

NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division
Washington, D.C. 20594

February 11, 2016

Flight Data Recorder

Specialist's Factual Report By Charles Cates

1. EVENT SUMMARY

Location: Fort Lauderdale, FL
Date: October 29, 2015
Aircraft: Boeing 767-200
Registration: N251MY
Operator: Dynamic Air
NTSB Number: DCA16FA013

On October 29, 2015, about 1233 eastern daylight time (EDT), Dynamic International Airways flight 405, a Boeing 767-200ER, N251MY, caught fire while taxiing for departure at Fort Lauderdale-Hollywood International Airport (FLL), Fort Lauderdale, Florida. One passenger received serious injuries and the remaining 89 passengers and 11 crewmembers received minor injuries or were not injured. The airplane sustained substantial damage from the fire. The scheduled charter flight was operating under the provisions of 14 *Code of Federal Regulations* Part 121 supplemental and was en route to Maiquetia - Simon Bolivar International Airport (CCS), Caracas, Venezuela.

2. FLIGHT DATA RECORDER GROUP

A flight data recorder (FDR) group was not convened.

3. FDR Carriage Requirements

The event aircraft, N251MY, was delivered in March, 1986, and was operating such that it was required to be equipped with an FDR that recorded, at a minimum, 22 parameters, as cited in Title 14 CFR Part 121.344.

4. DETAILS OF FDR INVESTIGATION

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

Recorder Manufacturer/Model: **Allied Signal UFDR**
Recorder Serial Number: **3718**

4.1. Allied Signal UFDR Description

The Allied Signal Universal Flight Data Recorder (UFDR) records airplane flight information in a binary format, using analog signals, onto eight tracks of 1/4-inch Mylar

tape. The UFDR can receive data in the ARINC 573/717/542 configurations and records 64 words of digital information every second, with each word 12 bits in length. Each grouping of 64 words (or 768 bits) is called a subframe. Each subframe has a unique 12-bit synchronization (sync) word identifying it as either subframe 1, 2, 3, or 4. The sync word is the first word in each subframe. Each grouping of consecutive 1, 2, 3 and 4 subframes comprise a frame (i.e., four seconds of data). The data stream is "in sync" when successive sync words appear at the proper 64-word intervals. Each data parameter (e.g. altitude, heading, and airspeed) has a specifically assigned word number within the subframe.

The UFDR records 8 distinct individual tracks, written bi-directionally. Approximately 3 hours of data are written on one track until reaching the end-of-tape sensor, and then the recorder reverses tape direction, switches to the next incremented track, and writes data in the reverse direction on the tape. Using this method, the FDR records even-numbered tracks in one direction and odd-numbered tracks in the opposite direction. A minimum of 25 hours of flight data is recorded by erasing the oldest data and replacing it with the newest.

The UFDR utilizes a data-checking process known as "check-stroke". The data are written onto the FDR tape in "bursts" of 1 subframe of data (768 bits). The UFDR adds a series of preamble and postamble bits to the beginning and end of each second of information. After writing a second of data, the tape is stopped, reversed, and read for accuracy. The tape is then advanced, past the most recent written second of data and stopped. The next second of data is then written. By writing the data onto the tape in this manner, a segment of unused or blank tape is created. The unused segment is known as an inter-record gap (IRG). The result of the check-stroke recording method is an alternating pattern of consecutive seconds of data, separated by IRGs. The pattern can be viewed optically with the use of a magnetically sensitive fluid. The inter-record gap and each second of data measure about 0.48 inches along the FDR tape. The UFDR's method of operation does not guarantee that the first word written within each second of data is the synch word – rather than appear at the beginning of each second of data, the IRG can appear at any point within the 64-word subframe. Each second of data may contain data that span 2 consecutive subframes. Therefore, a specific subframe of data can bridge an inter-record gap.

Additionally, the UFDR is designed to meet the crash and fire protection characteristics of TSO-C51a.

4.1.1. Recorder Condition

The FDR was examined upon receipt and was found to be in good condition. Upon removal, the magnetic tape was found to be undamaged. The data were transcribed from the tape medium to computer hard drive for analysis using the NTSB's laboratory equipment. The accident flight was located during the transcription.

4.1.2. Recording Description

The FDR recording contained approximately 25 hours of data. Timing of the FDR data is measured in subframe reference number (SRN), where each SRN equals one elapsed second. The event flight was found in track 1 of the FDR tape, and its duration was

approximately 5 minutes. The parameters evaluated for the purpose of this report appeared to be in accordance with the federal FDR carriage requirements.

