National Transportation Safety Board
Office of Research and Engineering
Washington, DC 20594

ERA22FA261

COCKPIT DISPLAY - RECORDED FLIGHT DATA

Specialist's Factual Report

January 5, 2023

TABLE OF CONTENTS

A. ACCIDENT

Location: Panama City, Florida
Date: June 6, 2022
Time: 16:10 eastern daylight time (EDT)
Airplane: Piper PA-28RT-201 Arrow IV, private operator, N160LL

B. COCKPIT DISPLAY - RECORDED FLIGHT DATA SPECIALIST

Specialist: Charles Cates
Mechanical Engineer/Recorder Specialist
National Transportation Safety Board (NTSB)

C. DETAILS OF THE INVESTIGATION

A cockpit display - recorded flight data group was not convened.

The NTSB Vehicle Recorder Division received the following electronic devices:

Recorder Manufacturer/Model: Dynon EFIS-D10A
Part Number: 503296-000
Recorder Serial Number: 12835

Recorder Manufacturer/Model: Dynon SkyView SV-HDX800
Part Number: 503473-000
Recorder Serial Number: 21122

1.0 Dynon Electronic Flight Information System D10A Description

The Dynon Electronic Flight Information System (EFIS) D10A is a 4" cockpit display mounted in non-type certificated (experimental) aircraft. The instrument integrates multiple flight instruments including airspeed, altitude, gyro-stabilized magnetic compass, turn rate, slip/skid ball, bank angle, pitch angle and vertical speed. The unit also has other functions that include a clock/timer, g-meter, voltmeter, and a density altitude/true airspeed calculator. The unit contains an Air Data, Attitude and Heading Reference System (ADAHRS) to provide air data, attitude and heading information to the display. Depending on the installation in the operator's aircraft certain parameters might not be displayed, for example angle-of-attack.

The data logging must be configured by the operator to enable logging and set the data log interval. The unit can also be configured to start logging data automatically at boot-up. The data logging interval can be set to store at 1, 3, 5, 10,

30 and 60 second intervals. The internal memory can store at least 2 hours of cumulative data at a 1 second recording interval or at least 120 hours at a 60 second data recording interval. When the recording limit in the internal memory is reached, the oldest record is erased and a new record is added.

1.1 Dynon EFIS-D10A Data Recovery

The Dynon EFIS D100 was damaged in the event. The extent of the damage is shown in figure 1. This device can store data in the non-volatile memory (NVM).[1] In this case the silicon chip containing the NVM was found to be cracked. The extent of the damage precluded normal recovery procedures and additional attempts were unsuccessful in yielding usable data. Therefore, no data pertinent to the event were recovered.

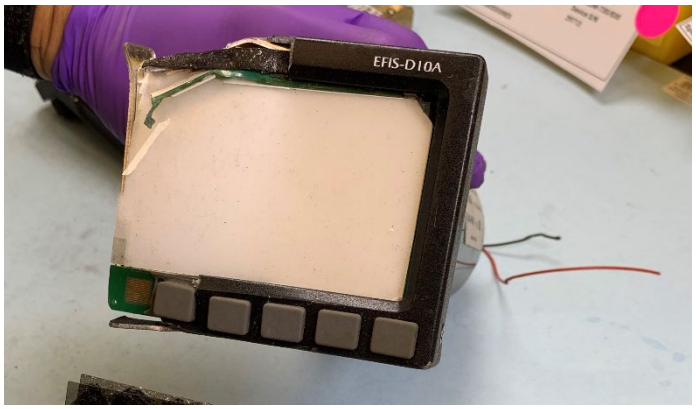

Figure 1. Dynon EFIS-D10A as received by vehicle recorder laboratory.

2.0 Dynon SkyView SV-HDX800 Description

The Dynon SV-HDX800 is a 7" widescreen display with touch interface suitable for mounting in the cockpit of various small aircraft. Its capabilities include engine monitoring, synthetic vision, moving map, traffic, airport diagrams, autopilot control, and radio integration.

The display receives input from multiple modules for flight instrumentation including modules for ADHARS, engine monitoring (EMS), Global Positioning System (GPS), transponder, radios, and intercoms.

