

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

January 4, 2018

## **Flight Data Recorder**

**Specialist's Factual Report**  
**By Bill Tuccio, Ph.D.**

### **1. EVENT SUMMARY**

Location: Raleigh-Durham Airport, North Carolina  
Date: May 20, 2017  
Aircraft: Boeing 757-200  
Registration: N633DL  
Operator: Delta Airlines  
NTSB Number: DCA17LA122

A description of this accident may be obtained from the National Transportation Safety Board (NTSB) *Aviation Accident Database & Synopses*, available via the NTSB public website.

### **2. FLIGHT DATA RECORDER GROUP**

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

### **3. FDR Carriage Requirements**

The event aircraft, N633DL, was manufactured in 1987, and as operating was required to be equipped with an FDR that recorded, at a minimum, 22 parameters, as cited in 14 *Code of Federal Regulations* (CFR) Part 121.344.

### **4. DETAILS OF FDR INVESTIGATION**

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received an electronic file containing the FDR data from the N633DL aircraft.

#### **4.1. FDR Data File 64 wps Description**

The FDR data in the electronic file was configured such that 64 12-bit words of digital information were recorded every second. Each grouping of 64 words (each second) is called a subframe. Each subframe has a unique 12-bit synchronization (sync) word identifying it as subframe 1, 2, 3, or 4. The sync word is the first word in each subframe. The data stream is "in sync" when successive sync words appear at proper 64-word intervals. Each data parameter (for example, pressure altitude, magnetic heading, vertical acceleration) has a specifically assigned word number within the subframe.

##### **4.1.1. Recording Description**

The FDR recording contained approximately 166 hours of data across 77 flights. Timing of the FDR data is measured in subframe reference number (SRN), where each SRN equals one elapsed second. The event flight was the last flight of the recording and its duration was

approximately 1 hour. The parameters evaluated for the purpose of this report appeared to be in accordance with federal FDR carriage requirements. Groundspeed was a listed parameter, but did not contain valid data.

#### 4.1.2. Engineering Units Conversions

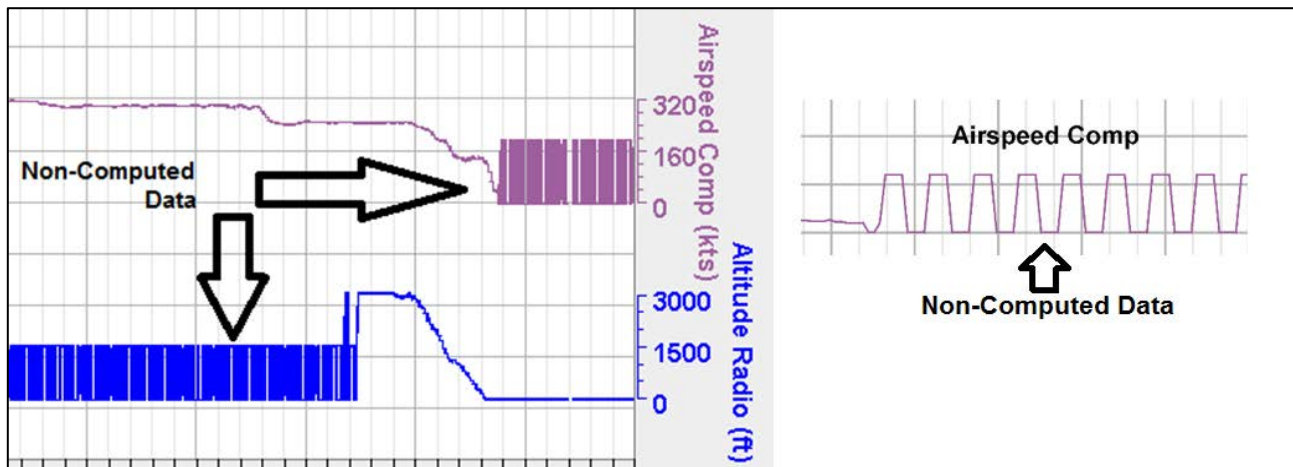
The engineering units conversions used for the data contained in this report are based on documentation from Delta Airlines.<sup>1</sup> Where applicable, the conversions have been changed to ensure that the parameters conform to the NTSB's standard sign convention that climbing right turns are positive (CRT=+).<sup>2</sup>

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

#### 4.1.3. Non-Computed Data

Certain parameters may not be computed in certain phases of flight; for example, airspeed below 40 knots, or radio altitude above 3000 feet. Figure 1 provides an example of how this non-computed data (NCD) appears in plots.

