

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

April 8, 2016

Flight Data Recorder

Specialist's Factual Report
By George Haralampopoulos

1. EVENT SUMMARY

Location: Beaumont, Texas
Date: November 7, 2015
Aircraft: Boeing 787-900
Registration: N27958
Operator: United Airlines
NTSB Number: DCA16CA010

On November 7, 2015, at about 0600 central daylight time, United Airlines flight #128, a Boeing 787-900, registration N27958, encountered moderate turbulence while descending to Houston G. Bush Intercontinental Airport (IAH). The seatbelt sign was on. There were no passenger injuries and one flight attendant reported injuries.

2. FLIGHT DATA RECORDER GROUP

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

3. FDR CARRIAGE REQUIREMENTS

The event aircraft, N27958, was manufactured in September 2015, and was operating such that it was required to be equipped with an FDR that recorded, at a minimum, 88 parameters, as cited in 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: **GE EAFR-2100**

Recorder Serial Number (S/N): **41X45V**

4.1. EAFR Device Description

The EAFR-2100 is a multifunction recorder which records flight data, audio data, and communication, navigation, surveillance air traffic management (CNSATM) messages designed to meet the characteristics of *ARINC Characteristic 767, Enhanced Airborne Flight Recorder* (EAFR). Two EAFRs are installed on Boeing 787 aircraft, one forward and one aft. The forward and aft recorders are powered by the left and right 28V DC buses respectively. The forward recorder is equipped with a recorder independent power supply (RIPS) to provide backup power to the recorder for approximately 10 minutes once left DC

bus power is lost. Both recorders record the same set of flight data independent of each other.

4.1.1. EAFR Recording Description

The EAFR recording contained approximately 50 hours of flight data in ARINC 767 format. The ARINC 767 format is composed of frames, which consists of an ordered set of parameters. Parameters are grouped into frames according to their sample rate and each frame is built at its specified rate and given a designation known as a frame ID. Each frame ID can vary in size and is independent of each other. Additionally, a parameter can be of any length within the frame ID. In contrast to the ARINC 717 data structure where each parameter has a specifically assigned word and associated time stamp, the ARINC 767 data structure records all parameters within a specific frame ID at the same time.

Timing of ARINC 767 data is measured in milliseconds from the start of each recording session and collectively displayed as elapsed seconds recorded (ESR). The event flight was identified as the last flight of the recording.

4.1.2. Engineering Units Conversions

The engineering units conversions used for the data contained in this report are based on the Flight Recorder Electronic Documentation (FRED) file which was stored on the EAFR. The FRED files are based on *ARINC Specification 647A-1, Flight Recorder Electronic Documentation (FRED)*. In some cases, parameter conversions were augmented based on additional documentation from the 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=+).

4.2. Time Correlation

Correlation of the EAFR data from ESR to Coordinated Universal Time (UTC) was established by using the EAFR's recorded time parameters in UTC.

Accordingly, the time offset for the event flight data from ESR to UTC is the following:

UTC = ESR – 265. For the rest of this report, all times are referenced as UTC, not ESR.

