

NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division

May 2, 2019

Cockpit Displays – Recorded Flight Data

Specialist's Factual Report
By Maryam Gracias

1. EVENT SUMMARY

Location: Brinnon, Washington
Date: April 2, 2017
Aircraft: Cirrus SR22
Registration: N167CB
Operator: The Flight Academy
NTSB Number: WPR17LA084

On April 2, 2017, at 1529 Pacific daylight time (PDT), a Cirrus Design Corporation SR22, N167CB, impacted mountainous terrain near Mount Christie, in Jefferson County, Washington. The airplane was operated by The Flight Academy under the provisions of 14 *Code of Federal Regulations* (CFR) Part 91. The certified flight instructor (CFI) and student pilot sustained serious injuries. The airplane sustained substantial damage during the accident sequence. The instructional flight departed Langley, Washington, about 1500. Visual meteorological conditions prevailed, and no flight plan had been filed.

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 electronic devices:

Recorder Manufacturer/Model: **Avidyne PFD**
Recorder Serial Number: **20540094**

Recorder Manufacturer/Model: **Avidyne MFD (CF Card Only)**
Recorder Serial Number: **N/A**

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 manufacturer's procedure.

3.1.2. PFD Data Description

The download files contained data from July 11, 2016, through the accident flight.

3.1.3. PFD Engineering Units Conversions

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 can 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.

Each MFD contains a compact flash (CF) memory card located in a slot on the side of the unit. This memory card contains all the software that the MFD needs to operate. Additionally, this card contains all 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.

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 = +.

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 download contained data from 87 power cycles from May 21, 2016, through April 2, 2017. The data captured 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

The data was recorded in Universal Coordinated Time (UTC). The difference between PDT and UTC is seven hours. The incident flight data has been offset from recorded MFD and PFD time to PDT by subtracting seven hours.

3.4. Plots and Corresponding Tabular Data

Figures 1 and 2 show the aircraft flight path over a Google Earth terrain model. Lighting and visual conditions are not representative of the accident day. Figure 3 shows PFD and MFD data plotted over the accident flight. PFD data was not recorded between 15:01:24 PDT and 15:11:38 PDT.

When the PFD data started recording again after takeoff, the aircraft was flying southwest over Puget Sound at about 1700 feet pressure altitude. At 15:18, the aircraft turned to the left on a south-southwesterly course. At 15:20:30, the aircraft turned to the west and crossed the shoreline over land at Brinnon, WA, and began flying generally along the Dosewallips River at about 1600 feet. At 15:23, the aircraft began climbing. At 15:26, the aircraft was about 2400 feet altitude and initiated a left turn, flying along Hungry Creek. At 15:28:13, the data was consistent with the aircraft striking terrain at about 5400 feet pressure altitude.

The corresponding tabular data used to Figures 1-3 are provided in electronic (*.csv²) format as Attachment 1 to this report.

² Comma Separated Value format.



Figure 1. Overview of flight path of last 10 minutes of accident flight.