Figure 1. Example of non-computed data.



#### 4.2. Time Correlation

Correlation of the FDR data from SRN to the event local time, EDT, was established by using the recorded Time GMT<sup>3</sup> hours, Time GMT Minutes, and Time GMT Seconds and then applying an additional 4 hours offset to change GMT to EDT.

<sup>1</sup> Source document: *Engineering Unit Conversion Document for Digital Flight Data Acquisition Unit, Part Number 2227000-85-A, for the Delta Airlines B757 and B767 Aircraft* (August 9, 2006).

<sup>2</sup> 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 = +.

<sup>3</sup> GMT is Greenwich Mean Time which is also known as Coordinated Universal Time (UTC).

Accordingly, the time offset for the event flight data from SRN to local EDT is the following: EDT = SRN – 522,337.6. Therefore, for the rest of this report, all times are referenced as EDT, not SRN.

### 4.3. FDR Plots and Corresponding Tabular Data

Figures 2 through 7 contain FDR data recorded during the event on May 20, 2017. All the parameters listed in table A-1 are plotted except Time GMT Hours, Time GMT Minutes, and Time GMT Seconds. Table 1 summarizes the contents of each plot.

**Table 1. Summary of plot contents.**

	<b>Time Period (EDT)</b>	<b>Basic Parameters</b>	<b>Other Parameters</b>
<b>Whole Flight</b>	20:15:00 – 21:25:00	Figure 2	Figure 5
<b>Approach and Landing</b>	21:17:15 – 21:21:45	Figure 3	Figure 6
<b>Flare and Touchdown</b>	21:18:00 – 21:18:44	Figure 4	Figure 7

Collectively, these plots show:

- At about 20:24:10 EDT, the aircraft departed.
- The aircraft climbed to a maximum cruising altitude of flight level 270.
- At about 20:53 EDT, the aircraft began a descent out of flight level 270.
- At about 21:03 EDT, the aircraft began a descent out of flight level 230, with some intermediate, short duration level offs, including at 10,000 feet at about 21:08 EDT.
- At 21:17:46 EDT, the computed airspeed was 140 knots, as the aircraft descended through 374 feet radio altitude.
- At 21:18:04 EDT, the pitch began to increase, as the radio altitude decreased through 196 feet, and the computed airspeed began to decrease out of 141 knots.
- At 21:18:16 EDT, the weight on wheels transitioned to ground, as the pitch angle increased through 8.1 degrees nose up, the computed airspeed fluctuated at about 120 knots, and the vertical g peaked at +1.66 g.
- At 21:18:18 EDT, with weight on wheels still indicating ground, the pitch reached a maximum up angle of 11.4 degrees, the computed airspeed decreased through 121.5 knots, and the vertical g fluctuated between +1.5 and +0.7 g.
- By 21:18:23 EDT, the pitch decreased to a steady value of about 0.2 degrees nose up.
- By 21:18:52 EDT, the computed airspeed began to read a non-computed value (less than 40 knots).

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 figures 2 to 7, including Time GMT Hours, Time GMT Minutes, and Time GMT Seconds, are provided in electronic comma separated value (\*.csv) format as attachment 1 to this report.

Figure 2. Plot of basic parameters during entire flight.