4.3. Plots and Corresponding Tabular Data

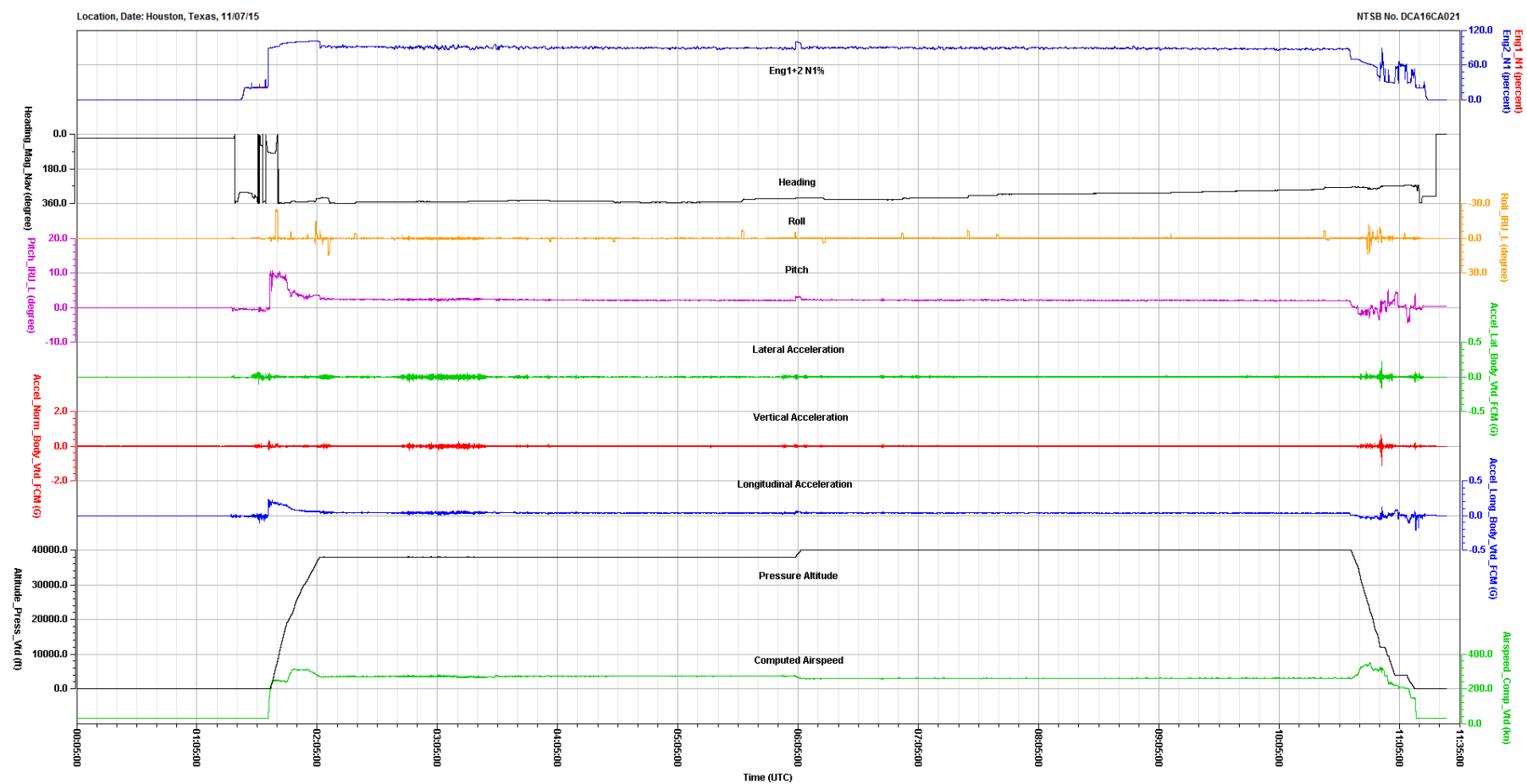
The following 3 figures contain EAFR data recorded during the November 7, 2015 event.

Figure 1 is an overview of basic parameters of the entire recorded event. The plot includes aircraft attitudes, accelerations, engine data, and air data. Figure 2 is an eight minute segment of figure 1 from 10:52:00 to 11:00:00 UTC, that highlights increases in acceleration consistent with a turbulence event. Increases in all three accelerations are noticeable from 10:55:00 to 10:56:30 UTC. Wind direction and speed are included in figure 2. Figure 3 contains flight control parameters during the identified turbulence segment shown in figure 2.

Control surface parameters are not plotted but are included in the attached tabular data.

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.

