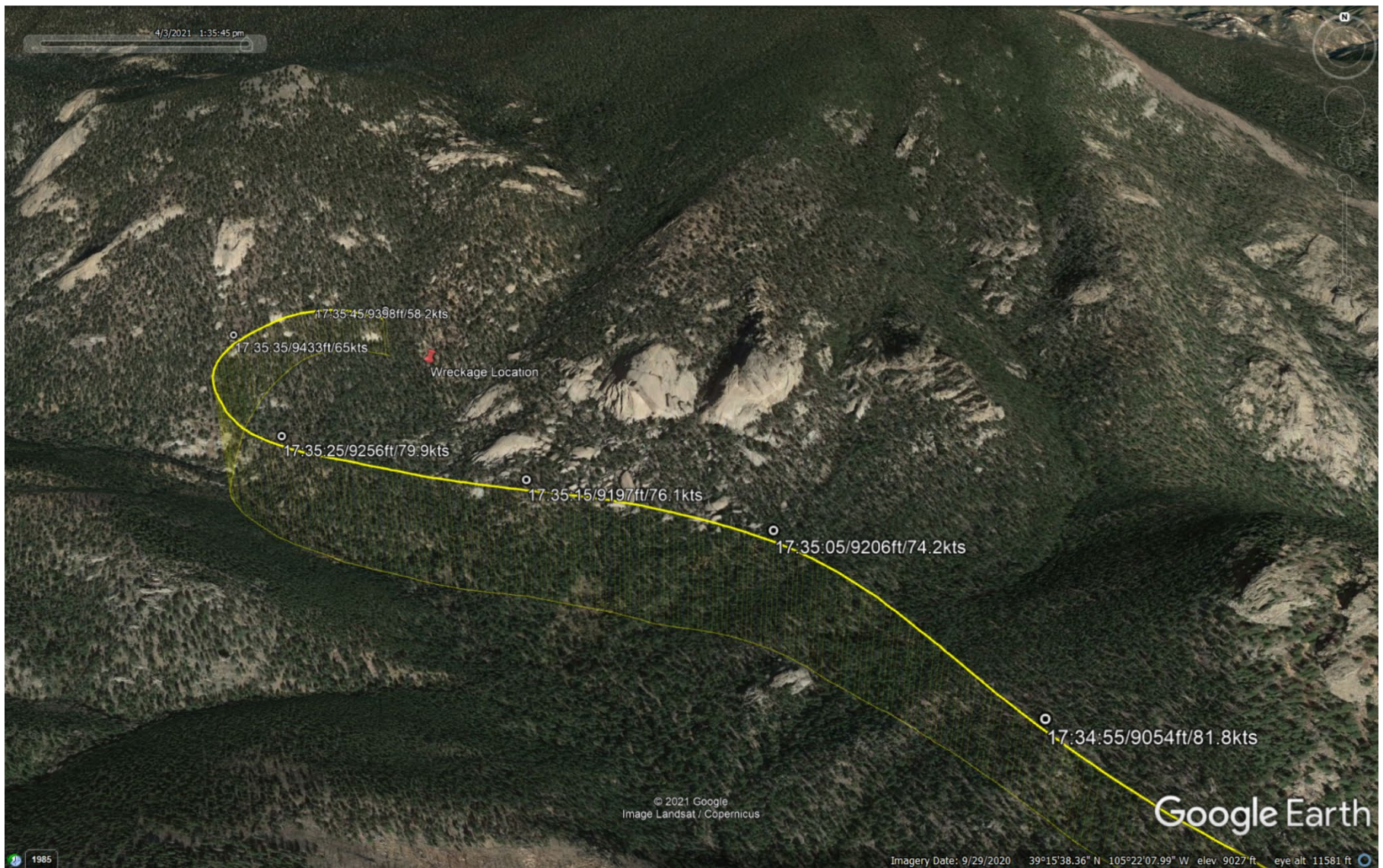


Figure 12: Google Earth overlay of the final portion of the accident flight with north up view.



Figure 13: Google Earth overlay of the final portion of the accident flight.