Flight Data Recorder - 10

Specialist's Factual Report
By Erin Gormley

1. EVENT SUMMARY

Location: Chicago, Illinois
Date: April 26, 2011
Aircraft: Boeing 737-700
Registration: N799SW
Operator: Southwest Airlines
NTSB Number: DCA11IA047

On April 26, 2011 at 1333 central daylight time (CDT), a Boeing 737-700, U.S. registration N799SW, operated by Southwest Airlines as flight 1919, departed the left side of runway 13C after landing at Chicago Midway International Airport, Chicago, Illinois (MDW). Initial data indicated that weather was moderate rain with southerly winds at the time of the event. There was minor damage to the airplane due to contact with a taxiway light during the excursion.

2. FLIGHT DATA RECORDER GROUP

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

3. FDR CARRIAGE REQUIREMENTS

The event aircraft, N799SW, was required to be equipped with an FDR that recorded, at a minimum, 88 parameters, as cited in 14 CFR 121.344.

4. DETAILS OF FLIGHT DATA RECORDER INVESTIGATION

The Safety Board's Vehicle Recorder Division received the following FDR:

    Recorder Manufacturer/Model: **Honeywell SSFDR, Model 980-4700, 256 Word**
    Recorder Serial Number: **4425**

4.1.   Honeywell SSFDR, Model 980-4700, 256 Word Description

The Honeywell Solid State Flight Data Recorder (SSFDR) records airplane flight information in a digital format using solid-state flash memory as the recording medium. The SSFDR can receive data in the ARINC 573/717/747 configurations and can record a minimum of 25 hours of flight data. It is configured to record 256 12-bit words of digital information every second. Each grouping of 256 words (each second) 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. The data

stream is "in sync" when successive sync words appear at proper 256-word intervals. Each data parameter (e.g. altitude, heading, airspeed) has a specifically assigned word number within the subframe. The SSFDR is designed to meet the crash-survivability requirements of TSO–C124.

4.1.1. Recorder Condition

The recorder was in good condition and the data were extracted normally from the recorder.

4.1.2. Recording Description

The FDR recording contained over 27 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 the last flight of the recording and its duration was about 2 hours and 28 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 Unit Conversions

The engineering unit conversions used for the data contained in this report are based on documentation from the aircraft manufacturer for a B737-3C FDR dataframe configuration. Where applicable, the conversions have been changed to ensure that the parameters conform to the NTSB's standard sign convention, climbing right turns are positive (CRT=+).[1] Appendix A lists the FDR parameters verified and provided in this report.

4.2. Time Correlation

Correlation of the FDR data from SRN to the event local time, central daylight time (CDT), was established by using the FDR recorded GMT hour, minute and second time parameters and then applying an additional -5 hour offset to change GMT to local CDT time.

Accordingly, the time offset for the event flight data from SRN to local CDT time is the following: CDT = SRN–49,111 seconds. All times referenced in this report are in CDT unless otherwise noted.

4.3. FDR Plots and Corresponding Tabular Data

The following six figures contain FDR data recorded during the April 26, 2011 event. The first plot shows select basic parameter for the entire flight and the remainder of the plots illustrate select parameters detailing the aircraft configuration during the landing event.

The data indicate that the aircraft took off at 1105, reached a cruising altitude of 37,000 feet about 18 minutes later, and began an initial descent around 1215. At 1245, the aircraft began a series of right holding turns for about 30 minutes and then the aircraft made a final descent for landing.

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[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 = +.

On final approach, the flaps were set to 40 degrees, and the speed brake armed light was not indicated. The autopilot disengaged at 1331:48. The weight on wheels (WOW) indication for the main gear and systems registered ground at 1333:04, at an airspeed of 136 knots, and the AT engage parameter turned off 1 second later. At 1333:06, the WOW nose gear parameter registered ground, the autobrake parameter showed applied for one second followed by an increase in left and right brake pressure. At 1333:21, the engine throttle resolver parameters began to show movement, there was an increase in speed brake handle position and the speed brake light indicated armed. Within the next 2 seconds, the engine thrust reversers were fully deployed and the spoiler panels showed full deployment. During the landing roll, the aircraft made a left excursion from the runway heading and stopped on a magnetic heading of 101 degrees. The last recorded FDR data point occurred at 1333.

