

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

January 2, 2018

Cockpit Displays – Recorded Flight Data

Specialist's Factual Report
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1. EVENT SUMMARY

Location: Bartow, Florida
Date: June 11, 2017
Aircraft: Cirrus SR22
Registration: N592BC
Operator: Private
NTSB Number: ERA17LA201

On June 11, 2017, about 1200 eastern daylight time, a Cirrus SR22, N592BC, was substantially damaged when it impacted a power pole, trees, and terrain while on approach to Bartow Municipal Airport (BOW), Bartow, Florida. The private pilot, who was also the owner of the airplane was seriously injured. Visual meteorological conditions prevailed and no flight plan was filed for the flight which departed Gainesville Regional Airport (GNV) about 1120. The personal flight was conducted under the provisions of 14 *Code of Federal Regulations* Part 91.

2. RECORDED FLIGHT DATA GROUP

A recorded flight data group was not convened.

3. DETAILS OF INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following devices:

Recorder Manufacturer/Model: **Avidyne Autopilot DFC-90**
Recorder Serial Number: **1026A73782**

Recorder Manufacturer/Model: **Avidyne PFD**
Recorder Serial Number: **24231144**

Recorder Manufacturer/Model: **Avidyne MFD Compact Flash Card**
Recorder Serial Number: **Not applicable**

The Avidyne Autopilot DFC-90 records some historical information. In agreement with the Investigator-in-Charge, it was decided the data from the autopilot was not necessary for this investigation.

3.1. Avidyne Primary Flight Display (PFD) Description

The PFD unit includes 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 PFD unit has external pitot/static inputs for altitude, airspeed, and vertical speed information. Each PFD contains two flash memory devices mounted on a riser card. The flash memory stores information the PFD unit uses to generate the various PFD displays. Additionally, the PFD has a data logging function, which is used by the manufacturer for maintenance and diagnostics. Maintenance and diagnostic information recording consists of system information, event data and flight data.

The PFD samples and stores several data streams in a sequential fashion; when the recording limit of the PFD is reached, the oldest record is dropped and a new record is added. Data from the Attitude/Heading Reference System (AHRS) is recorded at a rate of 5 Hz. Air data information such as pressure altitude, indicated airspeed, and vertical speed are recorded at 1 Hz. Global Positioning System (GPS) and navigation display and setting data are recorded at a rate of 0.25 Hz, and information about pilot settings of heading, altitude, and vertical speed references are recorded when changes are made.

3.1.1. PFD Data Recovery

The recorder was in good condition and the data were downloaded using the manufacturers' procedure.

3.1.2. PFD Data Description

The PFD recording contained records of 31 power cycles between March 5, 2017 and June 11, 2017. The accident flight was the last valid recording on the PFD. Timing of the PFD data is measured in seconds from power-on.

3.1.3. PFD Engineering Units Conversions

Conversion of the PFD data from the raw recorded information to engineering units is performed using conversions developed by the NTSB.

Where applicable, changes to the conversions have been made to ensure the parameters conform to the Safety Board's standard sign convention that climbing right turns are positive (CRT=+).¹

Appendix A lists the PFD parameters verified and provided in this report.

3.2. Avidyne Multi-Function Display (MFD) Description

The MFD unit is able to display the pilot checklist, terrain/map information, approach chart information and other aircraft/operational information depending on the specific configuration and options that are installed. One of the options available is a display of comprehensive engine monitoring and performance data.

¹ CRT=+ means that for any parameter recorded that indicates a climb or a right turn, the sign for that value is positive. Also, for any parameter recorded that indicates an action or deflection, if it induces a climb or right turn, the value is positive. Examples: Right Roll = +, Left Aileron Trailing Edge Down = -, Right Aileron Trailing Edge Up = +, Pitch Up = +, Elevator Trailing Edge Up = +.

Each MFD contains a compact flash (CF) memory card located in a slot on the side of the unit. This memory card contains all of the software that the MFD needs to operate. Additionally, this card contains all of the checklist, approach charts, and map information that the unit uses to generate the various cockpit displays.

During operation, the MFD display receives information from several other units that are installed on the aircraft. Specifically, the MFD receives GPS position, time and track data from the aircraft's GPS receiver. The MFD may also receive information from the aircraft concerning altitude, engine and electrical system parameters, and outside air temperature. This data is also stored on the unit's CF memory card.