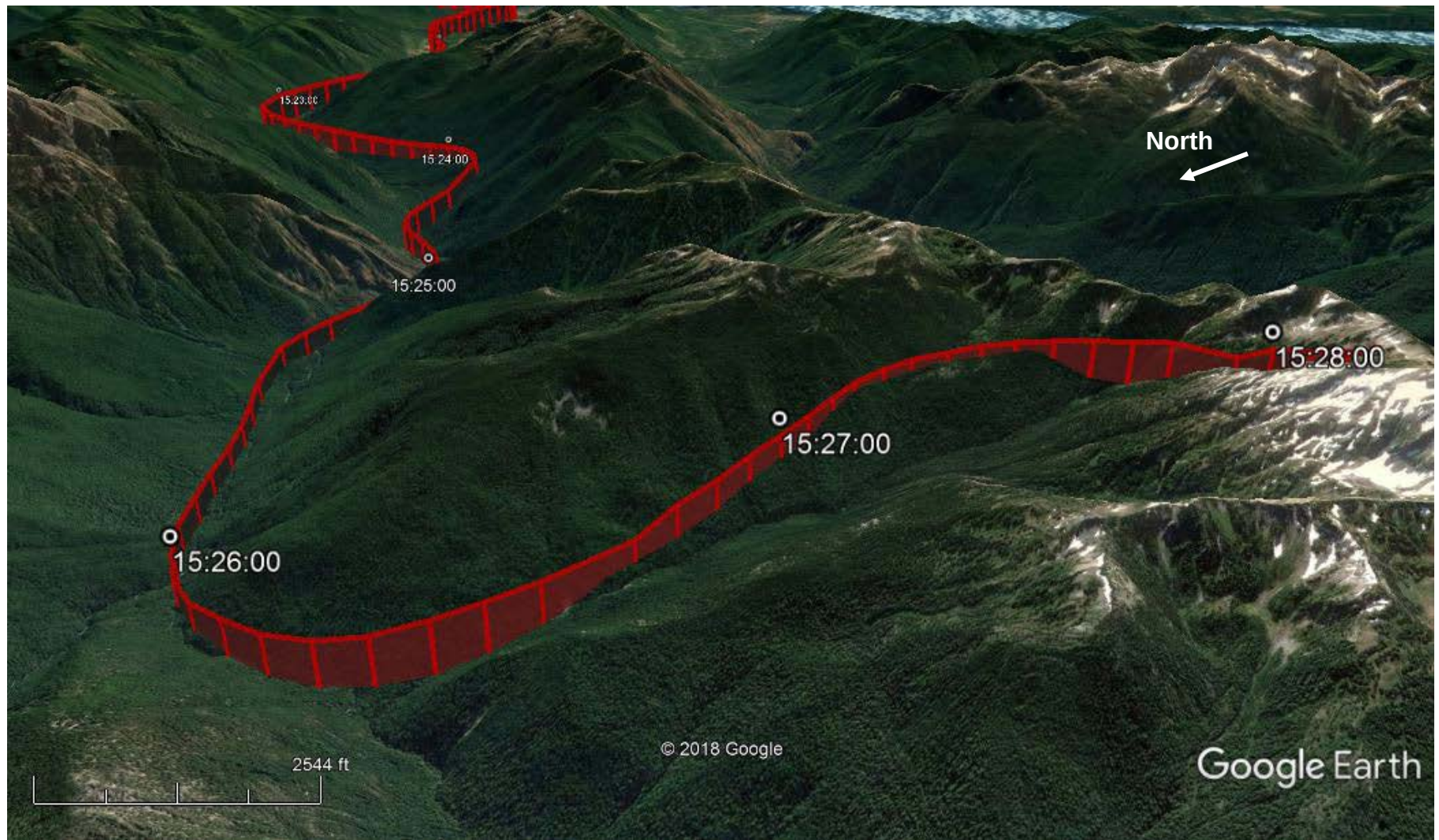


Figure 2. Flight path of last 5 minutes of accident flight.