4.1.3. Engineering Units Conversions

The engineering units conversions used for the data contained in this report are based on documentation from the operator and aircraft manufacturer. Where applicable, the conversions have been changed to ensure that the parameters conform to the NTSB's standard sign convention that climbing right turns are positive (CRT=+).¹

Table A-1 lists the FDR parameters verified and provided in this report. Additionally, table A-2 describes the unit and discrete abbreviations used in this report.

4.2. Time Correlation

Correlation of the FDR data from SRN to the event local time, EDT, was established by using the recorded Time GMT² hours, Time GMT Minutes, and Time GMT Seconds and then applying an additional -04 hours offset to change GMT to EDT.

Accordingly, the time offset for the event flight data from SRN to local EDT is the following: EDT = SRN + 38343.625. Therefore, for the rest of this report, all times are referenced as EDT, not SRN.

4.3. FDR Plots and Corresponding Tabular Data

The following three figures contain FDR data recorded during the October 29, 2015 event. All the parameters listed in table A-1 are plotted, except Time GMT Hrs, Time GMT Min, and Time GMT Sec.

Figure 1 contains aircraft basic parameters. Figure 2 contains aircraft configuration and warning parameters. Figure 3 contains engine parameters from both engines.

The three figures contain the full period of recorded data, spanning a time period of just over 5 minutes.

Several parameters in figures 2 and 3 are superframe parameters, meaning that they are only recorded once every 64 seconds. Specifically, Gross Weight, Emergency Lights, EGT, and Fuel Flow are superframe parameters, and therefore do not span the full duration of the recording.

A short gap can be seen in some parameters at 1233:15. This is because the left engine was shut down at this time, and normal aircraft power transfers interrupted the recording, causing a short gap in the data.

Seen in figure 1, at the beginning of the recording the aircraft was stationary, with weight on wheels, facing a heading of 270 degrees. The aircraft made a 180 degree turn to the

¹ CRT=+ means that for any parameter recorded that indicates a climb or a right turn, the sign for that value is positive. Also, for any parameter recorded that indicates an action or deflection, if it induces a climb or right turn, the value is positive. Examples: Right Roll = +, Pitch Up = +, Elevator Trailing Edge Up = +, Right Rudder = +.

² GMT is Greenwich Mean Time which is also known as Coordinated Universal Time (UTC).

right, and reached a max taxi ground speed of 20 knots. A master caution was recorded at 1233:14, and the aircraft was brought to a stop with -0.2g longitudinal force. A master warning was recorded 5 seconds after the master caution, with the aircraft stopped.

Figure 2 shows that the aircraft gross weight was around 250,000 lbs. The flap handle was set to 5 degrees, and the engines were operating at 1.00 EPR. Following the Master Caution and Master Warning, the wheel well fire detector recorded a fire alarm at 1233:20. The forward equipment bay smoke detector recorded a smoke alarm at 1233:29.

Figure 3 shows that the engines were operating at speeds typical of idle power. Engine 1 recorded a dip to sub-idle power at 1233:16. The fuel cutoff switch was recorded in the cutoff position at 1233:21, and the fuel valve transitioned from open to not open.

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.

The corresponding tabular data used to create these three plots are provided in electronic comma separated value (*.csv) format as attachment 1 to this report.

Figure 1. Plot of basic parameters during entire flight.