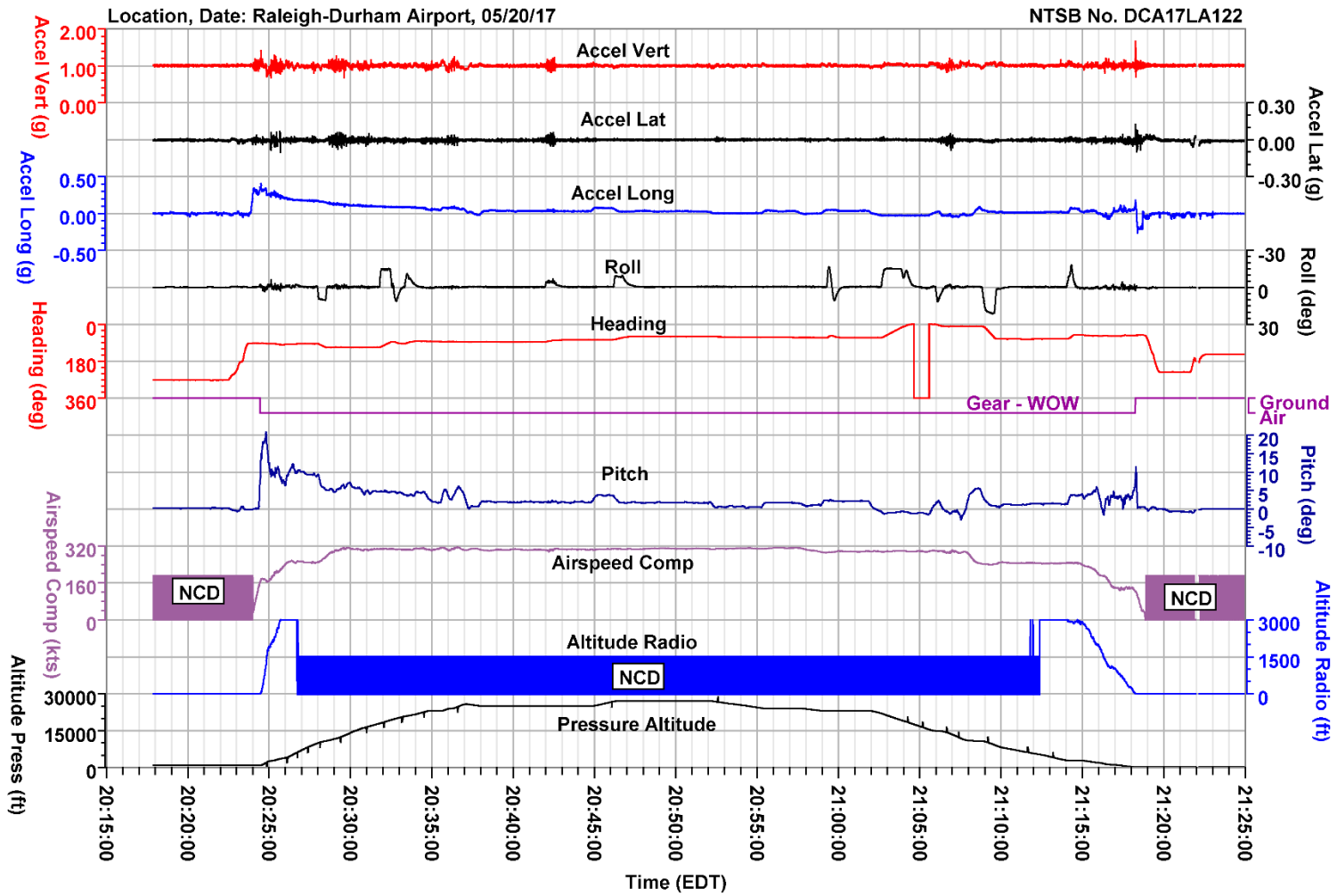


Figure 3. Plot of basic parameters during approach and landing.

