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

May 10, 2022

Engine Monitor and GPS

Specialist's Factual Report
by Nick Swann

1. EVENT

Location:	West Jordan, Utah
Date:	July 25, 2020
Aircraft:	Piper PA-32R-300
Registration:	N7677C
Operator:	Private
NTSB Number:	WPR20LA238

2. DETAILS OF INVESTIGATION

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

Device:	**JPI EDM 930**
Device Serial Number:	**01526**
Device:	**Garmin GPSMAP 695**
Device Serial Number:	**1H7003079**
Device:	**iFly 740**
Device Serial Number:	**ZZ20030163**

2.1. JPI EDM 930 Device Description

The J.P. Instrument (JPI) Engine Data Monitor (EDM) 930 is a panel-mounted gauge with color display that allows the operator to 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 (RPM), Fuel Flow, Amperage Load and Bus Voltage, etc.

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

2.1.1. JPI EDM 930 Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, the JPI EDM 930 showed signs of impact and heat damage as shown in figure 1.

Figure 1. Damage to JPI EDM 930.

After discussions with the manufacturer, it was determined this unit was an early serial number and therefore stored data in a different method than most other JPI EDM 930s. The device was disassembled, and the CPU board shown below in figure 2 was determined to be the board containing the non-volatile memory (NVM).[1] The board was then brought to the manufacturer and assembled into a surrogate unit that had been prepared to run an identical software version to what the accident device was running. The surrogate unit was then powered on and a download of the device was performed normally, following the manufacturer's recommendations.

[1] Non-volatile memory is semiconductor memory that does not require external power for data retention.

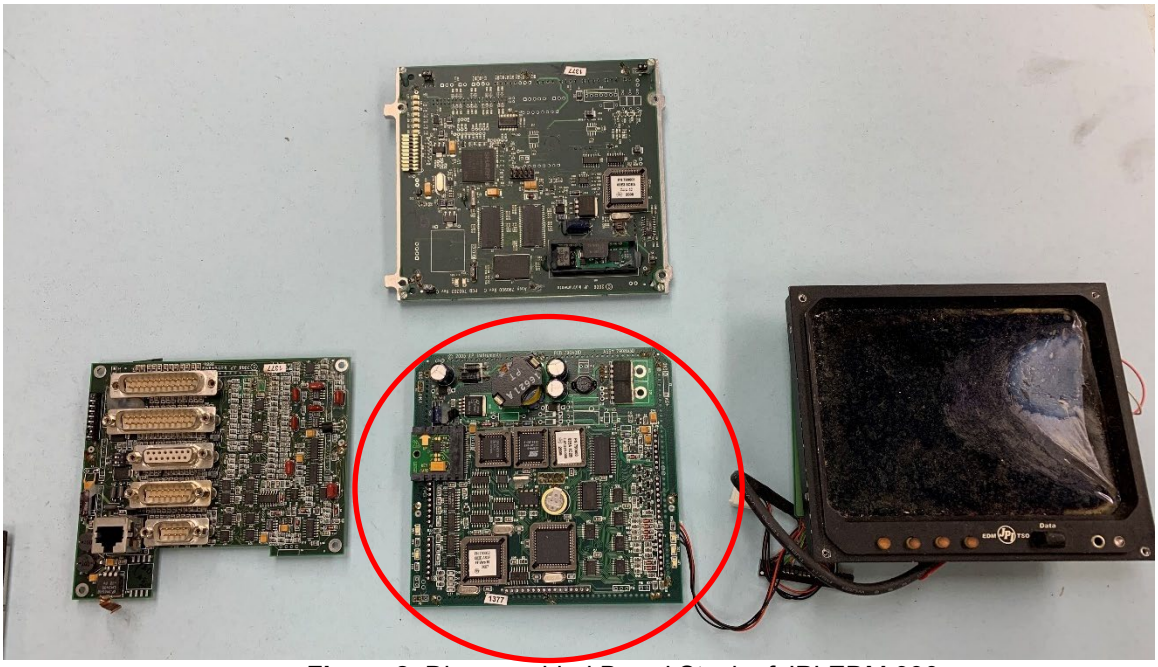

Figure 2. Disassembled Board Stack of JPI EDM 930.

