

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

March 17, 2016

Engine Data Monitor (EDM)

Specialist's Factual Report
By Sean Payne

1. EVENT SUMMARY

Location: Baldwin, Georgia
Date: November 4, 2015
Aircraft: Piper PA-28-180
Registration: N57WV
Operator: Private
NTSB Number: ERA16FA032

On November 4, 2015, about 2355, eastern standard daylight time (EST), a Piper PA-28-180, N57WV, was destroyed when it impacted wooded terrain, following a loss of control during an approach to the Habersham County Airport (AJR), Cornelia, Georgia. The private pilot and two passengers were fatally injured. The airplane was registered to and operated by a private individual as a personal flight conducted under the provisions of 14 *Code of Federal Regulations (CFR)* Part 91. Instrument meteorological conditions prevailed and no flight plan was filed for the planned flight to AJR. The flight originated from the St. Lucie County International Airport (FPR), Ft. Pierce, Florida, about 1830.

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 EDM and GPS database card:

Recorder Manufacturer/Model: **JPI EDM-700**
Recorder Serial Number: **25944**

Recorder Manufacturer/Model: **Garmin Database Card (Does not record data)**
Recorder Serial Number: **Unknown**

3.1. EDM 700 Description

The J. P. Instruments EDM-700 is a panel mounted gauge that the operator can monitor and record up to 24 parameters related to engine operations. Depending on the installation engine parameters monitored 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 memory 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. Garmin Database Card Description

The Garmin database card is used in Garmin aircraft navigation systems to store navigation chartkit information and charting graphics. The database card recovered from the aircraft is shown below in figure 1. This type of card is typically associated with a panel mount navigational system and does not record flight data.

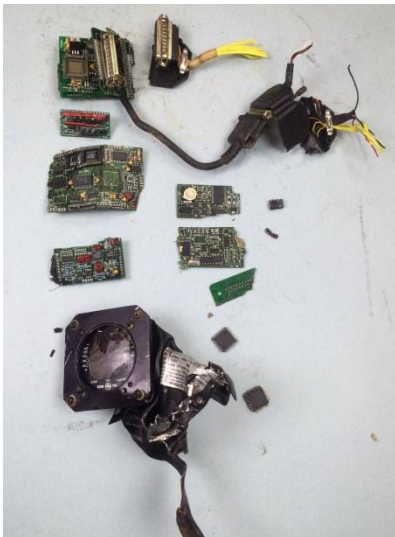
Figure 1. Damaged Garmin Database Card.



3.1.2. EDM 700 Data Recovery

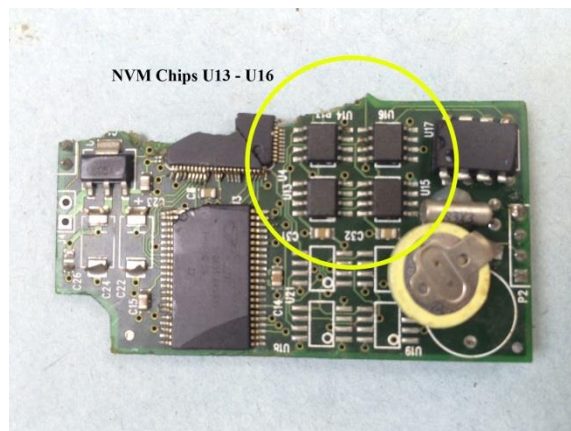
The recorder was damaged in the event. The extent of the damage is shown in figure 2. The unit's non-volatile memory (NVM)¹ chips containing the data were identified and were undamaged. The NVM chips are shown in figure 3 prior to removal from the board. The chips were removed, cleaned and read using the appropriate socket type adapter on the lab's chip reader. The data was then reconstituted using laboratory software.

Figure 2. Damaged engine data monitor.



¹ Semi-conductor memory that does not require power to retain data.

Figure 3. NVM chips U13, U14, U15 and U16 prior to extraction.



3.1.3. EDM 700 Data Description

The EDM recording contained data over approximately 20 power cycles. The event flight was the last flight of the recording (flight/power cycle 295) and its duration was approximately 1 hour, 59 minutes and 30 seconds.

3.1.4. EDM 700 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. EDM 700 Time Correlation

The EDM records time with the first data sample based on the unit's internal clock. This clock is set and updated by the operator. The clock was found to be out of alignment when compared to both local time of the accident (EST) and Universal Coordinated Time (GMT).

Correlation of the EDM data to the event local time, EST, was established by using the recorded Time and then applying an additional 63908 seconds offset to change GMT to EST. Therefore, for the rest of this report, all times are referenced as EST, not recorded time.

$$\text{JPI EDM 700 Time} + 63908 \text{ seconds} = \text{EST}$$

3.3. EDM 700 Plots and Corresponding Tabular Data

The following three figures contain EDM data recorded during the November 4, 2015, event.

