

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

April 4, 2017

Engine Data Monitor (EDM)

Specialist's Factual Report
By James Cash

1. EVENT SUMMARY

Location: Northport, Alabama
Date: August 14, 2016
Aircraft: Piper PA-31-325
Registration: N447SA
Operator: Private
NTSB Number: ERA16FA289

On August 14, 2016, about 1120 central daylight time, a Piper PA-31-325, N447SA, was substantially damaged when it impacted terrain near Northport, Alabama, while diverting to Tuscaloosa Regional Airport (TCL), Tuscaloosa, Alabama. The private pilot and five passengers were fatally injured. Day visual meteorological conditions prevailed and an instrument flight plan was filed for the personal flight. The flight was conducted under the provisions of Title 14 Code of Federal Regulations Part 91. The flight departed Kissimmee Gateway Airport (ISM), Orlando, Florida, around 0855, with an intended destination of Oxford University Airport (UOX), Oxford, Mississippi.

2. ENGINE DATA MONITOR GROUP

An Engine Data Monitor (EDM) group was not convened.

3. DETAILS OF INVESTIGATION

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

Recorder Manufacturer/Model: **JPI EDM-760**
Recorder Serial Number: **0666**

Recorder Manufacturer/Model: **Shadin Fuel Flow Indicator**
Recorder Serial Number: **Unknown**

3.1. EDM 760 Description

The J. P. Instruments EDM-760 is a panel mounted gauge that the operator can monitor and record up to 24 parameters related to twin engine operations. Depending on the installation engine parameters monitored, for both engines, can include:

- Exhaust Gas Temperature (EGT)
- Cylinder Head Temperature (CHT)
- Oil Pressure and Temperature
- Manifold Pressure
- Outside Air Temperature
- Turbine inlet Temperature
- Engine Revolutions per Minute
- Compressor Discharge Temperature
- Fuel Flow
- Carburetor Temperature
- Battery Voltage

The unit can also calculate, in real-time, horsepower, fuel used, shock cooling rate and EGT differentials between the highest and lowest cylinder temperatures. The calculations are also based on the aircraft installation.

The unit contains non-volatile memory¹ for data storage of the parameters recorded and calculated. The rate at which the data is stored is selectable by the operator from 2 to 500 seconds per sample. The memory can store up to 20 hours of data at a 6 second sample rate. The data can then be downloaded by the operator using the J.P. Instruments software.

3.1.1. Data Recovery

The unit had sustained some fire and heat damage during the accident as is shown in figure 1. The unit was disassembled to assess any internal fire damage. The interior electronics were not damaged except for the front display panel, which was determined to be nonfunctional due to extensive heat damage. A replacement front panel was installed and the unit powered up normally and was downloaded using the manufacturer's supplied software and procedures.

¹ Solid-state memory that retains the stored information after electrical power is removed.

Figure 1. Damaged exterior of EDM unit.



3.1.2. Data Description

The EDM recording contained approximately 16 hours of data over 6 power cycles. The event flight was the last flight of the recording and its duration was approximately 2 hours and 30 minutes.

3.1.3. Engineering Units Conversions

The engineering units conversions used for the data contained in this report are based on documentation from the manufacturer of the EDM.

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

3.2 Device Description Shadin Fuel Flow Indicator

The Shadin fuel flow indicator is a panel mount instrument that provides the pilot with the ability to manage the aircraft's fuel quantity and usage. The device provides the pilot with the following information: total fuel onboard, fuel used, fuel remaining, rate of fuel consumption and fuel to next waypoint if the unit is connected to a compatible navigation data source, such as a flight management system or GPS receiver. The unit also contains memory that retains the last fuel measurements prior to electrical power being removed from the device.

3.2.1 Data Description Shadin Fuel Flow Indicator

The data retained by the unit when it was powered up in the laboratory was showing that the total fuel remaining on-board the aircraft was 41.7 gallons, total fuel used since the unit was last reset was 141.2 gallons. The fuel remaining to the destination was 65.2 gallons, the fuel reserve was showing 75.7 gallons and the full fuel setting was set at 183.3 gallons.

3.3 Time Correlation

The EDM records time with the first data sample based on the units' internal clock. This clock is set and updated by the operator.

Correlation of the EDM data to the event local time, Central Daylight Time (CDT) was established by using the recorded time and then applying an additional -5 hours offset to change GMT to CDT. Therefore, for the rest of this report, all times are referenced, as CDT not recorded time.

3.4 Plots and Corresponding Tabular Data

The following two figures contain EDM data recorded during the August 14, 2016 event.

Figure 2 contains a graphical depiction of the engine data for the entire 3 ½ hour flight. The recording starts at about 0852:00 CDT on August 14, 2016 and continues until 1120:20 CDT. Figure 3 contains the same engine data zoomed in on the last 16 minutes of the accident flight. The corresponding tabular data used to create these two figures are provided in electronic (*.csv²) format as Attachment 1 to this report.