Data is recorded on a Serial-ATA based Disk on Module (DOM) mounted to the main board. The DOM contains a user-configurable log file that can record between 2-150 hours of data at sampling rates ranging from 0.1-16 samples per second (Hz). There is also an alert log file that is recorded whenever the device

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

triggers any kind of alert and a “Black Box” recent flight data log file which contains the most recent 15 minutes of flight recorded at 16 Hz.

2.1 Dynon SkyView SV-HDX800 Data Recovery

The device was damaged by mechanical impact forces and the screen and normal interfaces were not operational. The extent of the damage is shown in Figure 2. The DOM memory module was removed from the device and successfully downloaded using digital forensics software.

Figure 2. Dynon Skyview SV-HDX800 as received by vehicle recorder laboratory.

2.2 Dynon SkyView SV-HDX800 Data Description

The operator had the user log function set to record at a 4 Hz rate and begin recording at device power on. The data covered operation on 12 days in the previous month, although some recordings were brief powerups and did not contain flights. The accident flight was the last flight of the recording and had a duration of approximately 11 minutes.

2.3 Dynon SkyView SV-HDX800 Time Correlation

The unit records universal coordinated time (UTC) GPS time. The difference between eastern daylight time (EDT) and UTC is 5 hours, or 18,000 seconds. An offset is applied to display the data with the local time zone. Therefore, for the rest of this report, all times are referenced as EDT. However, previous flights are referenced in recorder elapsed time.

D. FIGURES AND TABULAR DATA

Figures 3 and 4 contain Dynon SV-HDX800 data recorded during the event flight on June 6, 2022. Figures 5 and 6 contain Dynon SV-HDX800 data recorded during the previous recorded flight, also on June 6, 2022. All the parameters listed in table 1 are plotted except UTC Hours, UTC Minutes, and UTC Seconds.

Figures 3 and 5 consist of basic aircraft parameters. Figures 4 and 6 consist of engine parameters. Figure 3 covers the time from when the aircraft turns on to the runway until the end of the recording, 1605:00 to 1610:40 EDT. Figure 4 covers the time from the recorder power on prior to the accident flight until the end of the recording, 1549:30 to 1610:40 EDT. Figures 5 and 6 cover the full recording of the previous flight.

These figures are configured such that right turns are indicated by the trace moving toward the bottom of the page, left turns towards the top of the page, and nose up attitudes towards the top of the page.

In summary, the data show that when the engine was started for the accident flight, oil pressure initially stabilized at about 67 pounds per square inch (psi) immediately after engine start. The oil pressure gradually decreased as oil temperature increased and continued decreasing as the aircraft taxied to the runway. Immediately prior to takeoff, oil pressure had reduced to about 10 psi. When the engine advanced to takeoff power, oil pressure dropped to 4 psi.

Following the engine start prior to the previous flight of the aircraft, the oil pressure initially stabilized at 89 psi and decreased gradually as oil temperature increased. Immediately prior to setting takeoff power, oil pressure had reduced to about 50 psi. Oil pressure remained steady at 80 psi during the flight. After landing, oil pressure ranged between 50-70 psi, depending on the engine power setting.

The corresponding tabular data used to create figures 3 and 4, including recorded system time, are provided in electronic comma separated value (CSV) format as attachment 1 to this report. The corresponding tabular data to create figures 5 and 6 are provided is CSV format as attachment 2 to this report.

Submitted by:

Charles Cates
Mechanical Engineer/Recorder Specialist

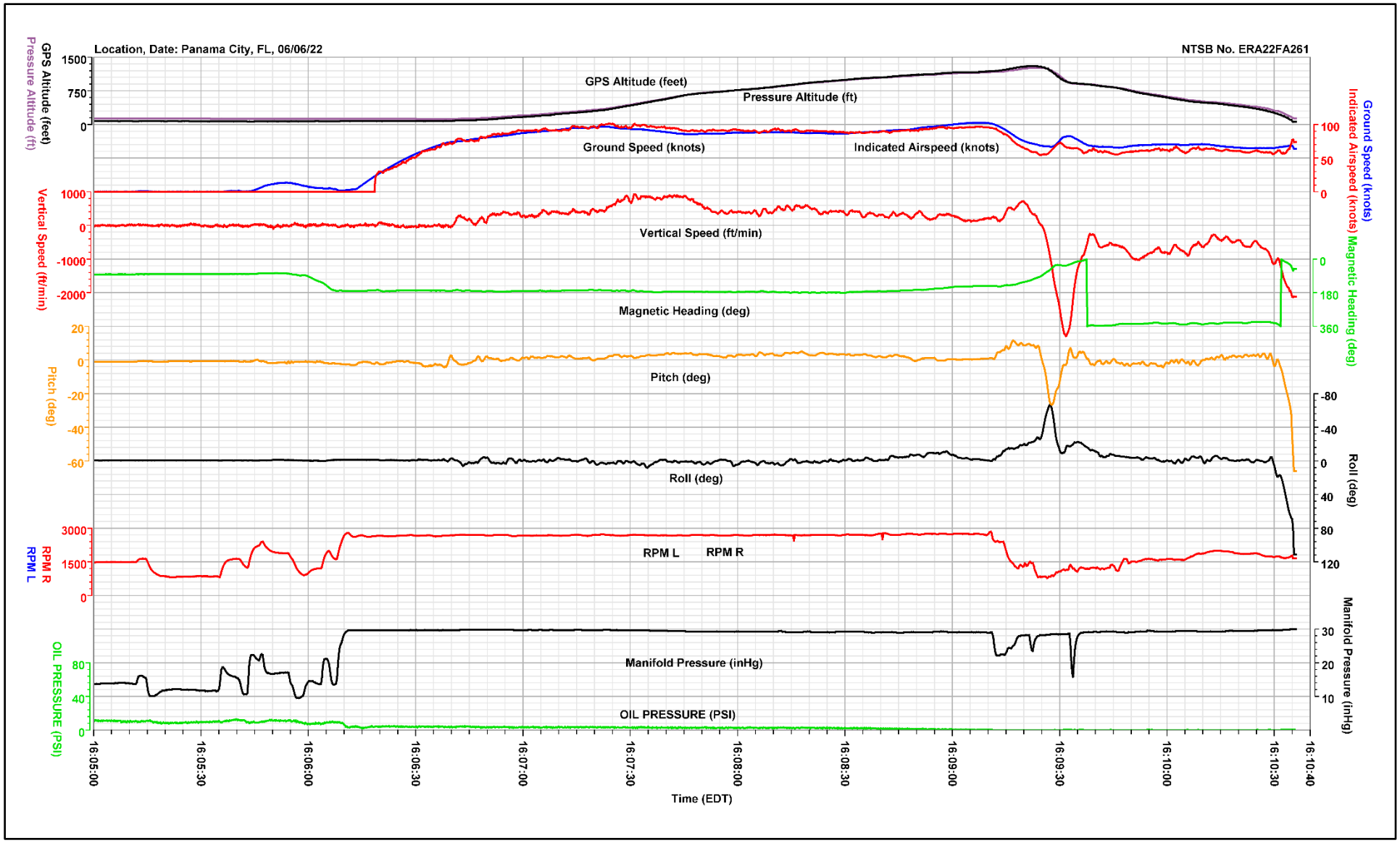

Figure 3. Plot of basic parameters during the accident flight.