The MFD generates new data files for each MFD power-on cycle. The oldest file is dropped and replaced by a new recording once the storage limit has been reached. MFD data are sampled every six seconds, and is recorded to memory once every minute. If an interruption of power occurs during the minute between MFD memory write cycles, data sampled during that portion of a minute are not recorded.

3.2.1. MFD Data Recovery

The recorder was in good condition and the data were downloaded using the manufacturer's procedure.

3.2.2. MFD Data Description

The MFD CF card contained 125 data files from April 22, 2016 through June 11, 2017. The last data file was identified as recording during the accident flight.

3.2.3. MFD Engineering Units Conversions

The data files downloaded from the MFD are in engineering units.

Appendix B lists the MFD parameters verified and provided in this report.

3.3. Time Correlation

Correlation of the PFD data to Universal Coordinated Time (UTC) was established using the recorded GPS time parameter from the PFD data. Recorded GPS time is updated in 6 second intervals on the PFD.² The GPS time is recorded in UTC. The PFD starts recording when power is applied to the unit. Each power cycle the timing begins at 0 seconds and the PFD data is measured in seconds from power-on. An offset is applied to each power cycle plotted to display the data in UTC. Therefore, for the rest of this report, all times are referenced as UTC, not recorded time.

MFD data was recorded in Universal Coordinated Time (UTC) and no conversion was applied.

² GPS information is recorded at 4 second (0.25 Hz) intervals; however it is possible to have the same UTC time recorded in consecutive GPS data records due to the 6 second update rate of the GPS time parameter.

3.4. Plots and Corresponding Tabular Data

Google Earth was used to create geographic overlays of the PFD data. Weather and lighting conditions shown in Google Earth may not be representative of the conditions at the time of the accident flight.

Figures 1 through 4 show geographical overlays of the accident flight. Figure 5 shows a plot of PFD data. Figures 6 and 7 show a plot of MFD data. Collectively these figures show:

- The recording began at 15:07:18 UTC at GNV, the aircraft was taxiing by 15:15:36 UTC, and by 15:19:30 UTC, the aircraft had departed.
- The aircraft climbed to 3,500 feet and cruised at that altitude until about 15:52:30 UTC, when it began to descend.
- By 15:55:30 UTC, the aircraft leveled off at about 1,500 feet.
- At 15:58:12 UTC, the manifold pressure and fuel flow increased slightly.
- By 16:03:54 UTC, all engine parameters began to show a loss of power.
- By 16:04:28 UTC, the aircraft began a descent.
- By 16:05:22 UTC, the indicated airspeed began to decrease.
- At 16:06:57 UTC, the indicated airspeed decreased to 0 knots, and remained at that value until the end of the recording at 16:11:08 UTC.

The corresponding tabular data used to create these 7 figures are provided in electronic (*.csv³) format as attachment 1 (PFD) and attachment 2 (MFD) to this report.

³ Comma Separated Value format.

Figure 1. Geographic overlay of entire flight.



Figure 2. Geographic overlay of start of recording.