2.1.2. JPI EDM 930 Data Description

The data extracted included 23 sessions from July 13, 2020, through July 25, 2020. The event flight was the last session, recorded starting at 21:54:42 recorder time and ending at 22:05:24 recorder time on July 25, 2020 (108 total data points).

2.2. Garmin GPSMAP 695 Device Description

The Garmin GPSMAP 695 is a battery-powered portable multi-function display and GPS receiver with a 7-inch diagonal high-resolution LCD display screen. The unit includes a built-in Jeppesen database and is capable of receiving XM satellite radio for flight information including NEXRAD Radar, lightning, METARs, TAFs, and TFRs. The unit can also perform and store weight and balance calculations. A built-in AOPA Airport Directory and Safe Taxi airport diagrams are included for selected airfields.

The unit stores date, route-of-flight, and flight-time information for up to 50 flights. A flight record is triggered when groundspeed exceeds 30 knots and altitude exceeds 250 feet and ends when the groundspeed drops below 30 knots for 10 minutes or more. A detailed track log including latitude, longitude, date, time, and GPS altitude information is stored within the unit whenever the receiver has a lock on the GPS navigation signal. Position is updated within the track log as a function of time or distance moved, depending on how the unit has been configured. Once the current track log memory becomes full, new information either overwrites the oldest information or recording stops, depending on how the unit is configured. The current track log can be saved to long-term memory and additional track logs can be maintained in addition to the current track log. Track log storage may be activated or de-activated at user discretion. All recorded data is stored in NVM.

2.2.1. Garmin GPSMAP 695 Recovery

Upon arrival at the Vehicle Recorder Laboratory, the GPSMAP 695 showed signs of slight impact and heat damage as shown in figure 3. The device would not power on normally and was disassembled. A chip level recovery was performed.

Figure 3. Damage to Garmin GPSMAP 695.

2.2.2. Garmin GPSMAP 695 Data Description

The data extracted included sessions from July 12, 2020, through July 25, 2020. The event flight was the last session. Recorded starting at 19:26:31 recorder time and ending at 19:38:24 (76 total data points).

2.3 iFly 740 Device Description

The iFly 740 is a battery powered handheld GPS receiver. The device provides a moving map display and shows GPS information regarding the flight. Information shown includes altitude, ground speed, track, a vertical profile, etc. The device is capable of storing information from previous flights.

2.3.1 iFly 740 Data Description

Due to the redundant nature of the information gained from the GPSMAP 695 and the information stored on the iFly 740, this device was not repaired and no data relevant to the accident flight was extracted from it.

2.4 Time Correlation

The Garmin GPSMAP 695 records time in Coordinated Universal Time (UTC). The JPI EDM 930 records in a user defined time. The EDM 930 was aligned with the GPSMAP 695 by corresponding relevant engine parameters with GPS recorded groundspeed during takeoff. The following plots of the accident flight are given in UTC. The plots from the previous flight containing only engine data are given as recorder time.

2.5 Plots and Corresponding Tabular Data

The following figures contain data recorded during the event flight. Relevant parameters recorded are included below. The data used to create these plots are attached to this report in electronic (*.csv) form. The data from the accident flight is will be included in Attachment 1 and the data from the previous flight will be included in Attachment 2. The following table shows the parameters used in this report and their meanings.

Table 1. List of Parameters Used in this Report.

Plot/Table Label	Parameter Name	Units
E	Exhaust Gas Temperature	degrees Fahrenheit
C	Cylinder Head Temperature	degrees Fahrenheit
HP	Percentage of Maximum Engine Horsepower	%
MAP	Manifold Pressure	inches mercury
RPM	Tachometer RPM	Rotations per minute
DIF	EGT Max Temperature Difference	degrees Fahrenheit
Oil P	Oil Pressure	inches mercury
Oil T	Oil Temperature	degrees Fahrenheit
Groundspeed	GPS measured groundspeed	knots
GPS Alt	GPS measured altitude	feet

Figure 4 is an image of a Google Earth overlay showing the flight path of the aircraft. Lighting and weather conditions in the overlay are not indicative of lighting and weather conditions during the accident flight.

