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

September 28, 2021

Engine Data Monitor (EDM)

Specialist's Factual Report
By Sean Payne

1. EVENT SUMMARY

Location:	Dinsmore, CA
Date:	July 15, 2021
Aircraft:	Mooney M20J
Registration:	N4474H
Operator:	Private
NTSB Number:	WPR21FA272

2. DETAILS OF INVESTIGATION

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

Recorder Manufacturer/Model:	**JPI EDM-730/830**
Recorder Serial Number:	**UNK**

2.1. EDM 730/830 Description

The J. P. Instruments EDM-730/830 is a panel-mounted LCD 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 storage of the recorded and calculated parameters. The rate at which the data is stored is selectable by the operator and ranges from 2 to 500 seconds between samples. The memory can store up to 20 hours of data at a 6-second sample rate. For a non-damaged unit, the data can be downloaded by the operator using a USB flash drive and following the instructions on the unit.

2.1.1. Data Recovery

The device was heavily fire damaged in the event. The extent of the damage is shown in figure 1. Figure 2 shows an extraction of the deivce's internal components (left side of photo) as well as electronic components associated with the device that were detached from the device (right side of the photo). The internal non-volatile memory (NVM) component that retains flight data was identified.[1] This component was then implanted in a surrogate unit of the same type. Power was applied to the unit and the unit was downloaded normally using the manufacuter's suggested procedure for a normal download.

Figure 1. Damaged exterior of EDM.

Figure 2. Damaged internal components of EDM (left) and displaced memory chips from device (right). The specialist's finger is pointing to the NVM chip containing flight data.

[1] Non-volatile memory (NVM) – Semi-conductor memory that does not need power applied to retain data.

2.1.2. Data Description

The EDM recording contained a multitude of engine data over numerous power cycles. Only the last few power cycles of data were evaluated. The event flight was the last flight of the recording and its duration was approximately 4 minutes and 12 seconds.

2.1.3. 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.

2.2. 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 date of the unit was found to be set correctly, however the time stamp of the unit was off by a number of minutes. Instead of correlating the event to local time, the data is presented below as JPI System Time which is given in elapsed seconds.

2.3. Plots and Corresponding Tabular Data

Figure 3 is a plot of EDM data recorded during the accident flight on July 15, 2021.

The plot begins with the engine operating around 1500 RPM for approximately two minutes. Other engine parameters appear nomimal during this time interval. Around two minutes into the recorded dataset, RPM increases to about 2200 rpm and back down to approximately 1100 RPM in about a 20 second interval. Other engine parameters appear nominal at this time. There was no obvious portion of the data that indicated RPM fluctuated in a way cosnsitent with a magneto check or a propellor governor check done at the proper RPM. Around three minutes into the recored dataset, engine RPM steps up to around 2150 RPM and then moments later up to just under 2700 RPM. Manifold pressure increases to 27 in.-Hg at this time. Other engine parameters behaved nominally at this time. The recording ended approximalty 35 seconds later with a recorded RPM value of 2685 RPM and a manifold pressure of 27.3 in.-Hg. Other engine parameters appeared nominal at this time.

The corresponding tabular data used to create these three plots are provided in electronic (*.csv[2]) format. Attachment 1 is all recorded data from the flight previous to the accident flight. Attachment 2 is all recorded data from the accident flight.

[2] Comma Separated Value format.