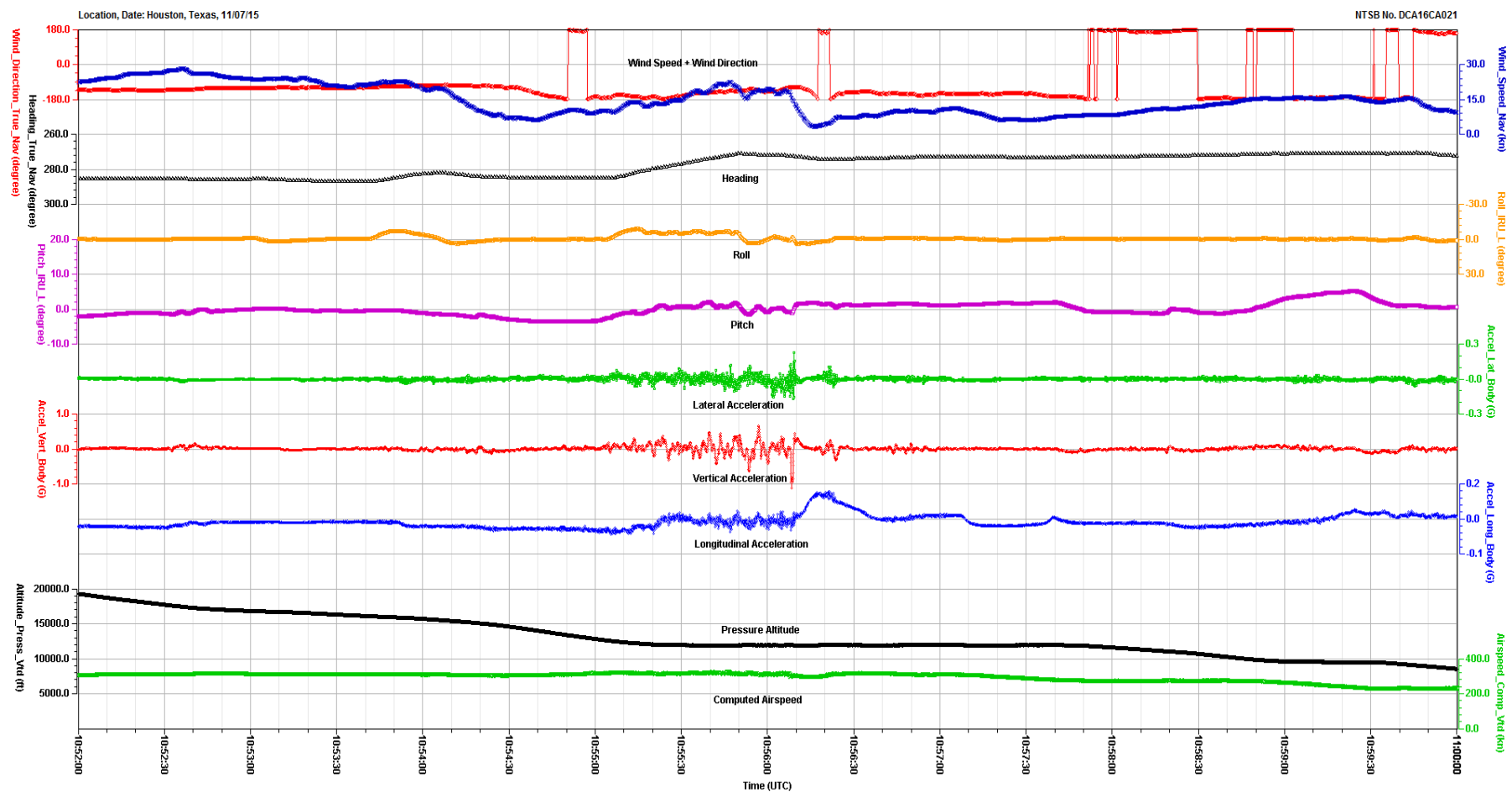
The corresponding tabular data used to create these three plots are provided in electronic comma separated value (*.csv) format as attachment 1 to this report.



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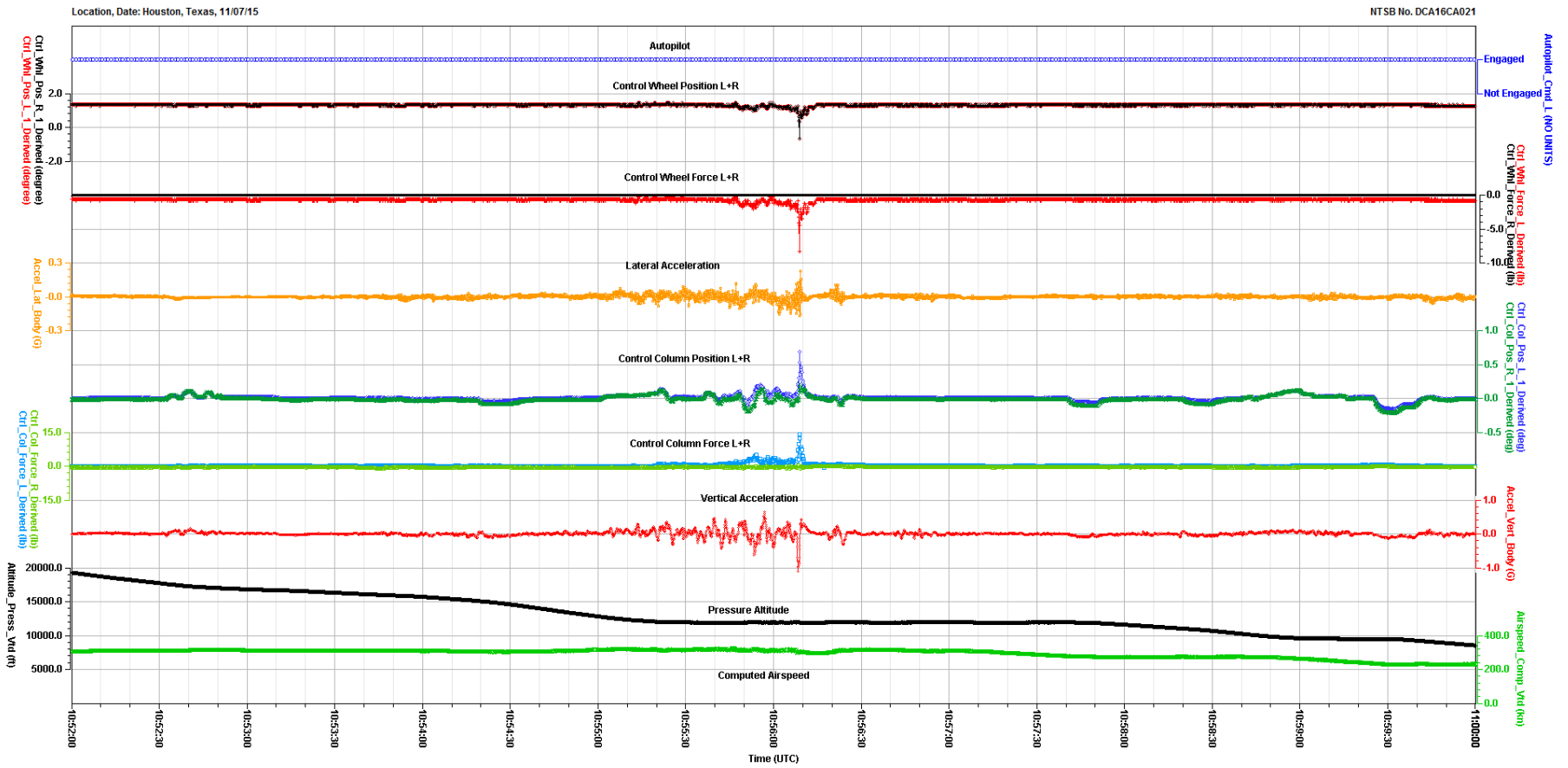
Figure 1. Plot of basic parameters during entire flight.