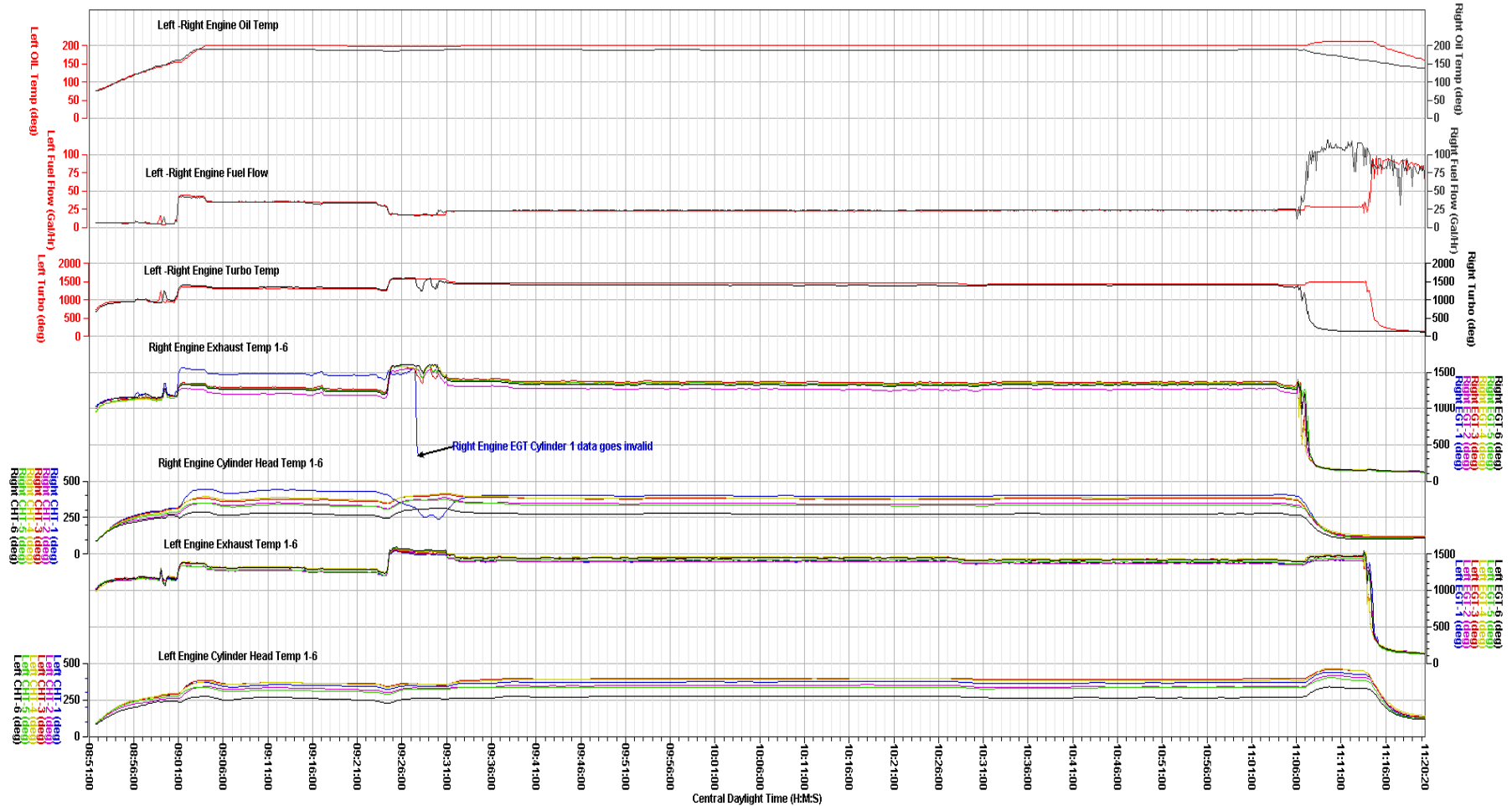
² Comma Separated Value format.

Figure 2. Plot of EDM Engine data during entire flight.