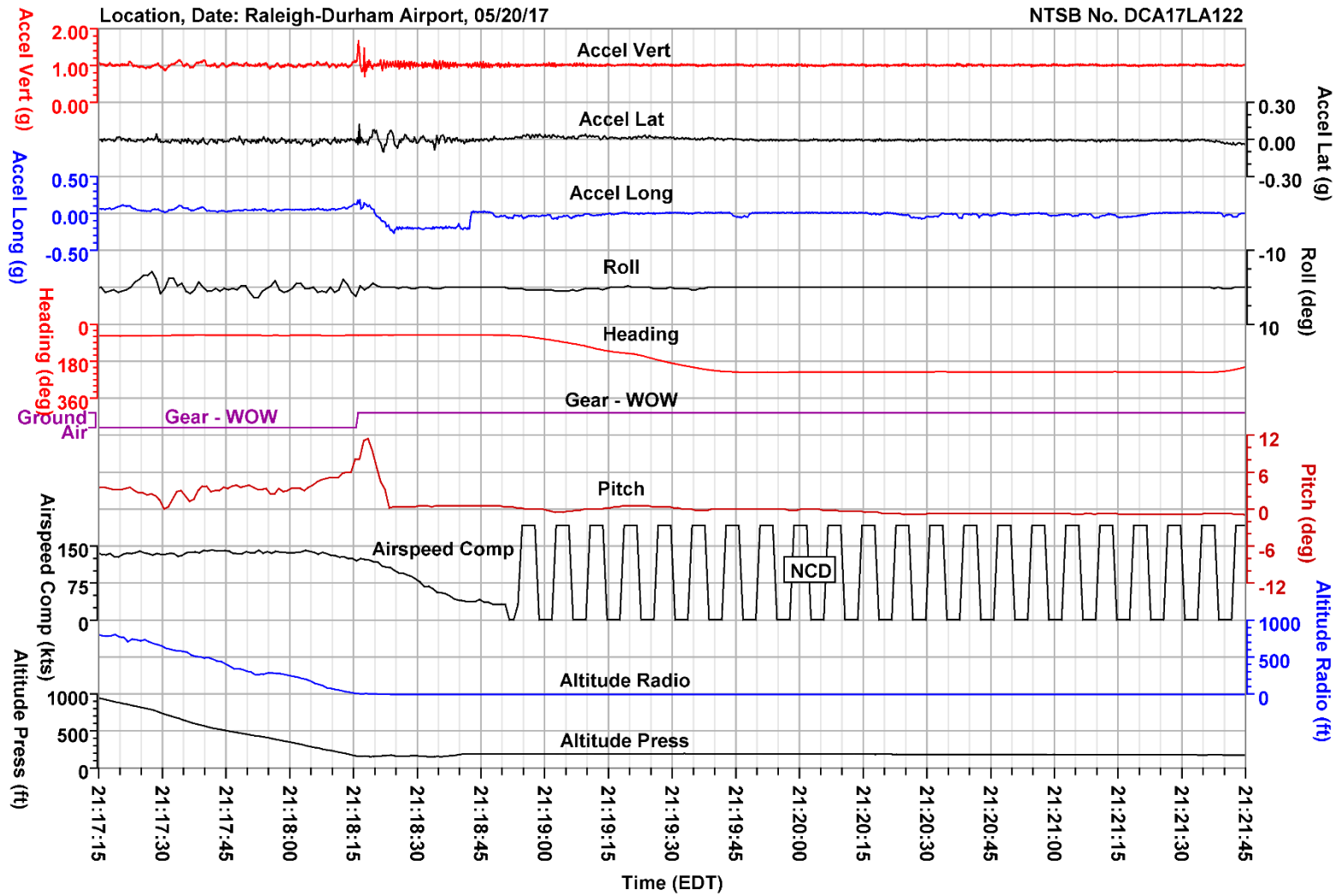


Figure 4. Plot of basic parameters during flare and touchdown.