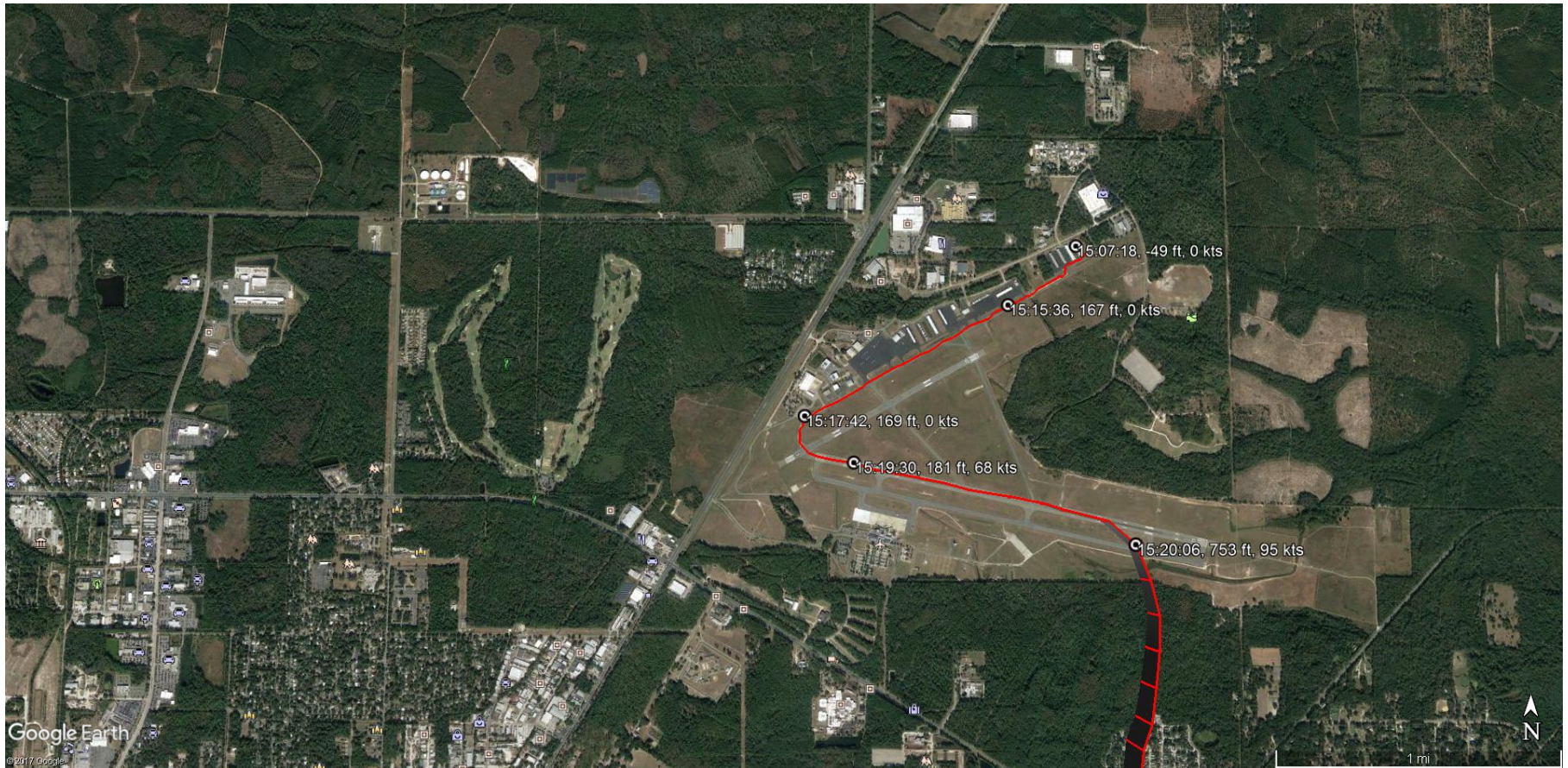


Figure 3. Geographic overlay of descent until end of recording.



Figure 4. Geographic overlay of end of recording.



Figure 5. Plot of PFD parameters for entire accident flight.