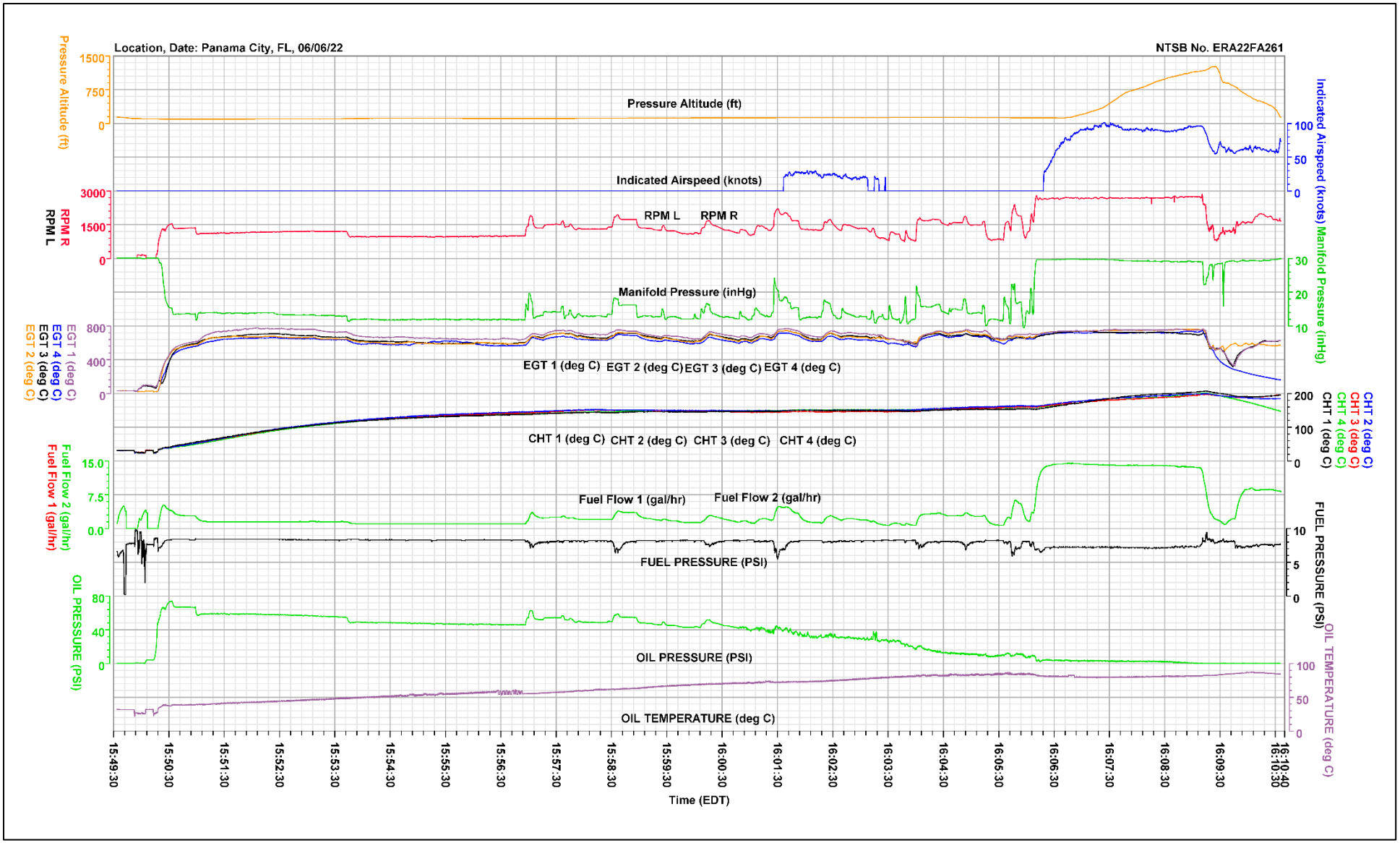

Figure 4. Plot of engine parameters from accident flight (full recording).