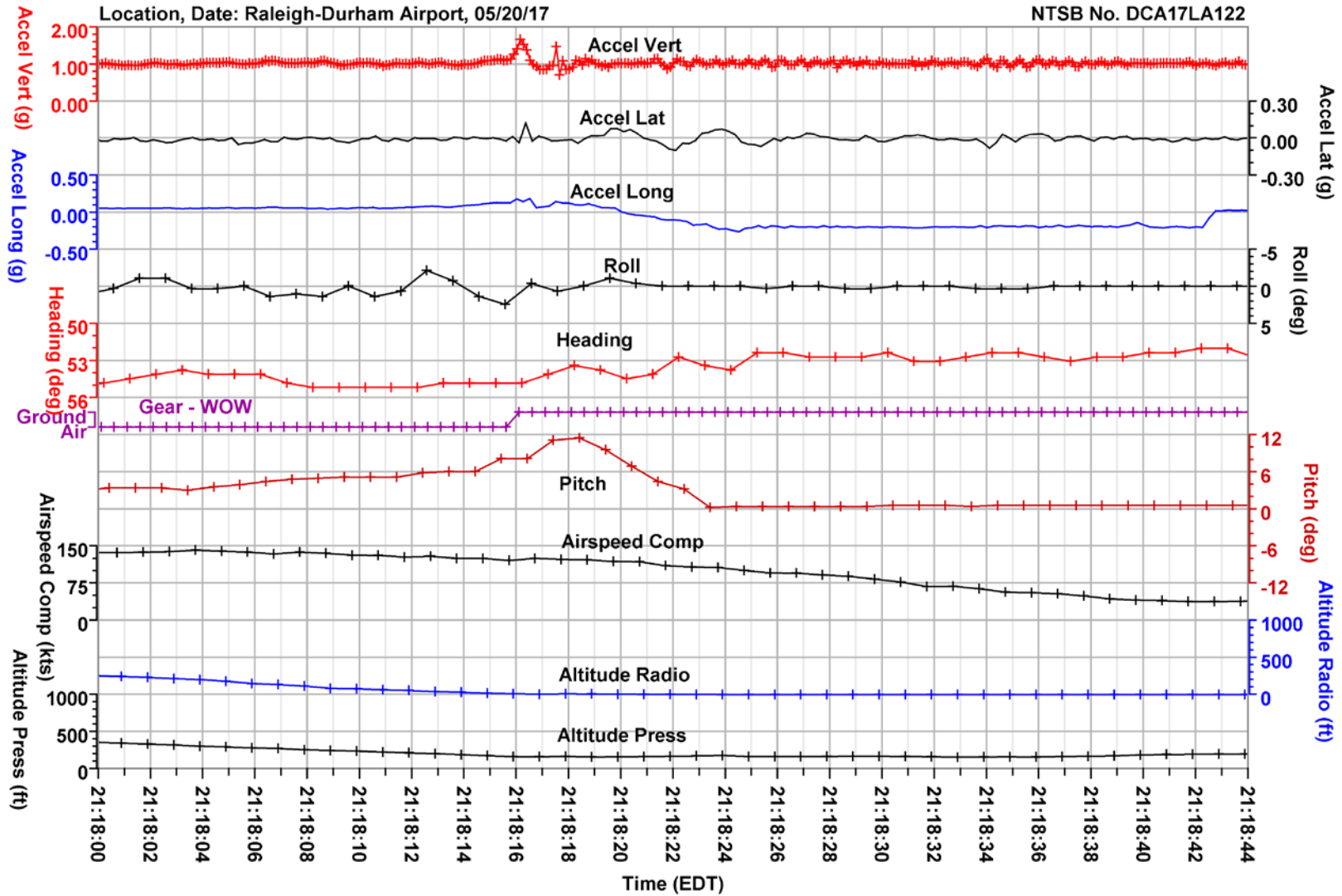


Figure 5. Plot of other parameters during entire flight.