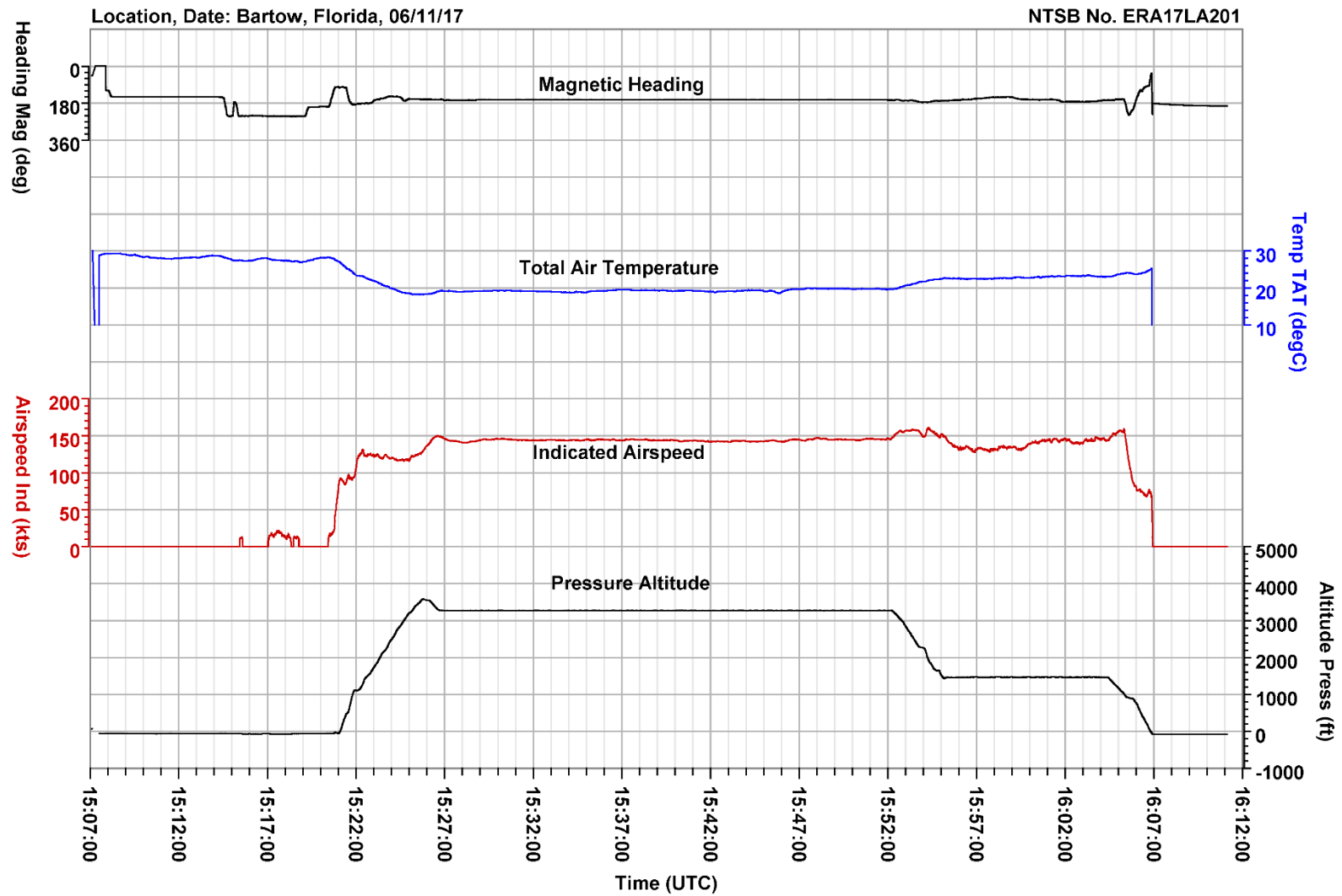


Figure 6. Plot of MFD parameters for entire accident flight.