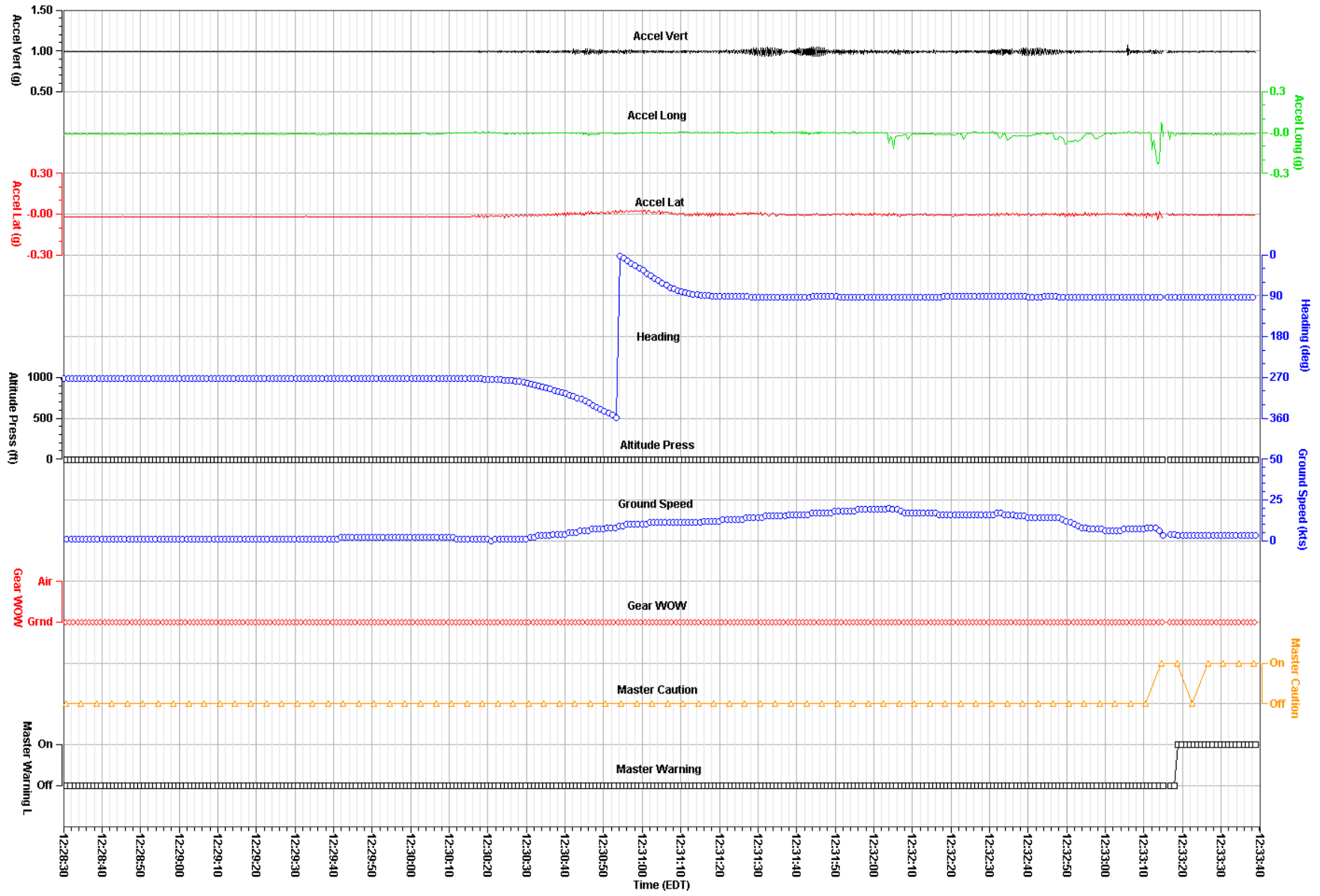


Figure 2. Plot of aircraft configuration and warning parameters during entire flight.