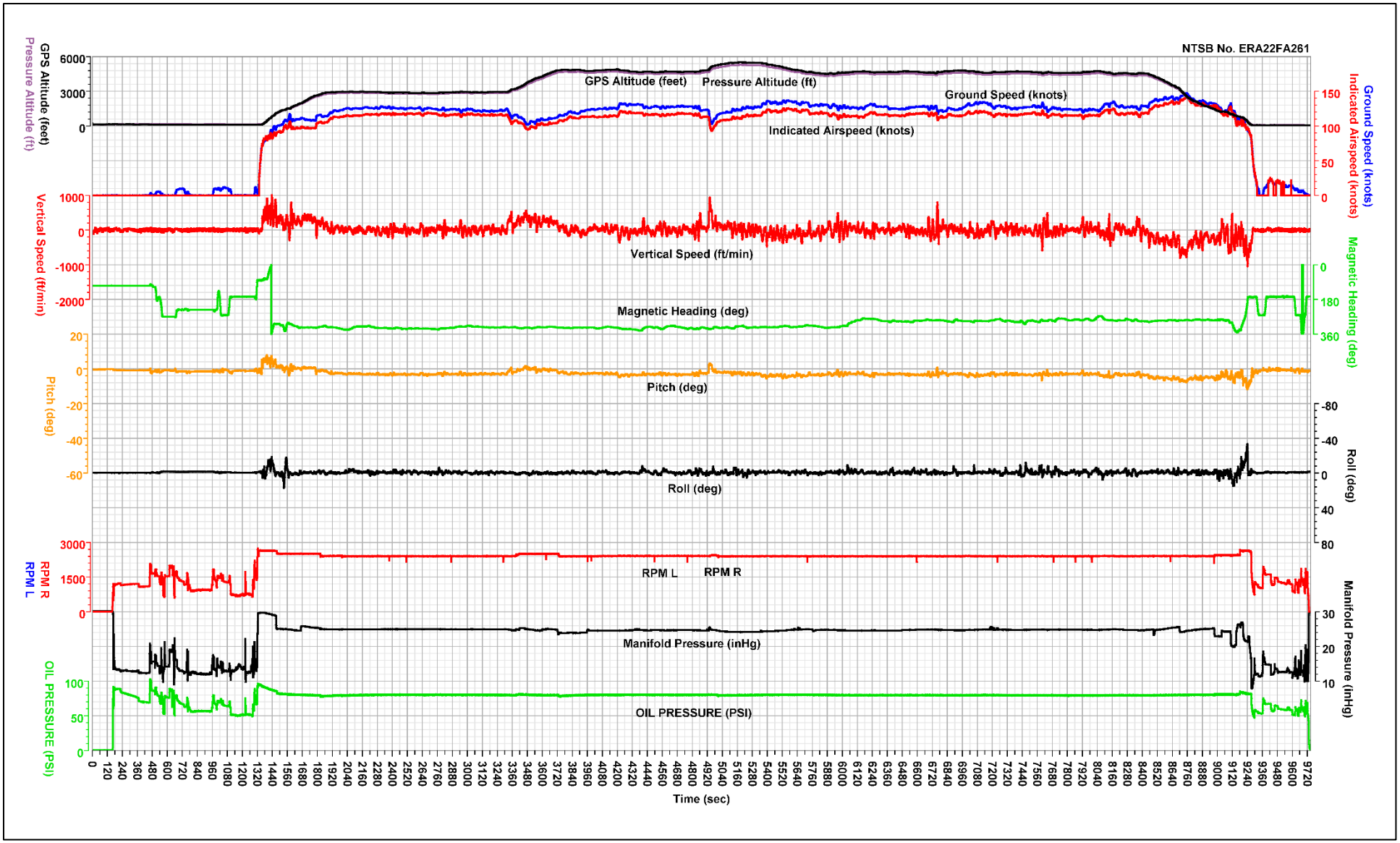

Figure 5. Plot of basic parameters from previous flight (full recording).

