

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

May 1, 2020

Electronic Devices

Specialist's Factual Report
by Nick Swann

1. EVENT

Location: Detroit, Michigan
Date: June 24, 2018
Aircraft: Cessna P210N
Registration: N3896P
Operator: Private
NTSB Number: CEN18FA236

On June 24, 2018, about 1957 eastern daylight time (EDT) a Cessna P210N single-engine airplane, N3896P, impacted trees and terrain during a forced landing in Detroit, Michigan. The pilot and front-seat passenger were fatally injured, and the rear-seat passenger sustained serious injuries. The airplane was substantially damaged during the forced landing and postimpact fire. The airplane was registered to and operated by the private pilot under the provisions of Title 14 *Code of Federal Regulations (CFR)* Part 91. Day visual meteorological conditions prevailed for the personal flight that departed West Memphis Municipal Airport (AWM), West Memphis, Arkansas, about 1642 with the intended destination of Coleman A. Young Municipal Airport (DET), Detroit, Michigan.

2. DETAILS OF INVESTIGATION

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

Device 1:	JPI EDM-730
Device 1 Serial Number:	Unknown
Device 2:	Appareo Stratus 2S
Device 2 Serial Number:	023480

2.1. JPI EDM-730 Device Description

The J.P. Instruments EDM-730 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 (RPM),

compressor discharge temperature, fuel flow, carburetor temperature, and 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 per sample rate. The data can then be downloaded by the operator using a USB memory stick and decoded using J.P. Instruments software.

2.1.1. JPI EDM-730 Data Recovery

Upon arrival at the Vehicle Recorder Division, the EDM-730 showed signs of extensive heat and post-accident fire damage as shown in Figure 1. The device was disassembled and the circuit board for the EDM-730 showed only minimal signs of charring. The memory chip was located and can be seen in below in Figure 2.



Figure 1. Heat and fire damage to the EDM-730.

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

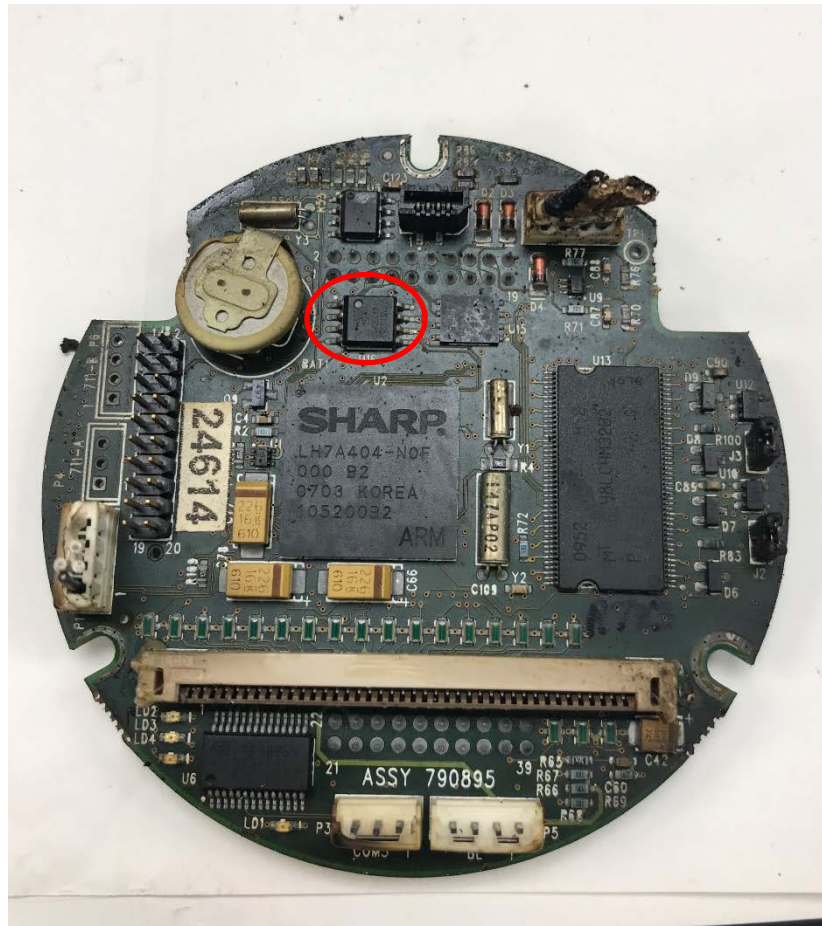


Figure 2. The circuit board of the EDM-730 with the memory chip.

The memory chip was removed from the accident board and soldered on to a functioning surrogate as advised by the manufacturer. After power was applied to the surrogate device, the memory was able to be downloaded according to the manufacturer's normal download procedure.