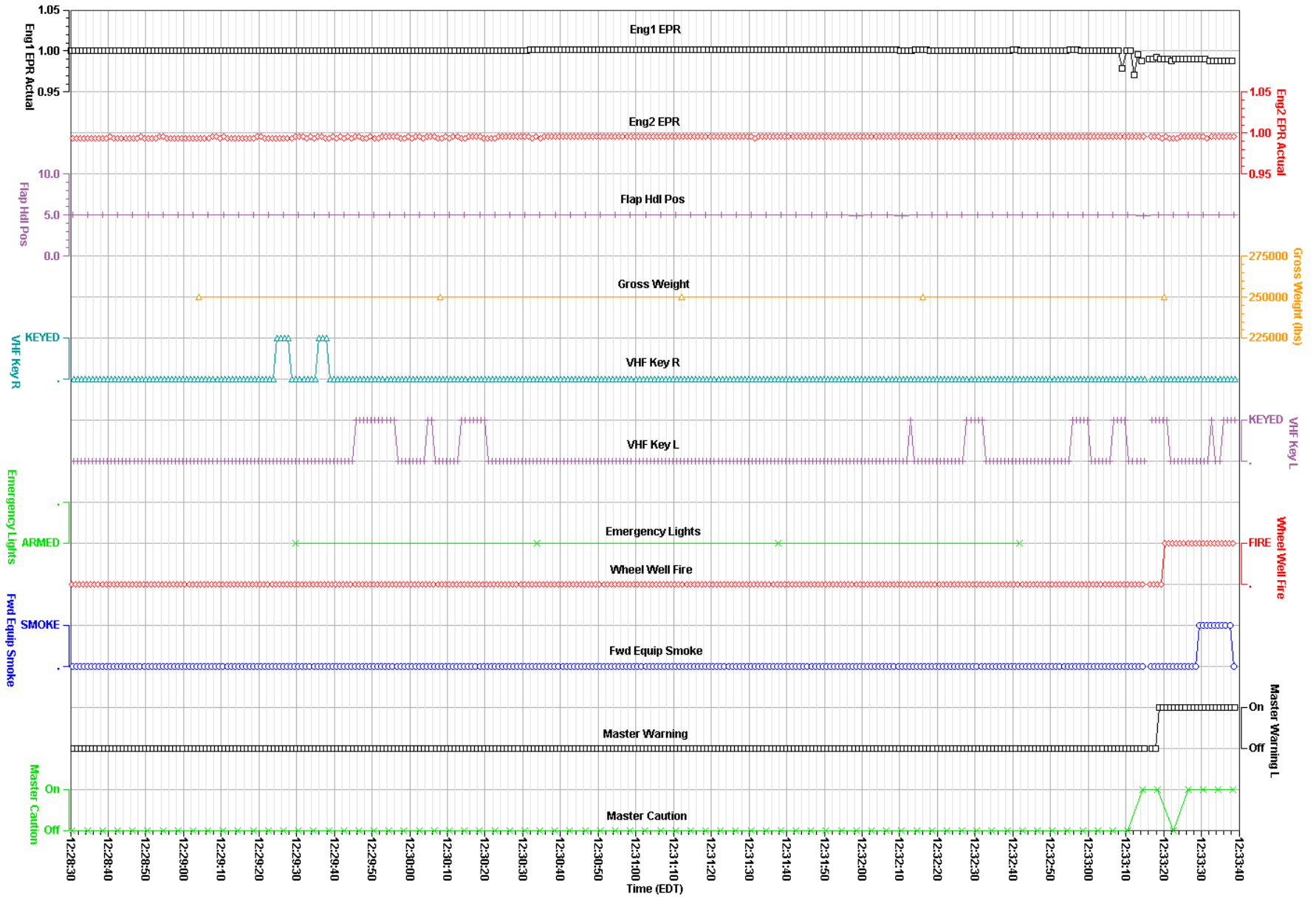
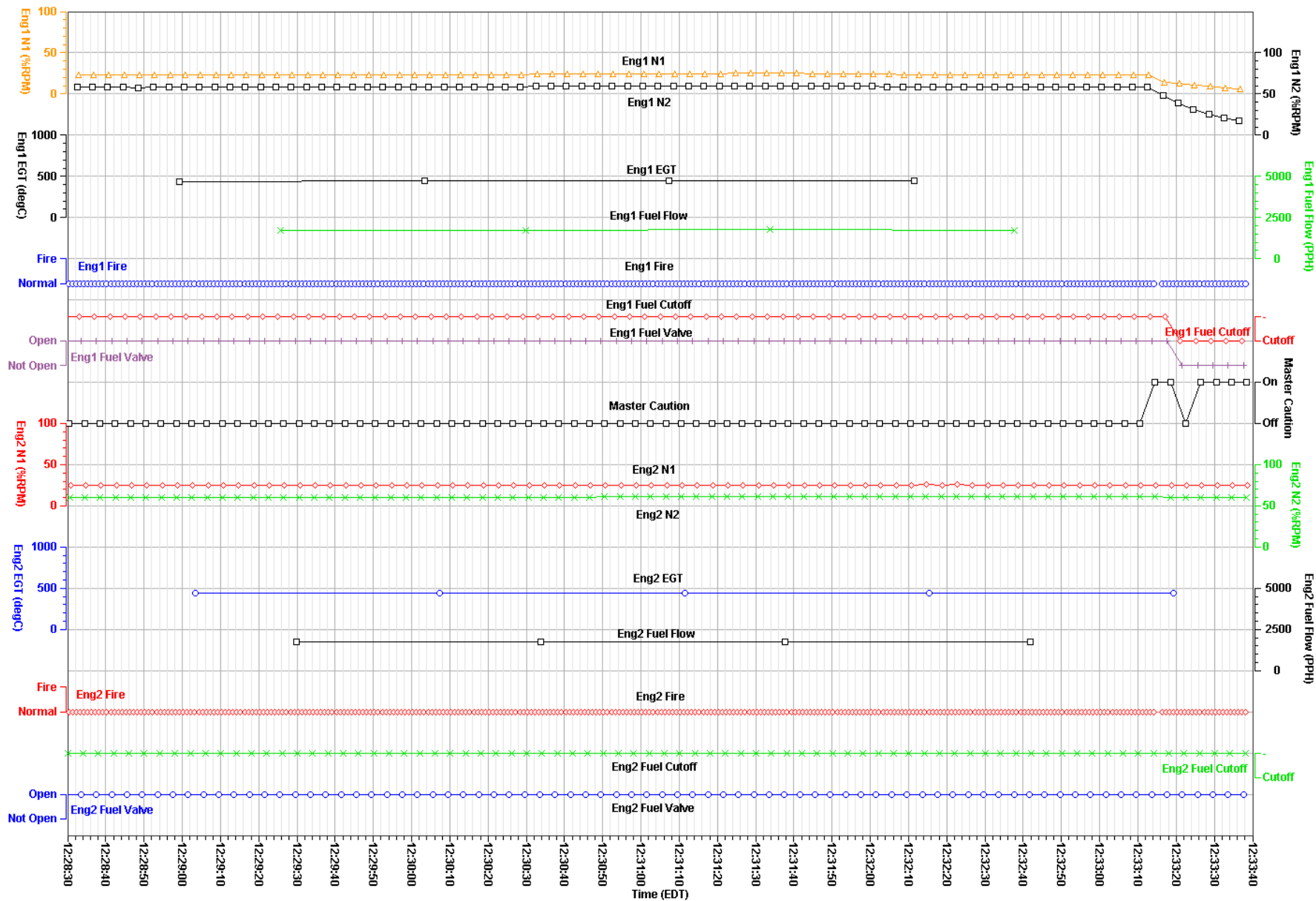