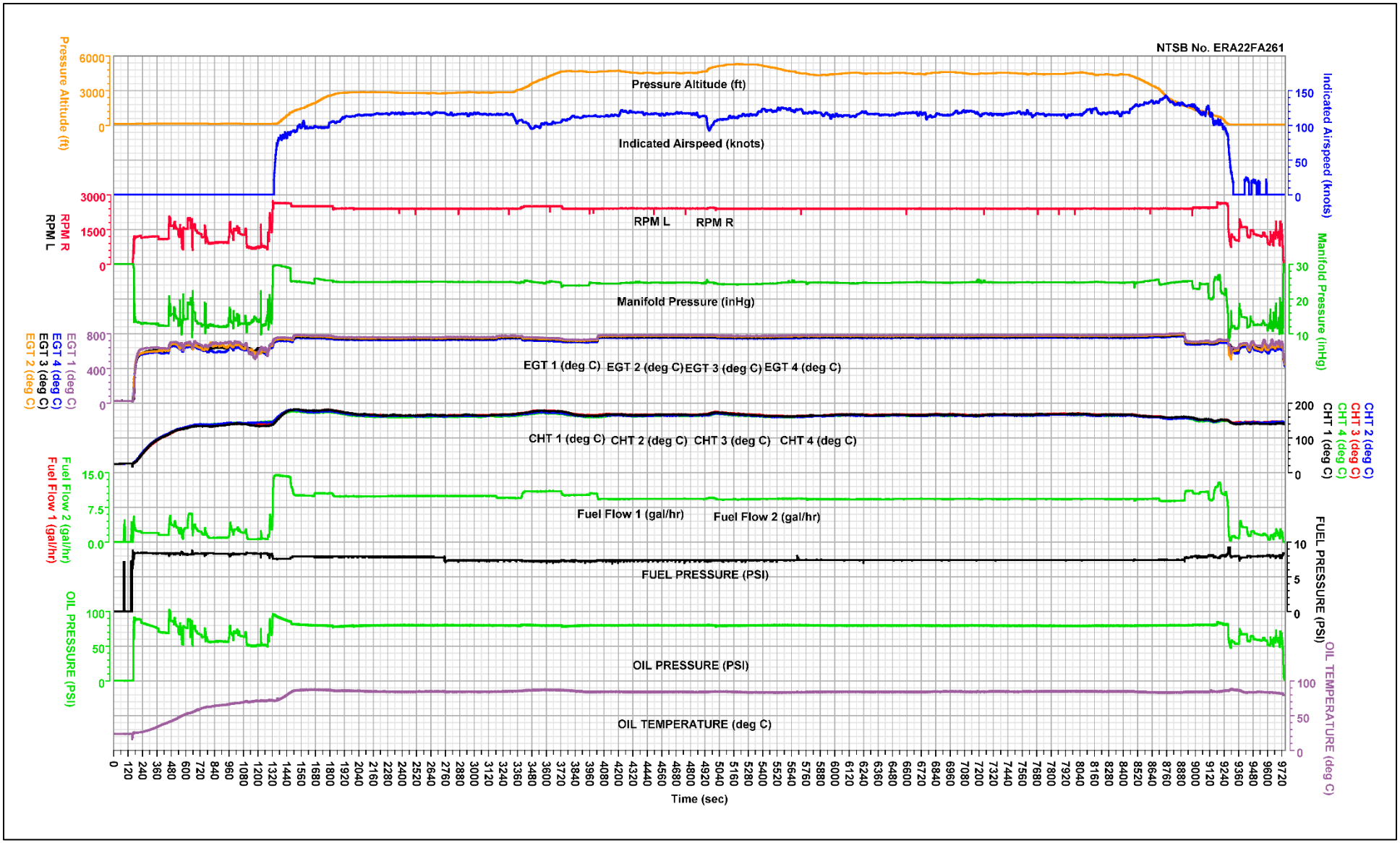

Figure 6. Plot of engine parameters from previous flight (full recording).

APPENDIX A. VERIFIED AND PROVIDED PARAMETERS

This appendix describes the parameters provided and verified in this report. Table 1 lists the Dynon SkyView SV-HDX800 parameters and table 2 describes the unit abbreviations used in this report for Dynon SkyView SV-HDX800 parameters.

Table 1. Verified and provided parameters.

Parameter Name	Parameter Description	Units
1. CHT 1	Cylinder Head Temperature Cylinder 1	deg C
2. CHT 2	Cylinder Head Temperature Cylinder 2	deg C
3. CHT 3	Cylinder Head Temperature Cylinder 3	deg C
4. CHT 4	Cylinder Head Temperature Cylinder 4	deg C
5. EGT 1	Exhaust Gas Temperature Cylinder 1	deg C
6. EGT 2	Exhaust Gas Temperature Cylinder 2	deg C
7. EGT 3	Exhaust Gas Temperature Cylinder 3	deg C
8. EGT 4	Exhaust Gas Temperature Cylinder 4	deg C
9. Fuel Flow 1	Fuel Flow reading 1	gal/hr
10. Fuel Flow 2	Fuel Flow reading 2	gal/hr
11. Fuel Pressure	Fuel delivery pressure	psi
12. GPS Altitude	GPS Altitude	ft
13. Ground Speed	Speed across the ground	kts
14. Indicated Airspeed	Indicated Airspeed	kts
15. Magnetic Heading	Magnetic Heading	deg
16. Manifold Pressure	Engine Intake Manifold Pressure	inHg
17. Oil Pressure	Oil Pressure	psi
18. Oil Temperature	Oil Temperature	deg C
19. Pitch	Pitch angle	deg
20. Pressure Altitude	Pressure Altitude	ft
21. Roll	Roll Angle	deg
22. RPM L	Engine RPM reading 1	rpm
23. RPM R	Engine RPM reading 2	rpm
24. Vertical Speed	Vertical Speed	ft/min

Note: The Dynon SkyView SV-HDX800 records pressure altitude, which is based on a standard altimeter setting of 29.92 inches of mercury (in Hg). The pressure altitude information presented in the plots and in the electronic data has not been corrected for the local altimeter setting at the time of the event.

Table 2. Unit abbreviations.

Units Abbreviation	Description
deg	degrees
deg C	degrees Celsius
ft	feet
ft/min	feet per minute
gal/hr	gallons per hour
inHg	inches of Mercury
kts	knots
psi	pounds per square inch
rpm	revolutions per minute