2.1.2. JPI EDM-730 Data Description

The date and timing from the JPI are set by the user. The timing from the JPI was converted into eastern daylight time by correlating the increase in fuel flow with the beginning of the takeoff roll using the ground speed data gathered by the Appareo Stratus. Accordingly, the time offset for the JPI from the internal time to EDT is the following: $EDT = JPI - 15,185 \text{ seconds}$. Therefore, for the rest of this report, all times are referenced as EDT.

The data extracted included 181 sessions (108,834 total data points) from November 18, 2012, through June 24, 2018. The accident flight was the last session, recorded starting at 16:34:21 and ending at 19:58:31 (2,451 total data points).

2.2. Appareo Stratus 2S Device Description

The Appareo Stratus 2S is a battery-operated ADS-B receiver with Global Positioning System (GPS) capability designed to interface with an iPad, iPhone, or iPod Touch running the ForeFlight mobile application via Wi-Fi. The Stratus uses ADS-B to provide access to NEXRAD radar, METARs, TAFs, NOTAMs, and other FAA products via the ForeFlight application installed on a mobile device. ADS-B NEXRAD weather data can be delayed as much as 15 to 20 minutes.

2.2.1.Appareo Stratus 2S Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed the unit had sustained moderate impact damage as shown below in Figure 3. The device was unable to be powered on normally. The memory chip was extracted and the data were recovered using lab equipment.



Figure 3. Damage to Appareo Stratus 2S.

2.2.2. Appareo Stratus 2S Data Description

The data extracted included 21 sessions between November 14, 2017, and June 24, 2018 (221,988 total data points). The accident flight was the 21st session, recorded starting at 16:31:47.0 EDT and ending at 17:56:50.4 EDT on June 24, 2018 (25,515 total data points). The recorded GPS information does not include all of the accident flight. This lack of data can be attributed to the Stratus losing battery power or being turned off by the user.

2.3. Plots and Tabular Data

The corresponding plots are from the accident flight and relevant previous flights. Parameters from the JPI and Stratus that were used in the following figures are listed in Appendix A. The corresponding tabular data used to create these plots are provided in electronic (*.csv) format as attachments to this report. Attachment 1 is the accident flight and previous flight leg, Attachment 2 is the flight on May 6, 2018, and Attachment 3 is the flights from April 18, 2018.

Table 1 shows a log of flight information stored on the JPI. The flight data on the JPI was correlated with the flight data on the Stratus to validate and characterize the flights taken since the aircraft was purchased on April 18, 2018. Each flight validated by the Stratus is plotted below.

Figure 4 shows an overview of engine parameters during the accident flight. The recorded data from the Appareo Stratus ends at approximately 17:55. After that, the groundspeed and altitude data is augmented with flight data taken from a commercial service, Harris OpsVue. During cruise, the fuel flow stayed at approximately 21 gallons per hour (gph).

Figure 5 shows the same engine parameters for the last 15 minutes of the accident flight.

Figure 6 shows additional engine parameters during the accident flight.

Figure 7 shows an overview of engine parameters during the leg prior to the accident flight. This was the leg of the trip that was from Baytown Texas (HPY) to West Memphis Municipal Airport (AWM). During cruise, the fuel flow stayed at approximately 21 gph.

Figure 8 shows an overview of engine parameters during the flight that occurred on May 6, 2018. The duration of this flight was approximately two hours and 36 minutes. The flight was from Richard Lloyd Jones Jr. Airport (KRVS) to Pearland Regional Airport (KLVJ). During cruise, the fuel flow stayed at approximately 21 gph. The matching recording from the Appareo Stratus did not begin until approximately 16:00.

Figure 9 shows an overview of engine parameters during the flight that occurred on April 18, 2018 starting at 18:10. Between approximately 18:22 and 18:35 the data from the Appareo Stratus is invalid. It is unclear why this occurred. The duration of this flight was approximately 1 hour and 17 minutes and was from KSFG to KRVS.

Figure 10 shows an overview of engine parameters during the flight that occurred on April 18, 2018 starting at 14:45. The duration of this flight was approximately 3 hours and 10 minutes and was from KLOU to KSGF.

Figure 11 shows an overview of engine parameters during the flight that occurred on April 18, 2018 starting at 12:45. The duration of this flight was 1 hour and 26 minutes and was from KOSU to KLOU.

Table 1. Flight History Since Purchase.