Figure 3. Plot of engine parameters during entire flight.



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 and discrete abbreviations used in this report.

Table A-1. Verified and provided FDR parameters.

Parameter Name	Parameter Description
1. Accel Lat (g)	Lateral Acceleration
2. Accel Long (g)	Longitudinal Acceleration
3. Accel Vert (g)	Vertical Acceleration
4. Altitude Press (ft)	Pressure Altitude
5. Emergency Lights (discrete)	Emergency Lighting Active
6. Eng1 EGT (deg C)	Engine 1 Exhaust Gas Temperature
7. Eng1 EPR (ratio)	Engine 1 Engine Pressure Ratio
8. Eng1 Fire (discrete)	Engine 1 Fire Detected
9. Eng1 Fuel Cutoff (discrete)	Engine 1 Fuel Cutoff Switch Position
10. Eng1 Fuel Flow (lbs/hr)	Engine 1 Fuel Flow
11. Eng1 Fuel Valve (discrete)	Engine 1 Fuel Cutoff Valve Position
12. Eng1 N1 (% RPM)	Engine 1 Fan Speed
13. Eng1 N2 (% RPM)	Engine 1 Core Speed
14. Eng2 EGT (deg C)	Engine 2 Exhaust Gas Temperature
15. Eng2 EPR (ratio)	Engine 2 Engine Pressure Ratio
16. Eng2 Fire (discrete)	Engine 2 Fire Detected
17. Eng2 Fuel Cutoff (discrete)	Engine 2 Fuel Cutoff Switch Position
18. Eng2 Fuel Flow (lbs/hr)	Engine 2 Fuel Flow
19. Eng2 Fuel Valve (discrete)	Engine 2 Fuel Cutoff Valve Position
20. Eng2 N1 (% RPM)	Engine 2 Fan Speed
21. Eng2 N2 (%RPM)	Engine 2 Core Speed
22. Flap Hdl Pos (deg)	Flap Handle Position
23. Fwd Equip Smoke (discrete)	Forward Equipment Bay Smoke Detected
24. Gear WOW (discrete)	Landing Gear Weight on Wheels
25. Gross Weight (lbs)	Aircraft Gross Weight
26. Ground Speed (kts)	Ground Speed
27. Heading (deg)	Heading
28. Master Caution (discrete)	Master Caution
29. Master Warning L (discrete)	Master Warning
30. Time GMT Hrs (hrs)	Greenwich Mean Time, Hours
31. Time GMT Min (min)	Greenwich Mean Time, Minutes
32. Time GMT Sec (sec)	Greenwich Mean Time, Seconds
33. VHF Key L (discrete)	Left VHF Radio Transmit Active
34. VHF Key R (discrete)	Right VHF Radio Transmit Active
35. Wheel Well Fire (discrete)	Wheel Well Fire Detected

NOTE: This FDR 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 FDR plots and in the electronic data has not been corrected for the local altimeter setting at the time of the event.

Table A-2. Unit and discrete abbreviations.

Units Abbreviation	Description
% RPM	percent revolutions per minute
deg	degrees
deg C	degrees Celsius
discrete	discrete state parameter
ft	feet
g	g
hrs	hours
kts	knots
lbs/hr	pounds per hour
min	minutes
sec	seconds

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.