Figure 4 is a plot of extracted EDM data for flight/power cycle number 293. The plotted time interval is 17:25 EST on November 4, 2015, to 21:05 EST on November 4, 2015.

Flight/power cycle 294 was identified as a brief power cycle. Between flight/power cycle 294 and 295, the value for fuel used was reset from zero. The duration of the recording was 28 seconds. This data was not plotted, but is included in the tabular data attachment described later in this report.

Figure 5 is a plot of extracted EDM data for flight/power cycle number 295. The plot contains data for the entire accident flight. The plotted time interval is 21:50 EST on November 4, 2015, to 24:00 EST on November 5, 2015.

Figure 6 is a plot of the last 14 minutes of flight during the accident flight.

The corresponding tabular data used to create these three plots are provided in electronic (*.csv²) format as Attachment 1 to this report.

² Comma Separated Value format.

Figure 4. Plot of basic parameters during flight/power cycle 293, the flight previous to the accident.

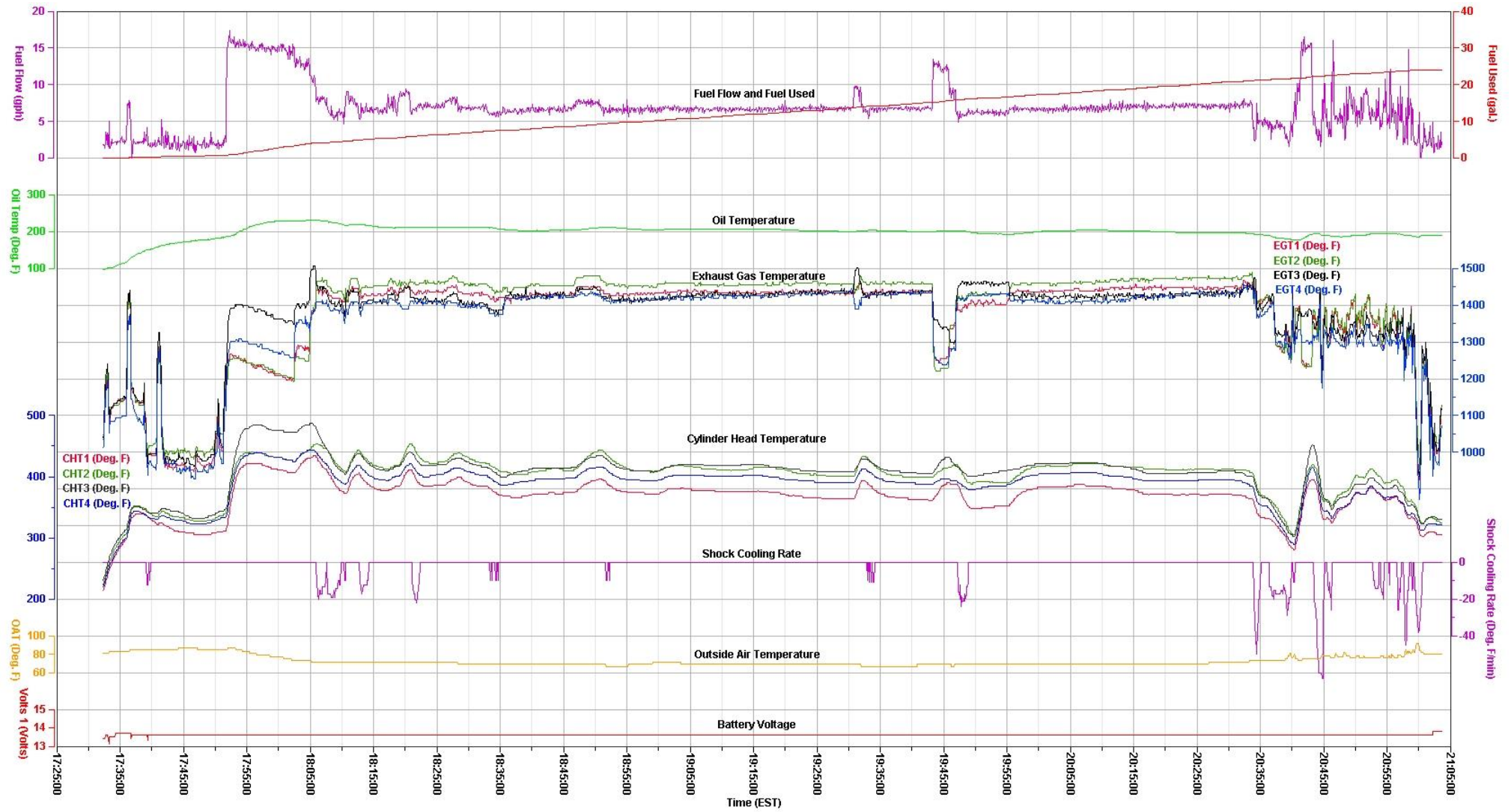


Figure 5. Plot of basic parameters during flight/power cycle 295, the accident flight.