Date	Start Time (EDT)	End Time (EDT)	Duration (hh:mm:ss)	On Stratus	Total Fuel Used During Flight (gal)	Detail
6/24/2018	16:34:21	19:58:31	03:24:10	Yes	71.6	KAWM to KDET (Accident Flight)
6/24/2018	11:35:39	14:20:24	02:44:45	Yes	54.3	KLVJ to KAWM
6/16/2018	14:42:47	15:12:32	00:29:45	No	-	No Flight (Maintenance Run)
6/13/2018	19:29:31	19:46:51	00:17:20	No	-	No Flight (Maintenance Run)
5/6/2018	15:33:43	18:09:33	02:35:50	Yes	49.6	KRVS TO KLVJ
5/6/2018	10:34:15	11:38:55	01:04:40	No	-	Confirmed Flight Likely Traffic Pattern Work
5/5/2018	12:48:53	14:20:18	01:31:25	No	-	Confirmed Flight without Stratus
4/27/2018	15:09:45	15:23:05	00:13:20	No	-	No Flight (Day of Maintenance)
4/18/2018	18:11:41	19:28:54	01:17:13	Yes	23.0	KSGF to KRVS
4/18/2018	14:46:35	17:56:25	03:09:50	Yes	62.2	KLOU to KSGF
4/18/2018	12:47:59	14:14:07	01:26:08	Yes	26.8	KOSU to KLOU
4/18/2018	09:11:19	09:28:44	00:17:25	No	-	Engine Run, No Flight
4/18/2018	08:15:39	08:23:34	00:07:55	No	-	Engine Run, No Flight

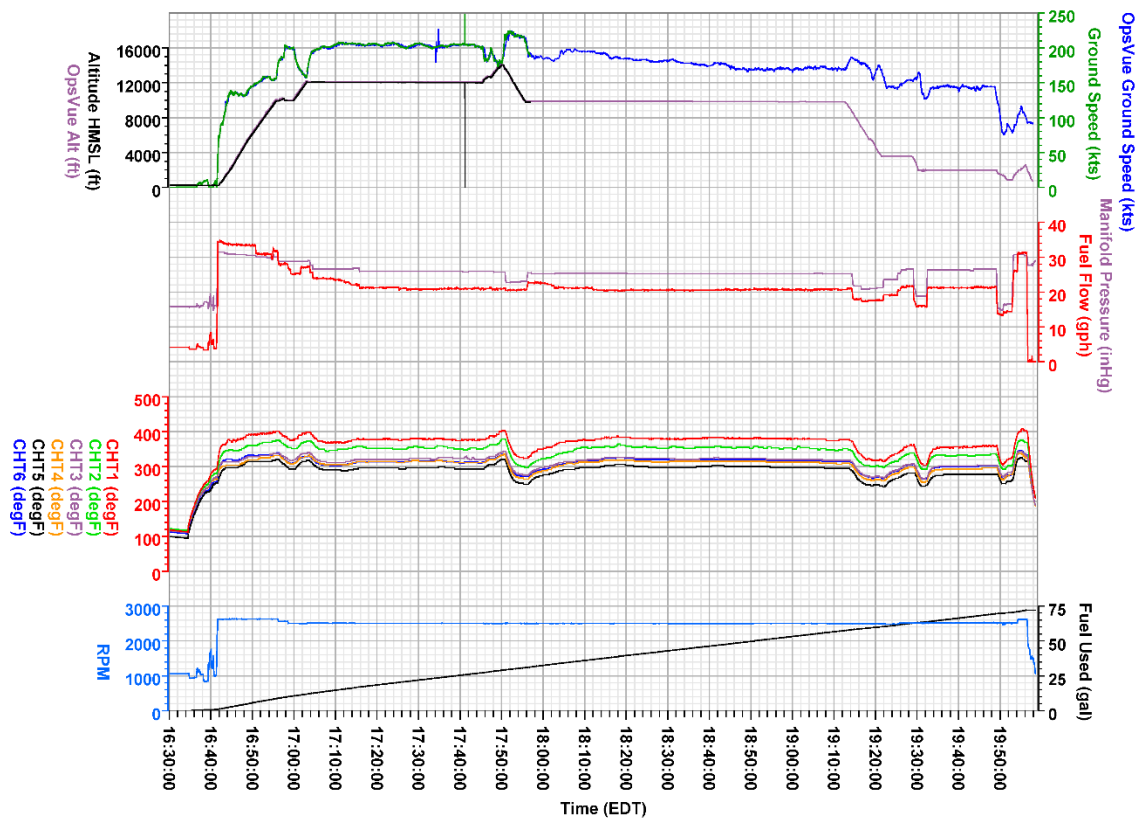


Figure 4. Overview of Engine Parameters from Accident Flight.