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Figure 2. Plot of basic parameters during identified turbulence event.



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Figure 3. Plot of control input parameters during identified turbulence event.

APPENDIX A

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_Body (g)	Body Lateral Acceleration
2. Accel_Long_Body (g)	Body Longitudinal Acceleration
3. Accel_Vert_Body (g)	Body Vertical Acceleration
4. Aileron_LIB ^a (deg)	Aileron Left Inboard Position
5. Aileron_RIB ^a (deg)	Aileron Right Inboard Position
6. Airspeed_Comp_Vtd (kts)	Computed Airspeed
7. Altitude_Press_Vtd (ft)	Pressure Altitude
8. Autopilot_Cmd_L (discrete)	Left Autopilot Engaged
9. Ctrl_Col_Force_L (lb)	Left Control Column Force
10. Ctrl_Col_Force_R (lb)	Right Control Column Force
11. Ctrl_Col_Pos_L_1 (deg)	Left Control Column Position from Source 1
12. Ctrl_Col_Pos_R_1 (deg)	Right Control Column Position from Source 1
13. Ctrl_Whl_Force_L (lb)	Left Control Wheel Force
14. Ctrl_Whl_Force_R (lb)	Right Control Wheel Force
15. Ctrl_Whl_Pos_L_1 (deg)	Left Control Wheel Position from Source 1
16. Ctrl_Whl_Pos_R_1 (deg)	Right Control Wheel Position from Source 1
17. Elevator_LIB ^a (deg)	Elevator Left Inboard Position
18. Elevator_RIB ^a (deg)	Elevator Right Inboard Position
19. Heading_Mag_Nav (deg)	Magnetic Heading from Navigation Source
20. Heading_True_Nav (deg)	True Heading from Navigation Source
21. Pitch_IRU_L (deg)	Pitch Angle from Left IRU
22. Roll_IRU_L (deg)	Roll Angle from Left IRU
23. Rud_Pos_Lwr ^a (deg)	Lower Rudder Position
24. Time_UTC_Hr_Nav(hr)	Time UTC Hour from Navigation Source
25. Time_UTC_Min_Nav(min)	Time UTC Minute from Navigation Source
26. Time_UTC_Sec_Nav(sec)	Time UTC Second from Navigation Source
27. Wind_Direction_True_Nav (deg)	True Wind Direction from Navigation Source
28. Wind_Speed_Nav (kts)	Wind Speed from Navigation Source

^a Denotes parameter is included only in the attached tabular data.

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 abbreviations.

Units Abbreviation	Description
deg	degrees
discrete	discrete
ft	feet
g	g
kts	knots
lb	pound
hr	hour
min	minute
sec	second