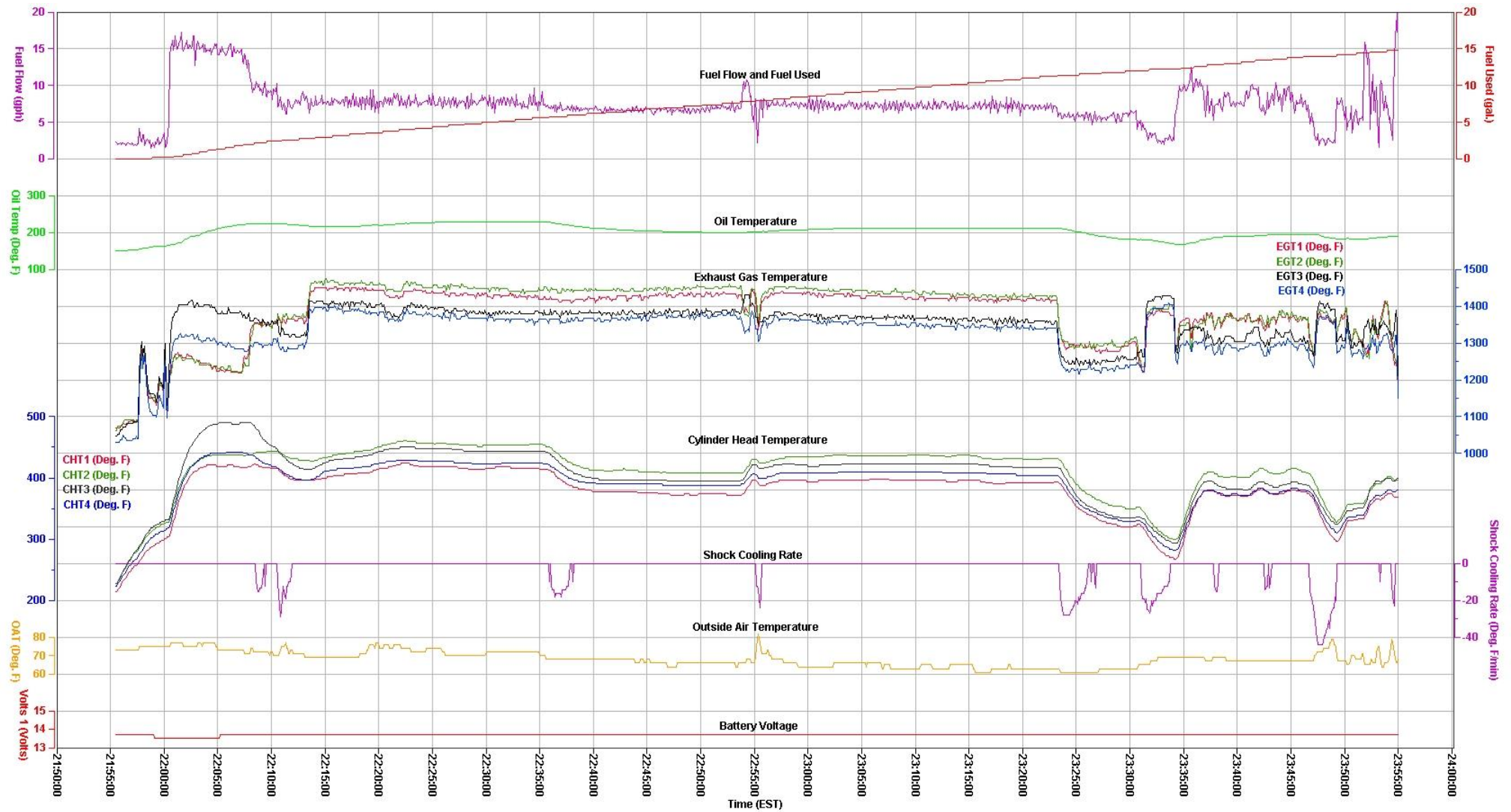
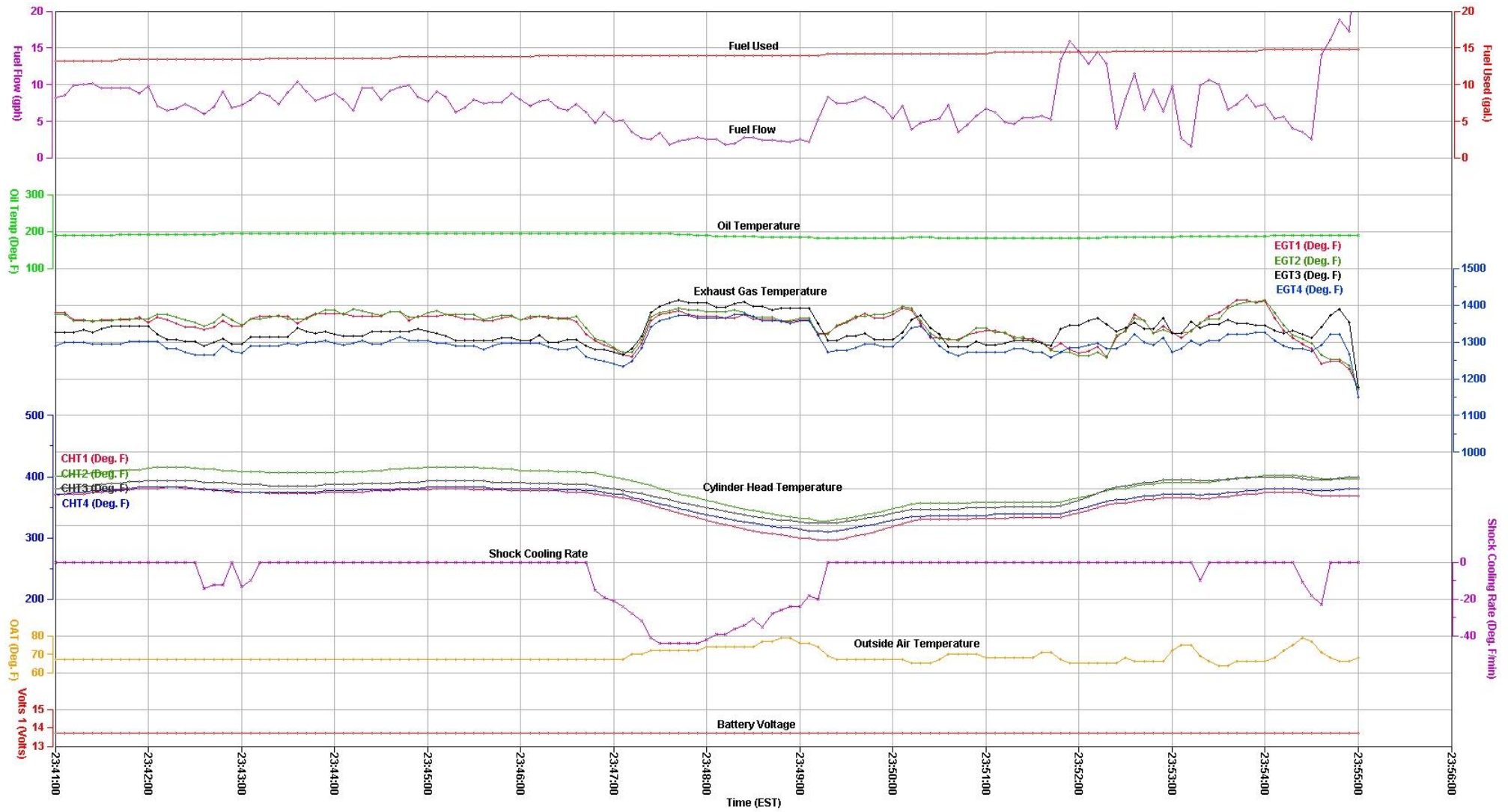


Figure 6. Plot of EDM parameters during the last 14 minutes of the accident flight.



APPENDIX A

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

Table A-1. Verified and provided parameters.

1. Volts 1 (Volts)	Battery Voltage Input 1
2. CHT # (deg. F)	Cylinder Head Temperature Cylinder # ³
3. EGT # (deg. F)	Exhaust Gas Temperature Cylinder #
4. Fuel Flow (gph)	Fuel Flow
5. Fuel Used (gal)	Fuel Used
6. Oil Temp (deg)	Oil Temperature
7. Shock Cooling Rate (deg. F/min)	Shock Cooling Rate
8. Flight Number	Power Cycle / Flight Number
9. OAT (deg. F)	Outside Air Temperature

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

Table A-2. Unit abbreviations.

Units Abbreviation	Description
Volts	Volts
deg. F	degrees Fahrenheit
gph	gallons per hour
gal.	gallons
deg. F/min	degrees Fahrenheit per minute

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.