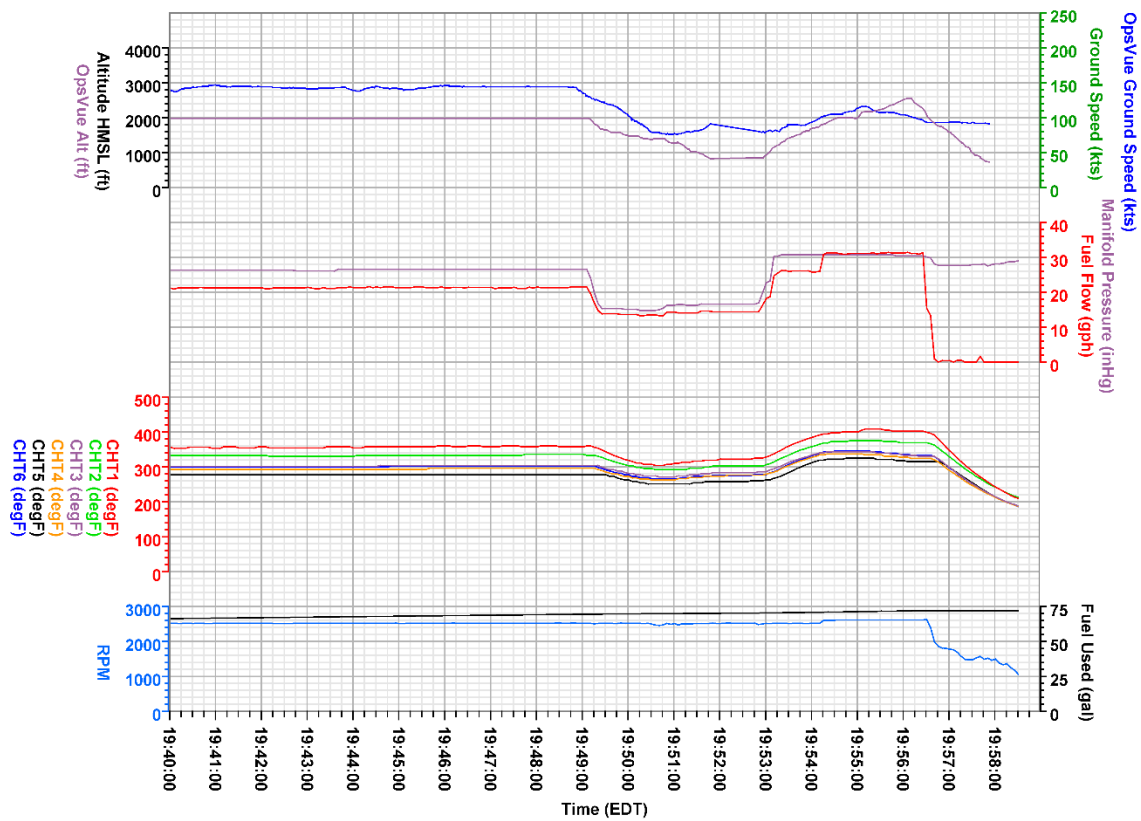


Figure 5. Engine Parameters from End of Accident Flight.