Figure 5 shows an overview of core engine parameters from the accident flight with additional GPS parameters to provide context.

Figure 6 shows additional engine parameters from the accident flight.

Figure 7 shows engine parameters during the takeoff from the previous flight.

Figure 4. Google Earth Overlay of Accident Flight.

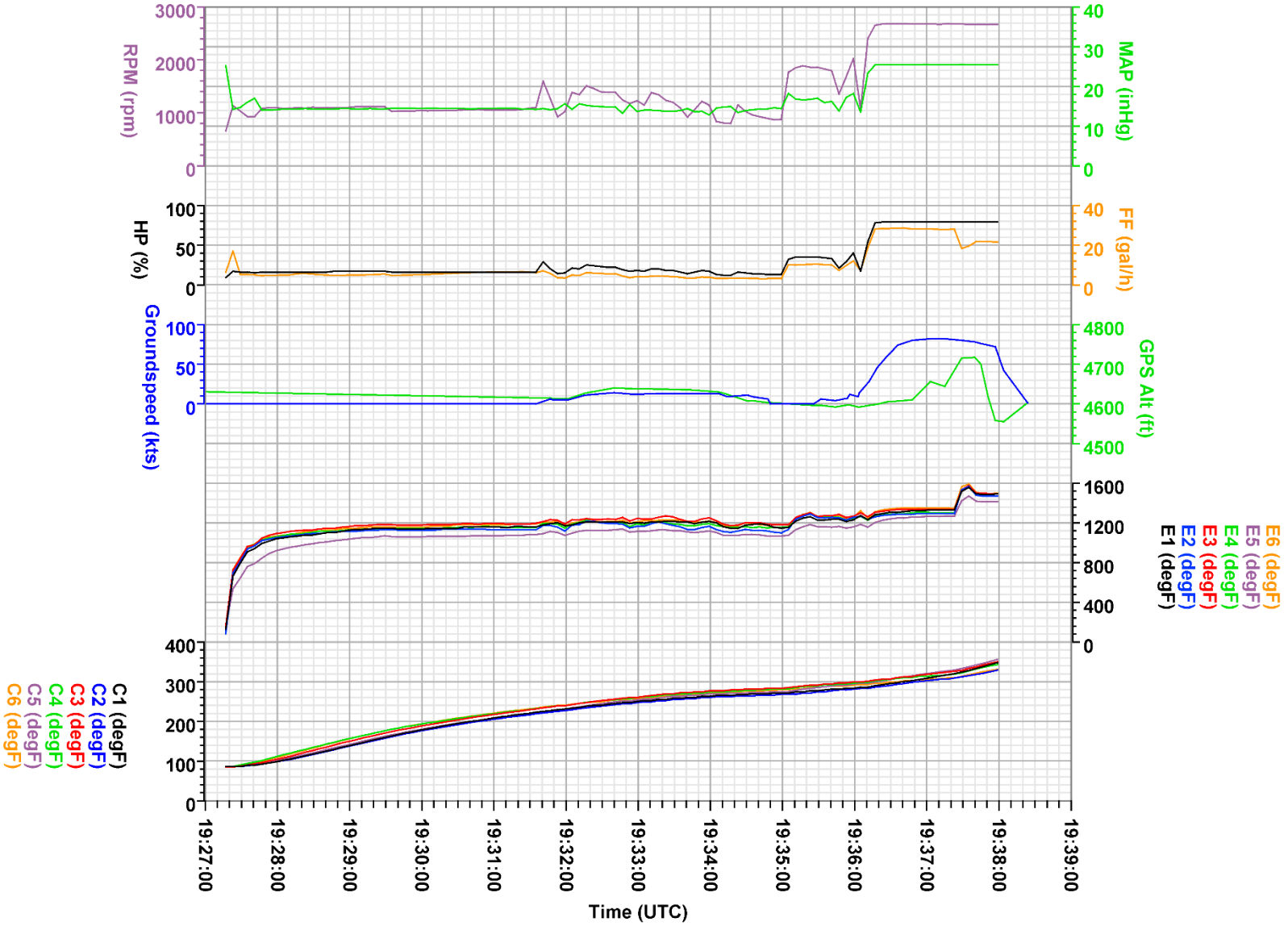

Figure 5. Overview of Core Engine Parameters from Accident Flight.