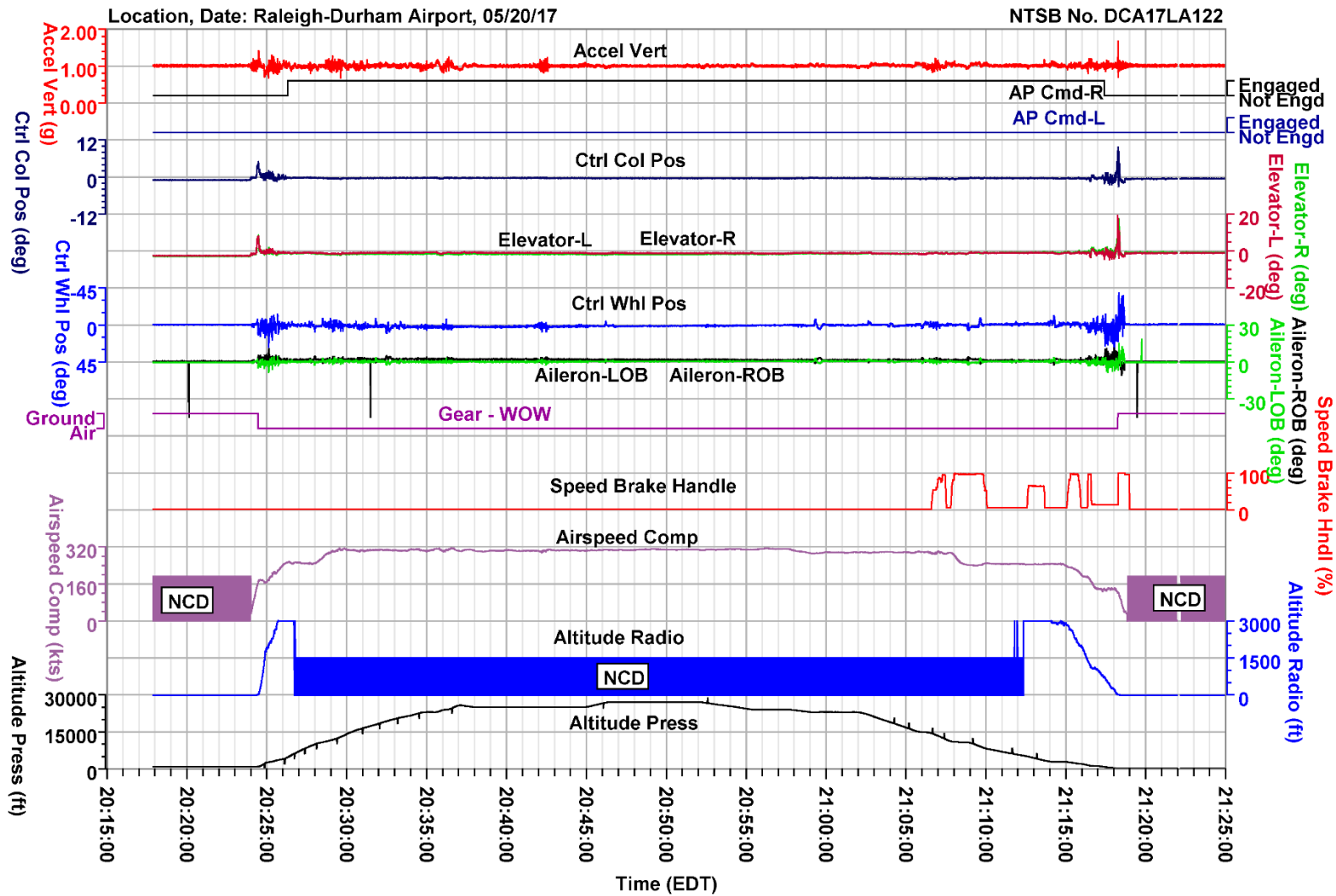


Figure 6. Plot of other parameters during approach and landing.