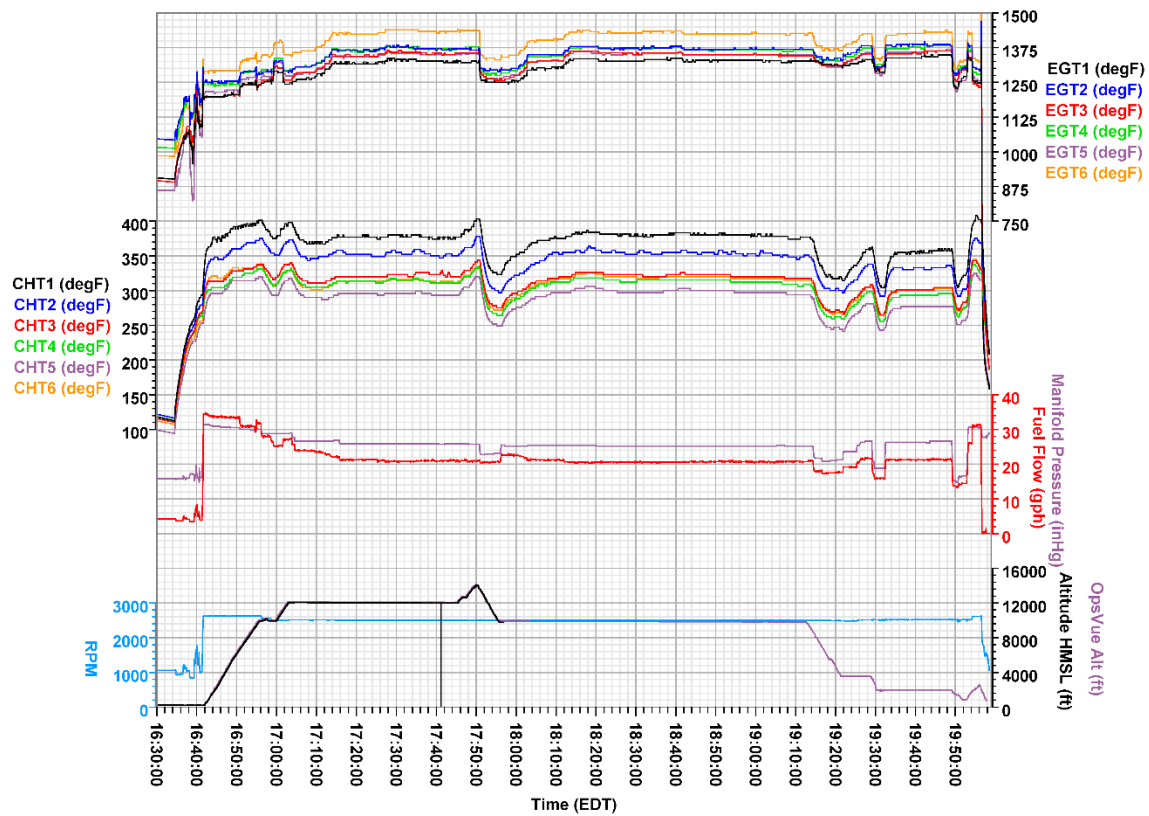


Figure 6. Additional Engine Parameters from the Accident Flight.

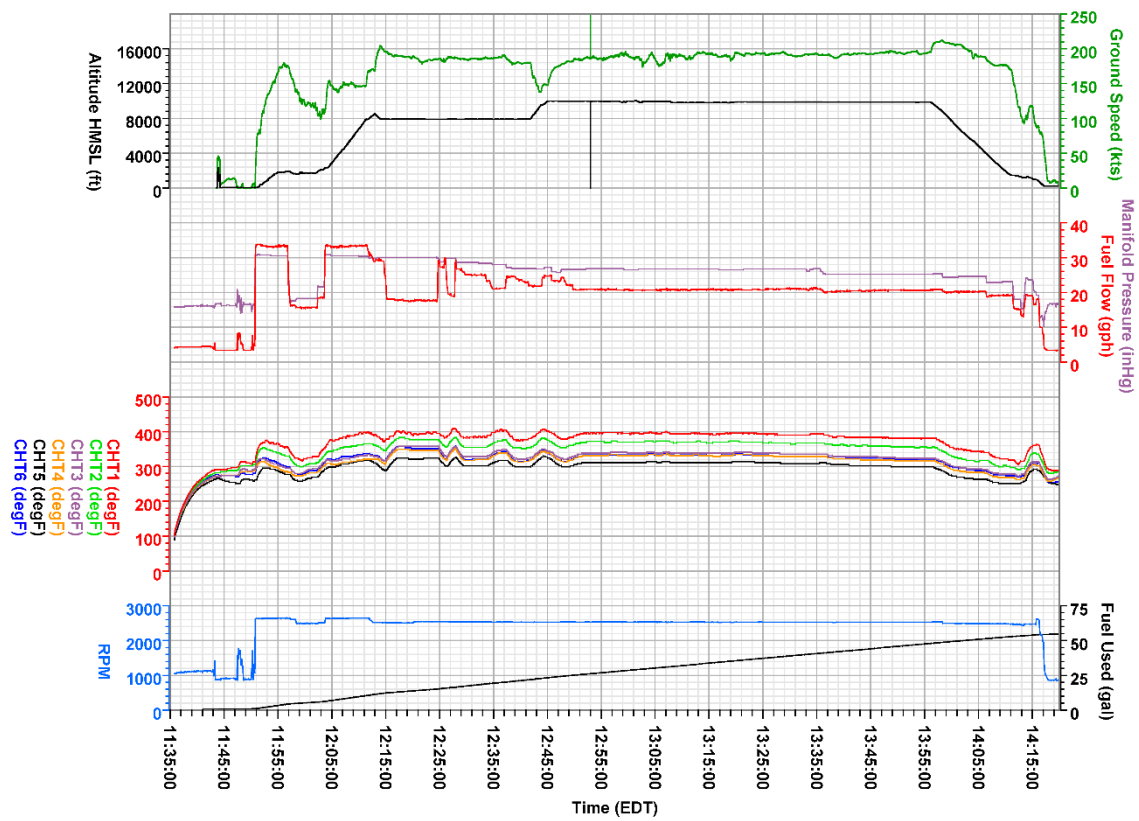


Figure 7. Overview of Engine Parameters from the Prior Flight.