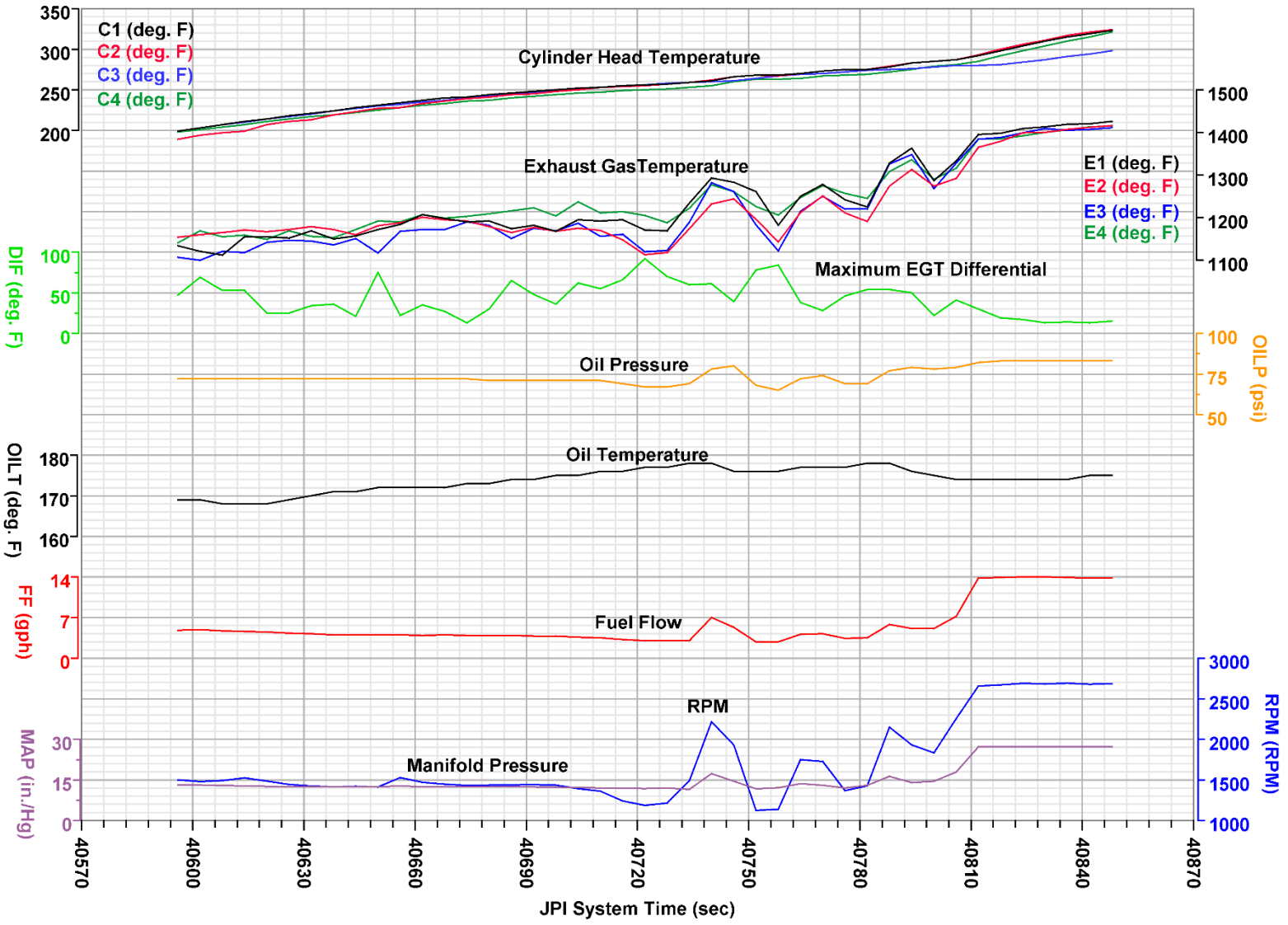

Figure 3. Plot of entire previous flight.

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.

Parameter Name and Units	Parameter Description
1. DIF (Deg. F)	Maximum Temperature Differential – Exhaust Gas Manifolds
2. C-# (Deg. F)	Cylinder Head Temperature Cylinder #[3]
3. E-# (Deg. F)	Exhaust Gas Temperature Cylinder #
4. FF (gph)	Engine Fuel Flow
5. MAP (in.-Hg)	Engine Manifold Pressure
6. USD (gal)	Engine Fuel Used
7. OilT (Deg. F)	Engine Oil Temperature
8. OilP (psi)	Engine Oil Pressure
9. CLD (Deg. F/min)	Engine Shock Cooling Rate

Table A-2. Unit abbreviations.

Units Abbreviation	Description
Deg. F/Min	degrees Fahrenheit per minute
Deg. F	degrees Fahrenheit
gal	gallons
gph	gallons per hour
in.-Hg	inches of Mercury

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