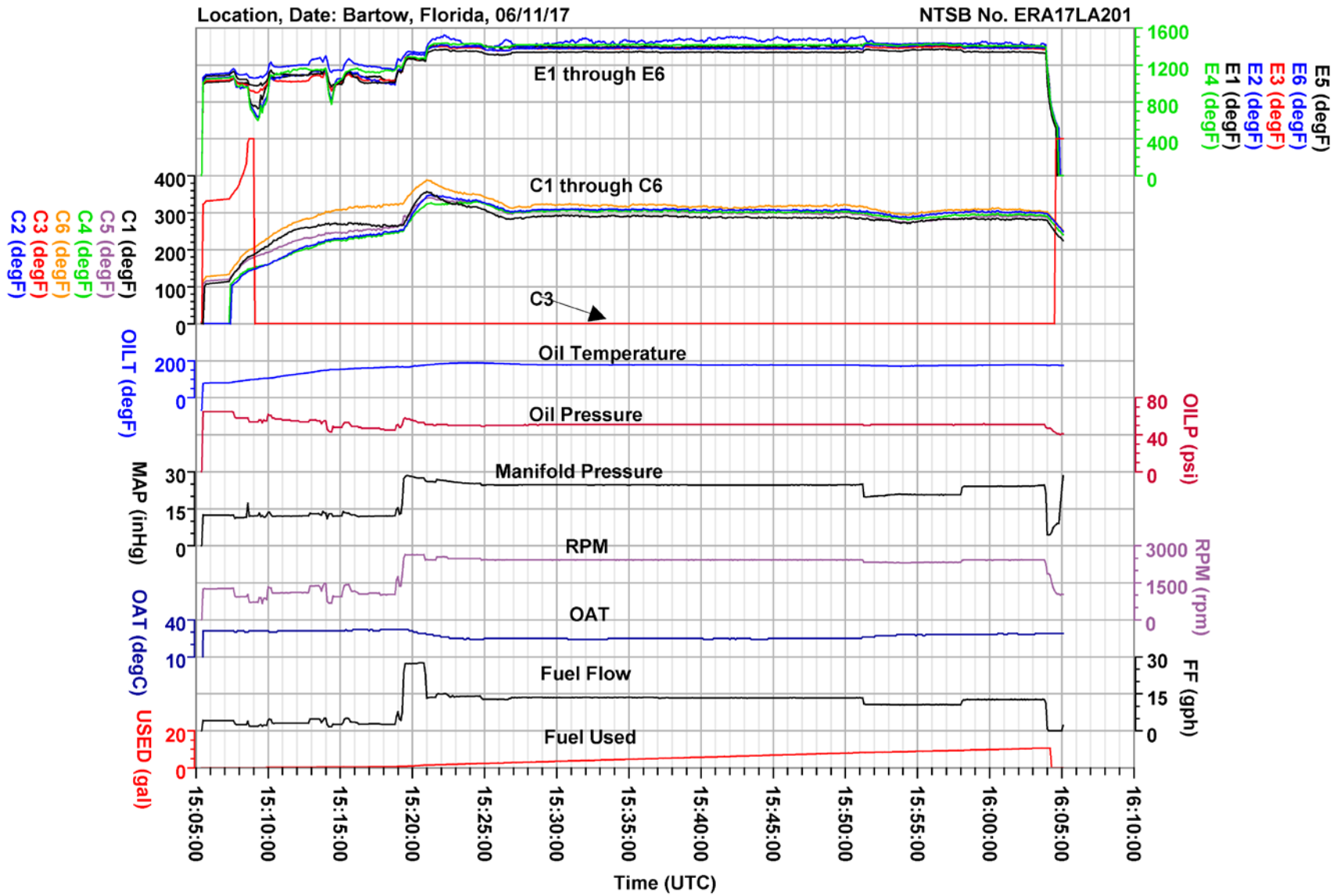
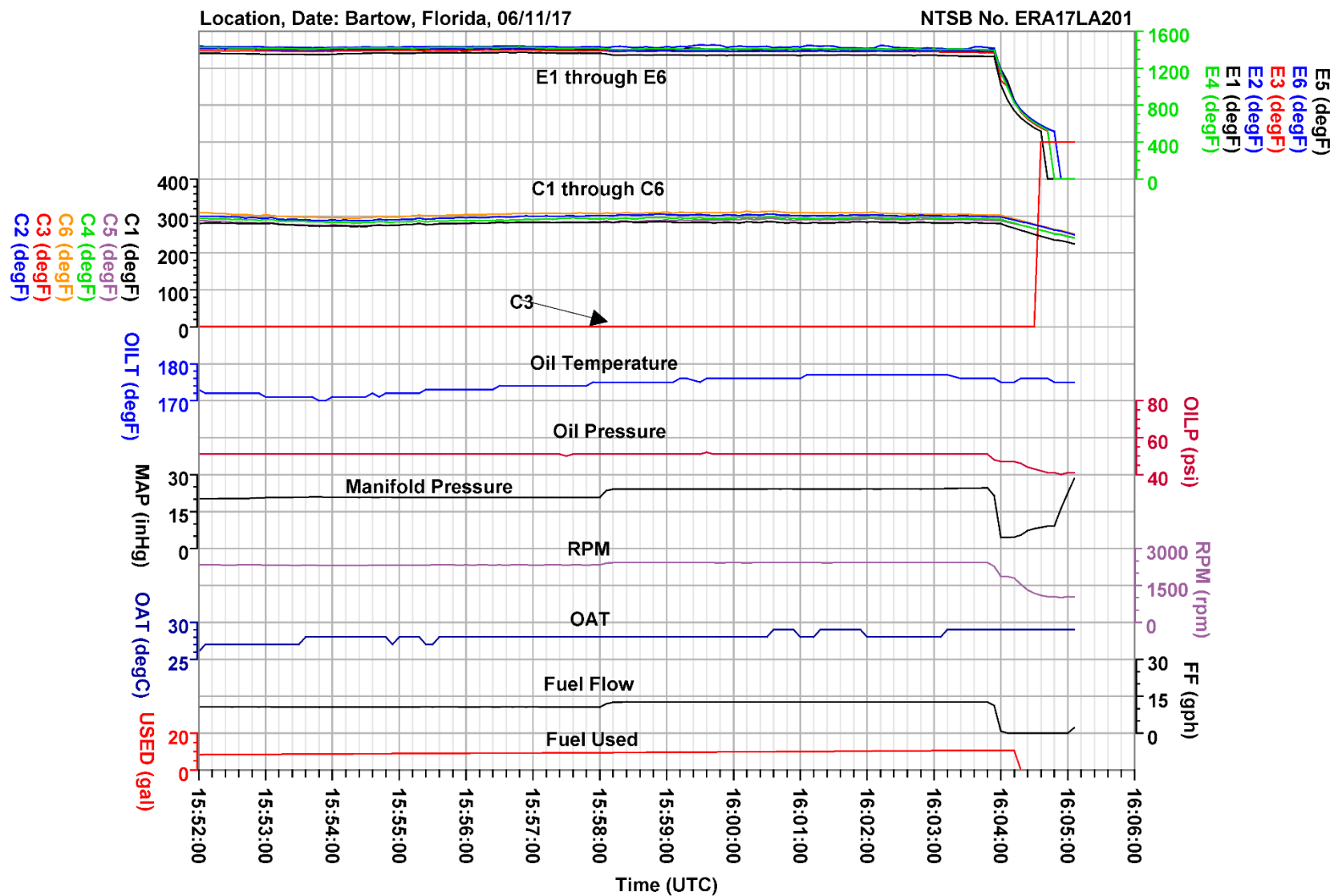