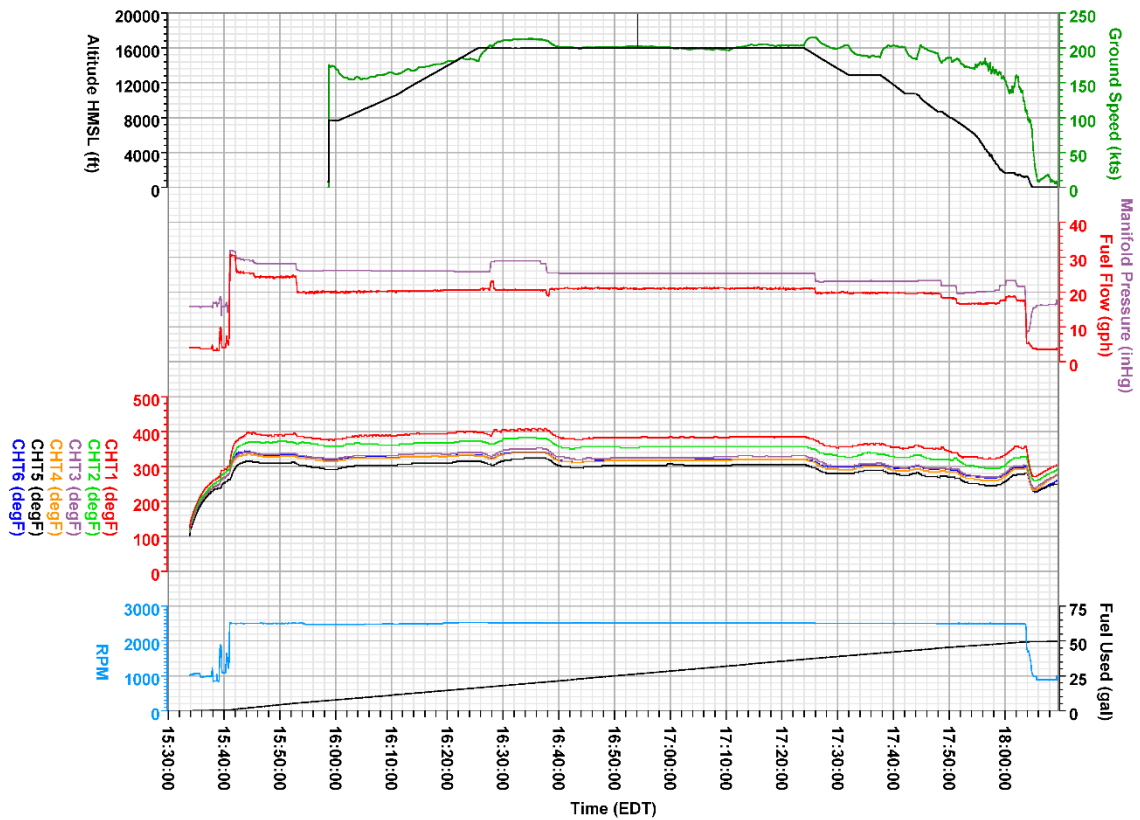


Figure 8. Overview of Engine Parameters from Flight on May 6, 2018, Starting at 15:30