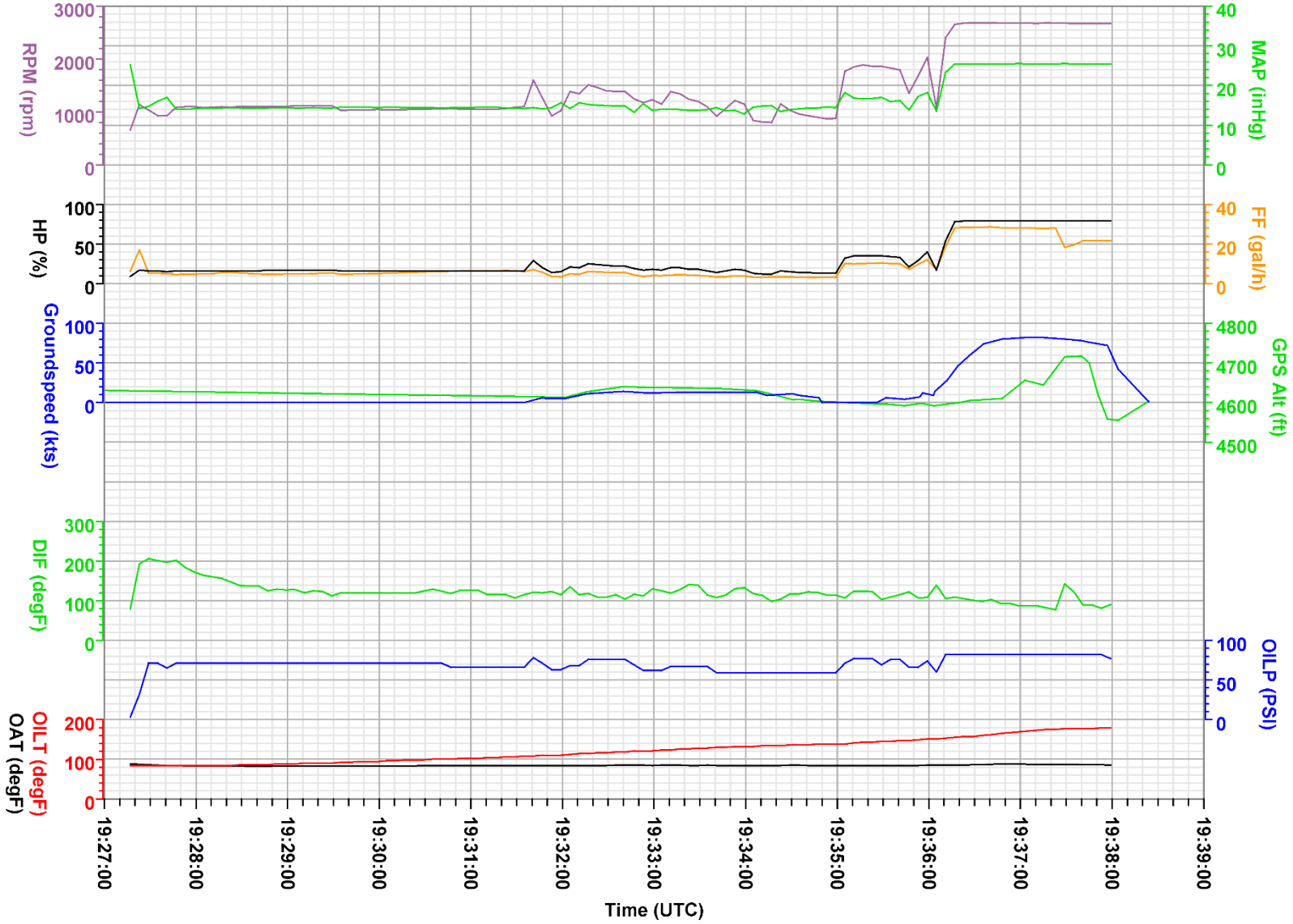

Figure 6. Overview of Additional Engine Parameters from Accident Flight.