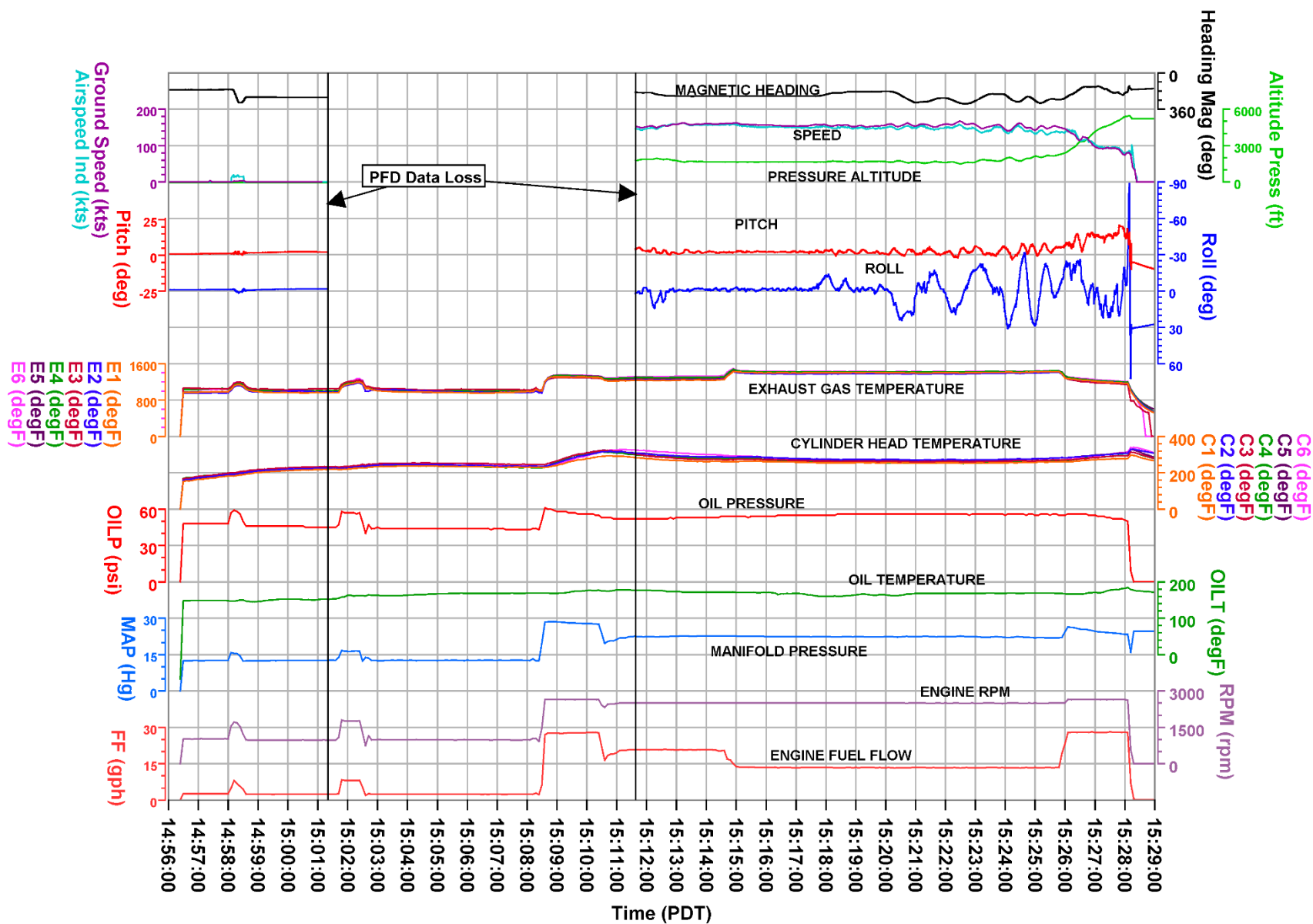


Figure 3. Plot of basic parameters of MFD and PFD during entire flight.

APPENDIX A

This appendix describes the parameters of PFD 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
1. Airspeed Ind (kts)	Indicated Airspeed
2. Altitude Press (ft)	Pressure Altitude
3. Ground Speed (kts)	Ground Speed
4. Heading Mag (deg)	Magnetic Heading
5. Latitude (deg) ³	Latitude
6. Longitude (deg) ³	Longitude
7. Pitch (deg)	Pitch Angle
8. Roll (deg)	Roll Angle

NOTE: The PFD 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 A-2. Unit abbreviations.

Unit Abbreviations	Descriptions
deg	degrees
kts	knots
ft	feet

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.

³ This data is available in tabular format only

APPENDIX B

This appendix describes the parameters of MFD 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
1. AMP1 (A) ⁴	Bus 1 Current
2. AMP2 (A) ⁴	Bus 2 Current
3. AMPB (A) ⁴	Battery Current
4. C (degF)- # ⁵	Cylinder Head Temperature
5. EBUS (V) ⁴	Essential Bus Voltage
6. E (degF)- # ⁵	Exhaust Gas Temperature
7. MBUS (V) ⁴	Main Bus Voltage
8. OilP (psi)	Oil Pressure
9. OilT (degF)	Oil Temperature
10. FF (gph)	Engine Fuel Flow
11. MAP (inHg)	Manifold Pressure
12. RPM (rpm)	Engine Speed

Table B-2. Unit abbreviations.

Unit Abbreviations	Descriptions
psi	pound per square inch
degF	degrees Fahrenheit
inHg	Inches Mercury
rpm	revolutions per minute
gph	gallon per hour
A	Amperage
V	Voltage

⁴ This data is available in tabular format only

⁵ Depending on aircraft configuration, the number of cylinders that are instrumented varies. In the data plots the '#' is replaced with the appropriate cylinder ID.