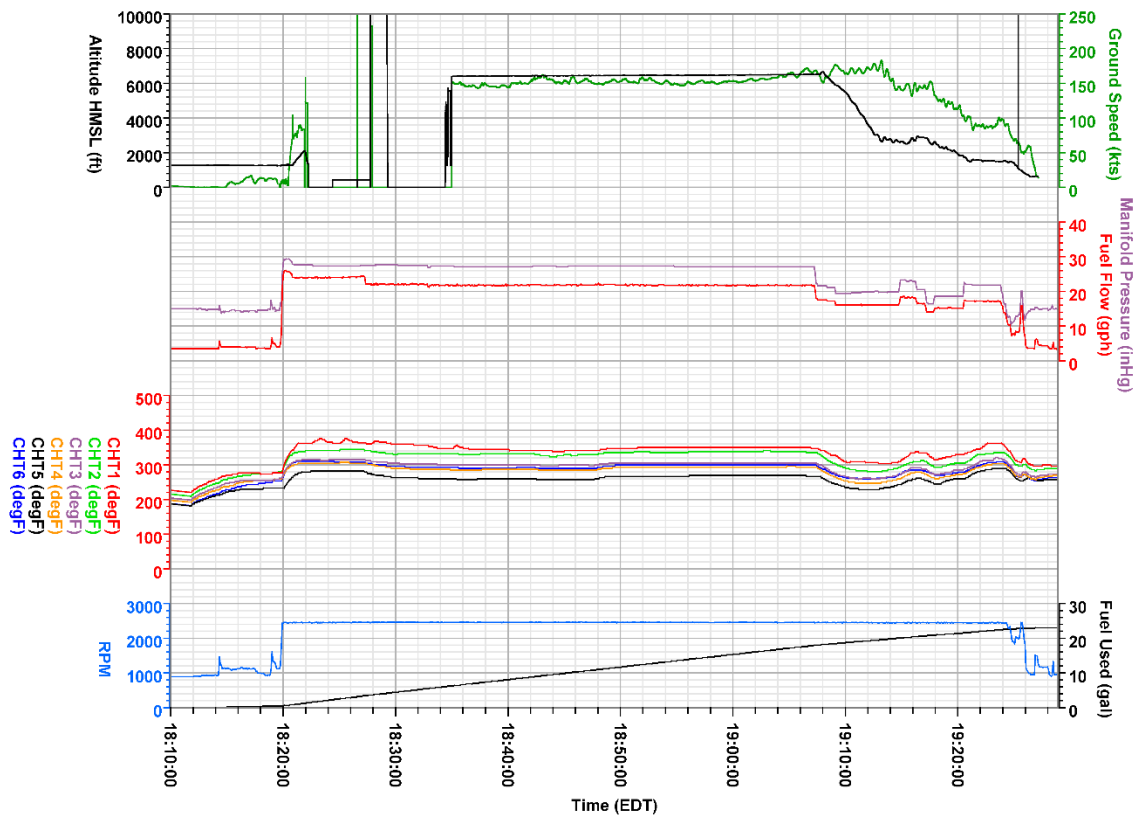


Figure 9. Overview of Engine Parameters from Flight on April 18, 2018, Starting at 18:10

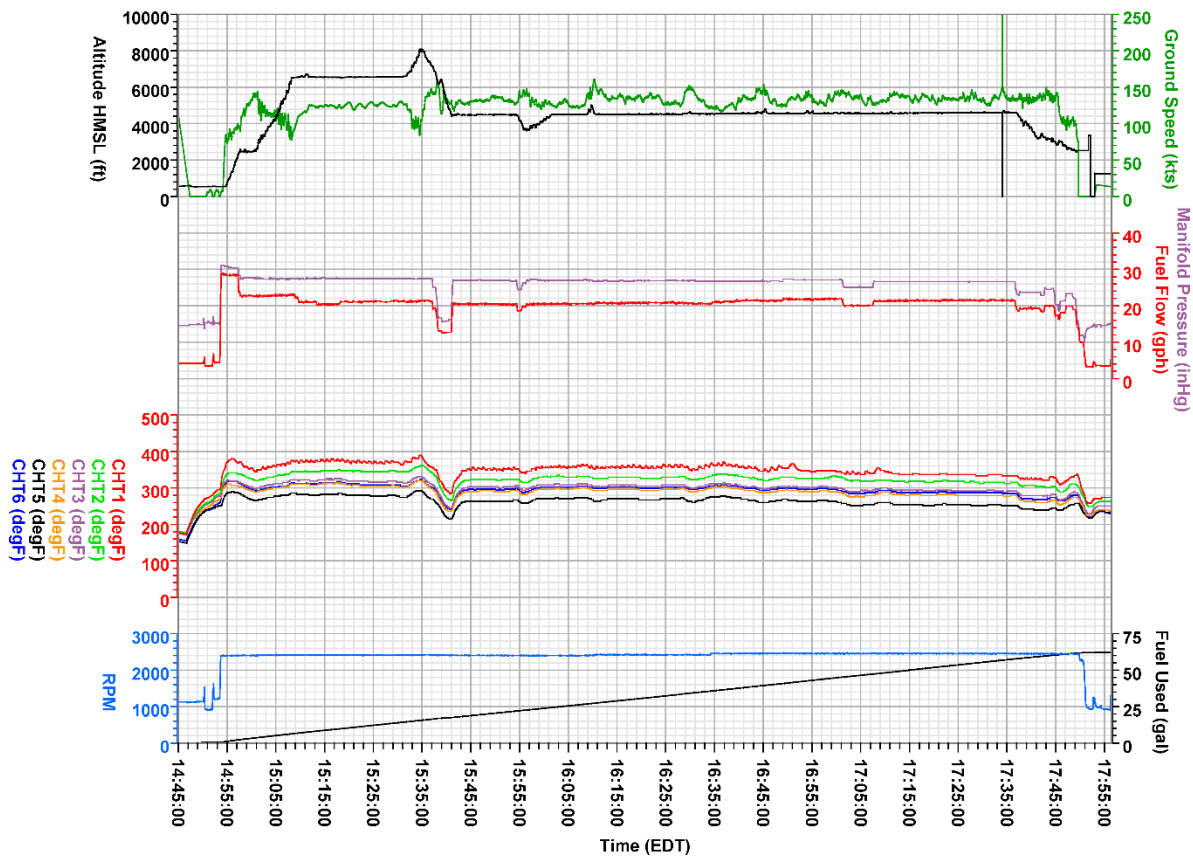


Figure 10. Overview of Engine Parameters from Flight on April 18, 2018, Starting at 14:45