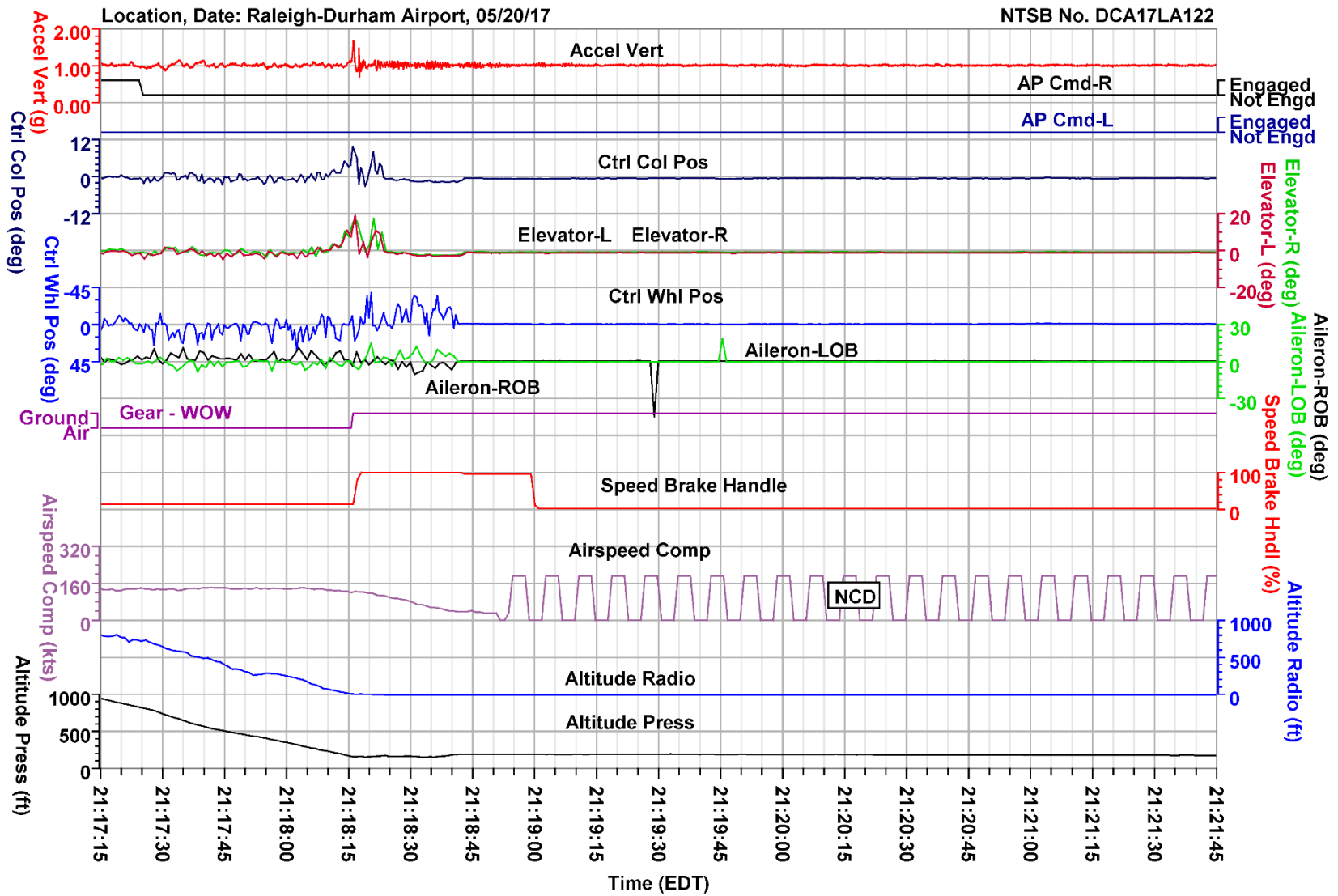
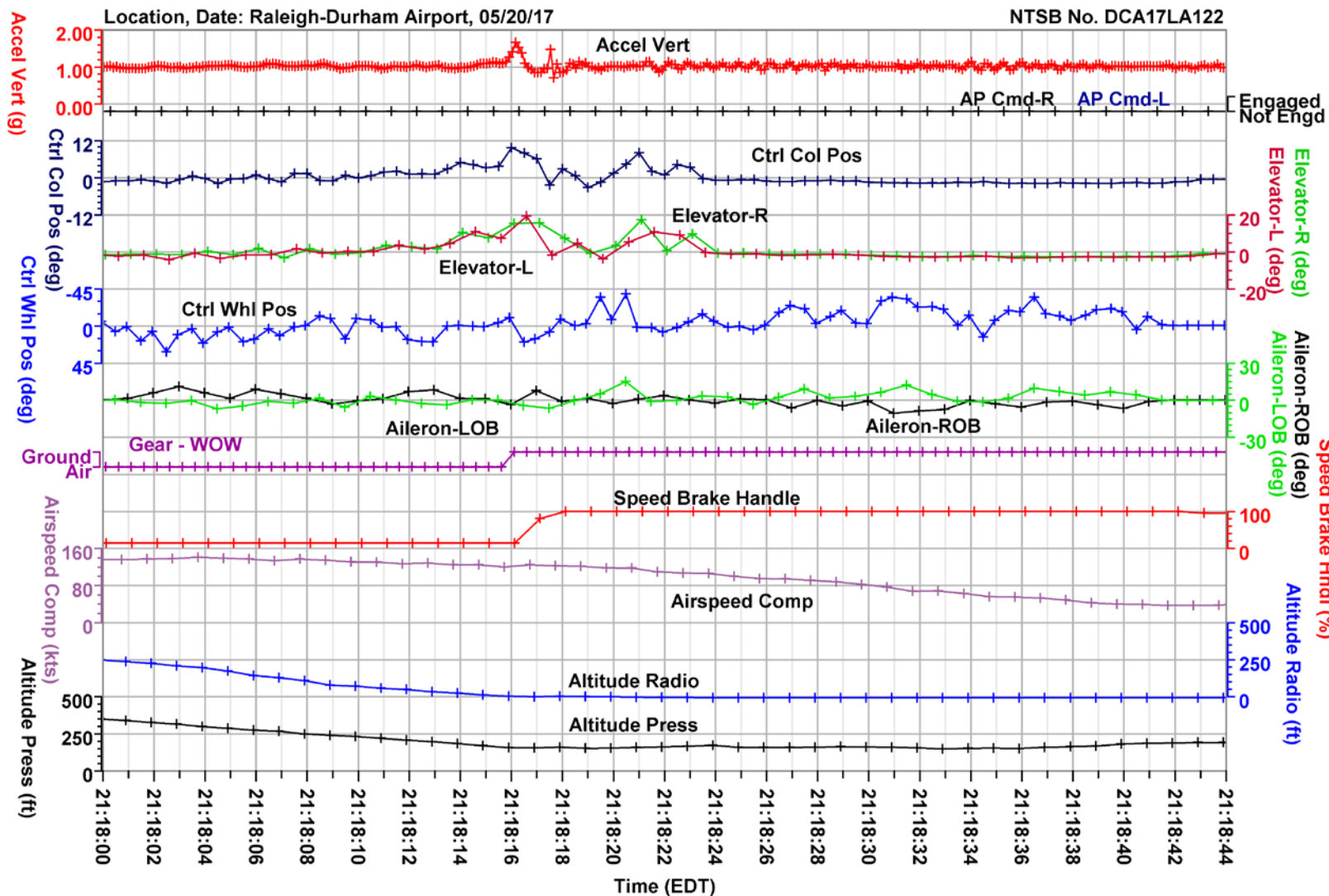