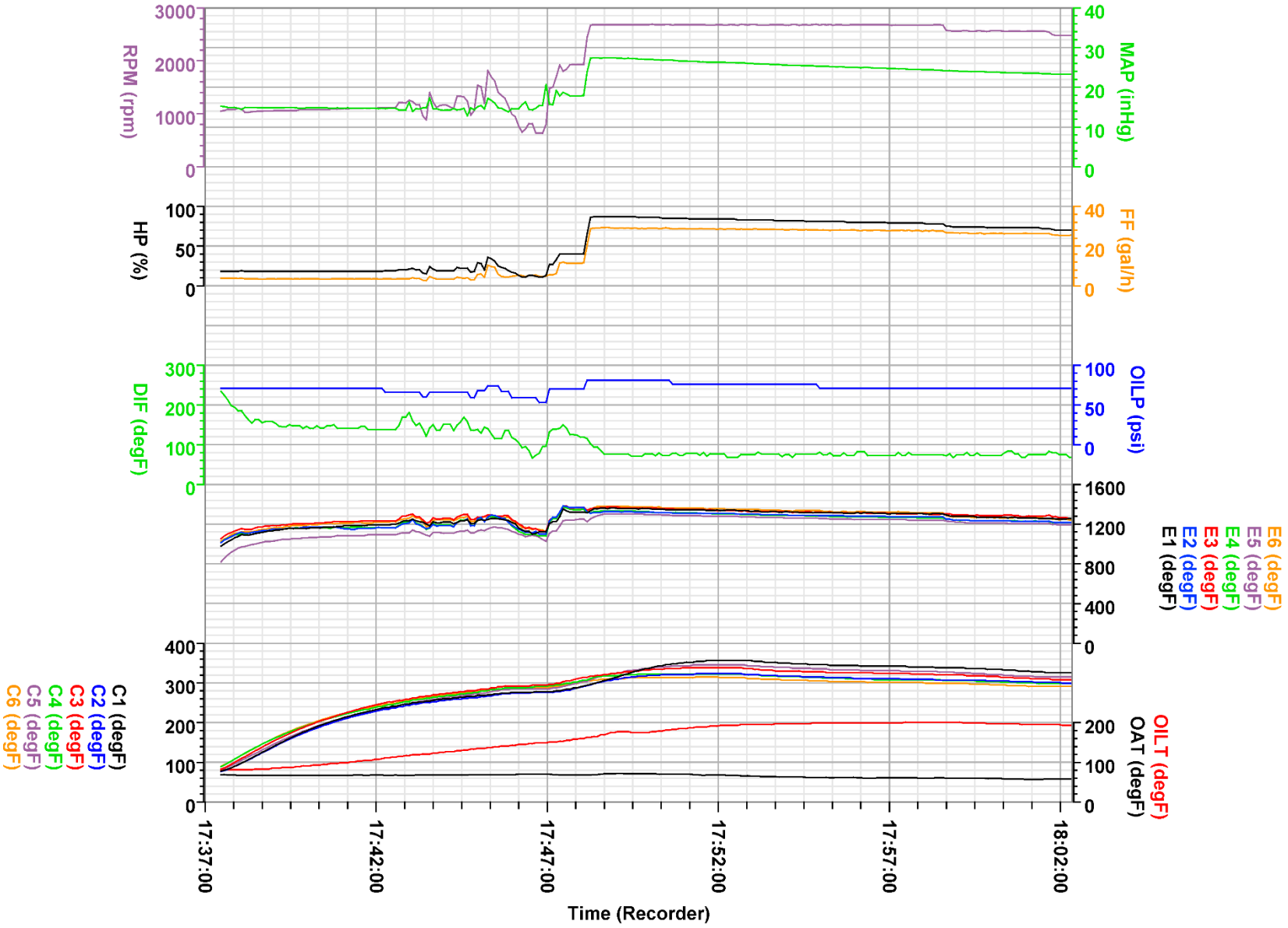

Figure 7. Overview of Engine Parameters from Previous Takeoff.