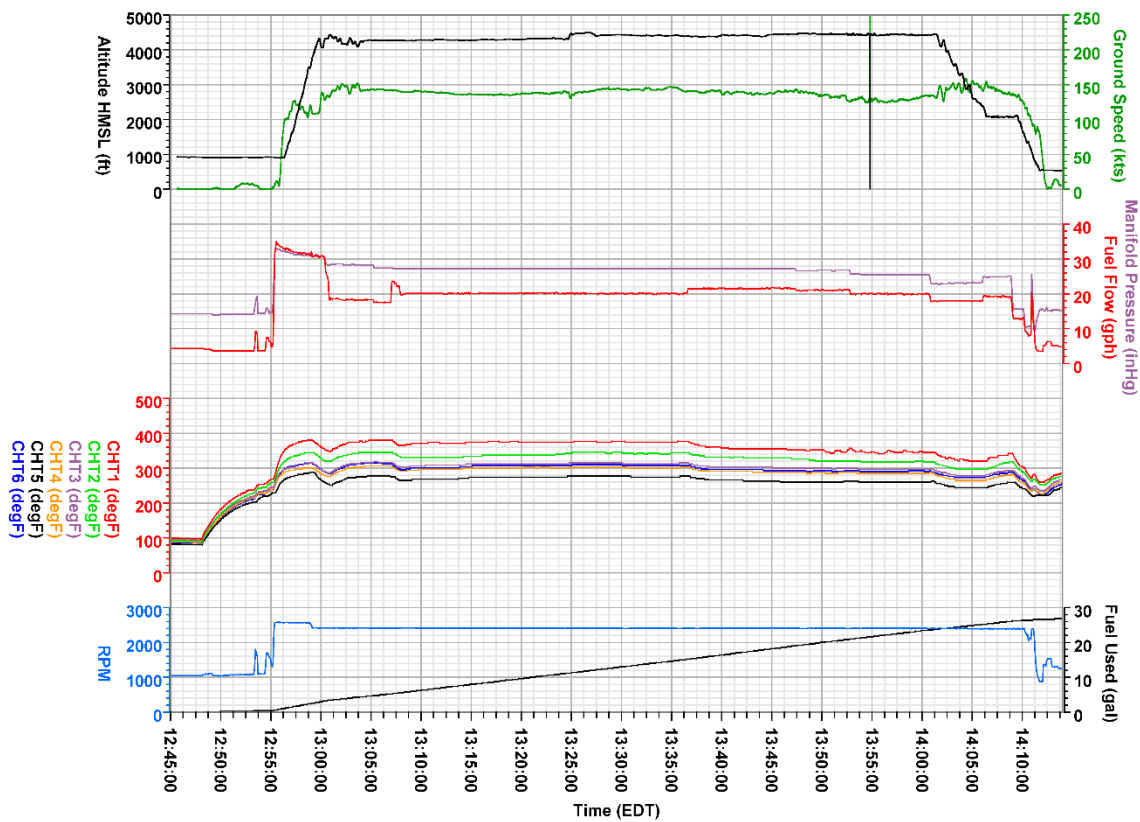


Figure 11. Overview of Engine Parameters from Flight on April 18, 2018, Starting at 12:45

APPENDIX A

This appendix describes the parameters provided and verified in this report.

Table A-1 - Verified and provided parameters.

Parameter Name	Parameter Description	Source
EGT #	Exhaust Gas Temperature of each cylinder # 1-6 in degrees Fahrenheit (degF)	JPI
CHT #	Cylinder Head Temperature of each cylinder # 1-6 in degrees Fahrenheit (degF)	JPI
Fuel Flow	Fuel flow measured in gallons per hour (gph)	JPI
Manifold Pressure	Manifold pressure in inches mercury (inHg)	JPI
RPM	Engine RPM in rotations per minute	JPI
Fuel Used	The total quantity of fuel used in gallons (gal)	JPI
Altitude HMSL	Altitude above mean sea level in feet (ft)	Stratus
Ground Speed	Ground speed in knots (kts)	Stratus