Figure 7. Plot of MFD parameters for end of accident flight.



APPENDIX A - PFD Parameters

This appendix describes the parameters provided and verified in this report. Table A-1 lists the PFD parameters and table A-2 describes the unit abbreviations used in this report for PFD parameters.

Table A-1 - Verified and provided parameters.

Parameter Name	Parameter Description
Airspeed Ind (kts)	Indicated Airspeed
Altitude Press (ft)	Pressure Altitude
Magnetic Heading (deg)	Heading
Latitude (deg)	Latitude
Longitude (deg)	Longitude
Temp TAT (deg)	Temp TAT
Time - Day (day)	Time - Day
Time - Month (month)	Time - Month
Time - Year (year)	Time - Year
Time UTC Hrs (hr)	Time UTC Hrs
Time UTC Min (min)	Time UTC Min
Time UTC Sec (sec)	Time UTC Sec

The PFD records pressure altitude, which is based on a standard altimeter setting of 29.92 inches of mercury (in Hg). The barometric correction is also recorded by the PFD. In this report, barometric altitude in feet, Mean Sea Level, is calculated using the pressure altitude and the barometric correction using the following formula for plotting in Google Earth:

$$Altitude_{Baro} (ft\ MSL) = Altitude_{Pressure} (ft) + (Baro\ Correction\ (inHg) - 29.92\ (inHg)) \times 924.82\ (ft/inHg)$$

Table A-2 - Unit abbreviations.

Units Abbreviation	Description
day	day
deg	degrees
degC	degrees Celsius
ft	feet
hr	hours
kts	knots
min	minutes
month	month
sec	seconds
year	year

APPENDIX B - MFD Parameters

This appendix describes the parameters provided and verified in this report. Table B-1 lists the MFD parameters and table B-2 describes the unit abbreviations used in this report for MFD parameters.

Table B-1 - Verified and provided parameters.

Parameter Name	Parameter Description
C# (degF)	Cylinder Head Temperature Cylinder # ⁴ (degrees Fahrenheit)
E# (degF)	Exhaust Gas Temperature Cylinder # ⁴ (degrees Fahrenheit)
FF (gph)	Fuel Flow (gallons per hour)
USED (gal)	Fuel Used (gallons)
MAP (inHg)	Manifold Pressure (inches of mercury)
OILP (psi)	Oil Pressure (pounds per square inch)
OILT (degF)	Oil Temperature (degrees Fahrenheit)
RPM (rpm)	Revolutions Per Minute (revolutions per minute)
OAT (degC)	Outside Air Temperature (degrees Celsius)

The MFD records pressure altitude, which is based on a standard altimeter setting of 29.92 inches of mercury (in Hg). The pressure altitude information presented in the plots and in the electronic data has not been corrected for the local altimeter setting at the time of the event.

Table B-2 - Unit abbreviations.

Units Abbreviation	Description
degC	degrees Celsius
degF	Degrees Fahrenheit
gal	gallons
gph	gallons per hour
inHg	inches of Mercury
psi	pounds per square inch

⁴ Depending on aircraft configuration, the number of cylinders that are instrumented varies. In the data plots the '#' is replaced with the appropriate cylinder ID.