Figure 7. Plot of other parameters during flare and touchdown.



## APPENDIX A

This appendix describes the parameters provided and verified in this report. Table A-1 lists the parameter name 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. Aileron-L (deg)	Left Aileron Position
5. Aileron-R (deg)	Right Aileron Position
6. Airspeed Comp (kts)	Computed Airspeed
7. Altitude Press (ft)	Pressure Altitude
8. AP Cmd-L (discrete)	Left Autopilot
9. AP Cmd-R (discrete)	Right Autopilot
10. Ctrl Col Pos-L (deg)	Left Control Column Position
11. Ctrl Whl Pos-L (deg)	Left Control Wheel Position
12. Elevator-L (deg)	Left Elevator Position
13. Elevator-R (deg)	Right Elevator Position
14. Gear – WOW (discrete)	Gear Weight on Wheels
15. Heading Mag (deg)	Magnetic Heading
16. Pitch (deg)	Pitch Angle
17. Roll (deg)	Roll Angle
18. Speed Brake Hndl (%)	Speed Brake Handle
19. Time GMT Hrs (hrs)	Time GMT Hours
20. Time GMT Min (min)	Time GMT Minutes
21. Time GMT Sec (sec)	Time GMT Seconds

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.

NOTE: Parameters with a blank unit description in table A-1 are discrettes. 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.

**Table A-2. Unit and discrete abbreviations.**

Unit and discrete Abbreviations	Descriptions
deg	degrees
kts	knots
g	g
discrete	discrete
ft	feet
hrs	hours
min	minutes
sec	seconds

<b>Unit and discrete Abbreviations</b>	<b>Descriptions</b>
%	percent
Not Engd	not engaged