Private, Piper PA-31-325, N447SA

Location, Date: Northport, Alabama, 08/14/16

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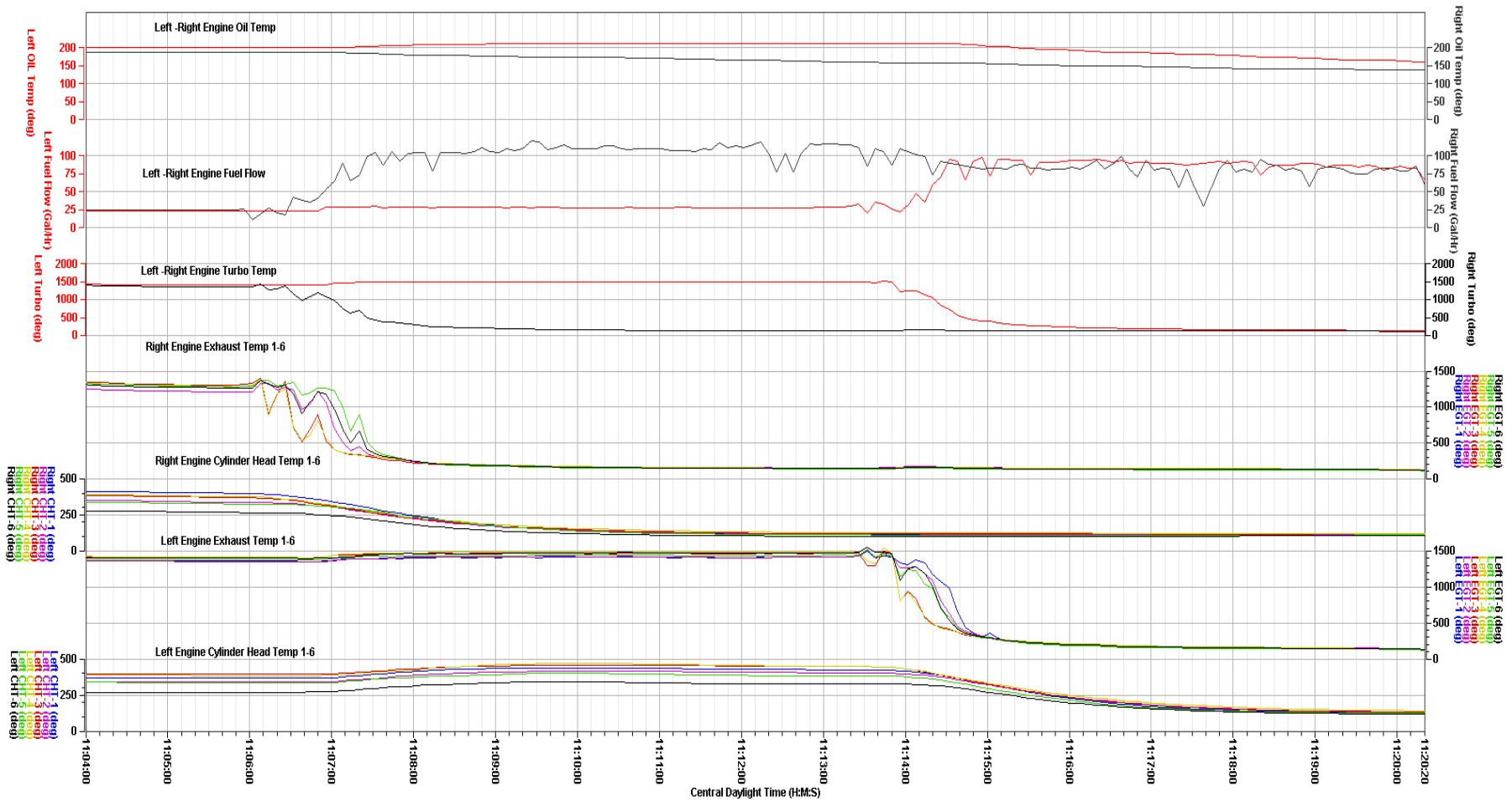
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Figure 3. Plot of EDM Engine data for the last 16 minutes of the flight

Private, Piper PA-31-325, N447SA, Last 16 Minutes of Accident Flight

Location, Date: Northport, Alabama, 08/14/16

NTSB No. ERA16FA289



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APPENDIX A

Table A-1. Verified and provided parameters.

Parameter Name	Parameter Description
1. Batt-1 (V)	Battery Voltage Input 1
2. Eng1 CHT-# (deg)	Left Cylinder Head Temperature Cylinder # ³
3. Eng1 EGT-# (deg)	Left Exhaust Gas Temperature Cylinder # ³
4. Eng1 Fuel Flow (gph)	Left Engine Fuel Flow
5. Eng1 Oil Temp (deg)	Left Engine Oil Temperature
6. Eng1 TIT-1 (deg)	Left Engine Turbine Inlet Temperature-Input 1
7. Eng2 CHT-# (deg)	Right Cylinder Head Temperature Cylinder # ³
8. Eng2 EGT-# (deg)	Right Exhaust Gas Temperature Cylinder # ³
9. Eng2 Fuel Flow (gph)	Right Engine Fuel Flow
10. Eng2 TIT-1 (deg)	Right Engine Turbine Inlet Temperature-Input 1
11. Eng2 Oil Temp (deg)	Right Engine Oil Temperature

Table A-2. Unit abbreviations.

Units Abbreviation	Description
deg	degrees
degF	Degrees Fahrenheit
gal	gallons
gph	gallons per hour
hrs	hours
V	Volts DC

³ Depending on aircraft configuration number of cylinders that are instrumented varies. In the data plots the '#' is replaced with the appropriate cylinder ID.