The 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 plots are provided in electronic (*.csv[2]) format as Attachment 1 to this report.
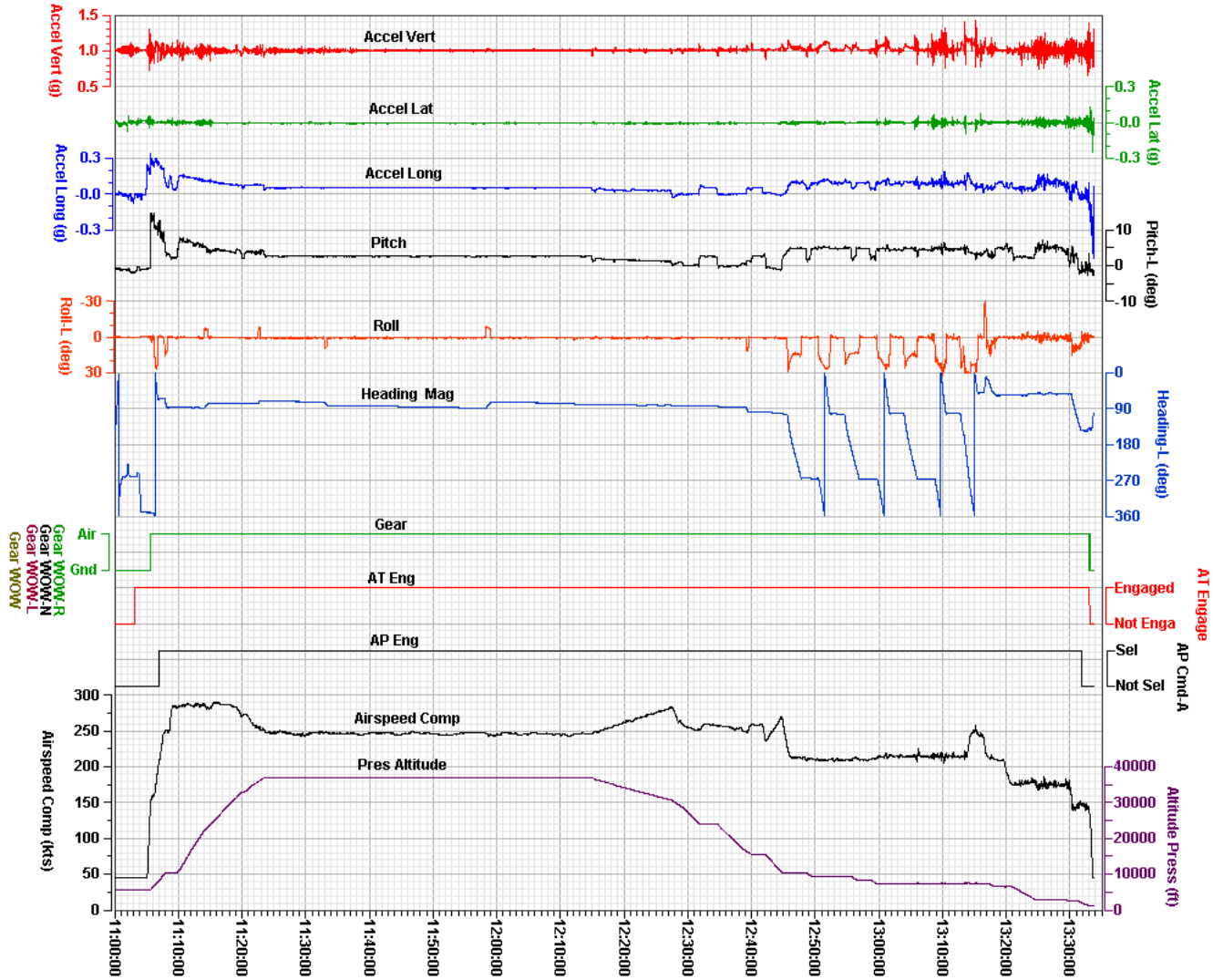
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[2] Comma Separated Value format.

Figure 1. Plot of basic parameters during entire flight

Southwest Airlines, Boeing B737-700, Flight #1919, N799SW

Location, Date: Chicago, Illinois, 04/26/11

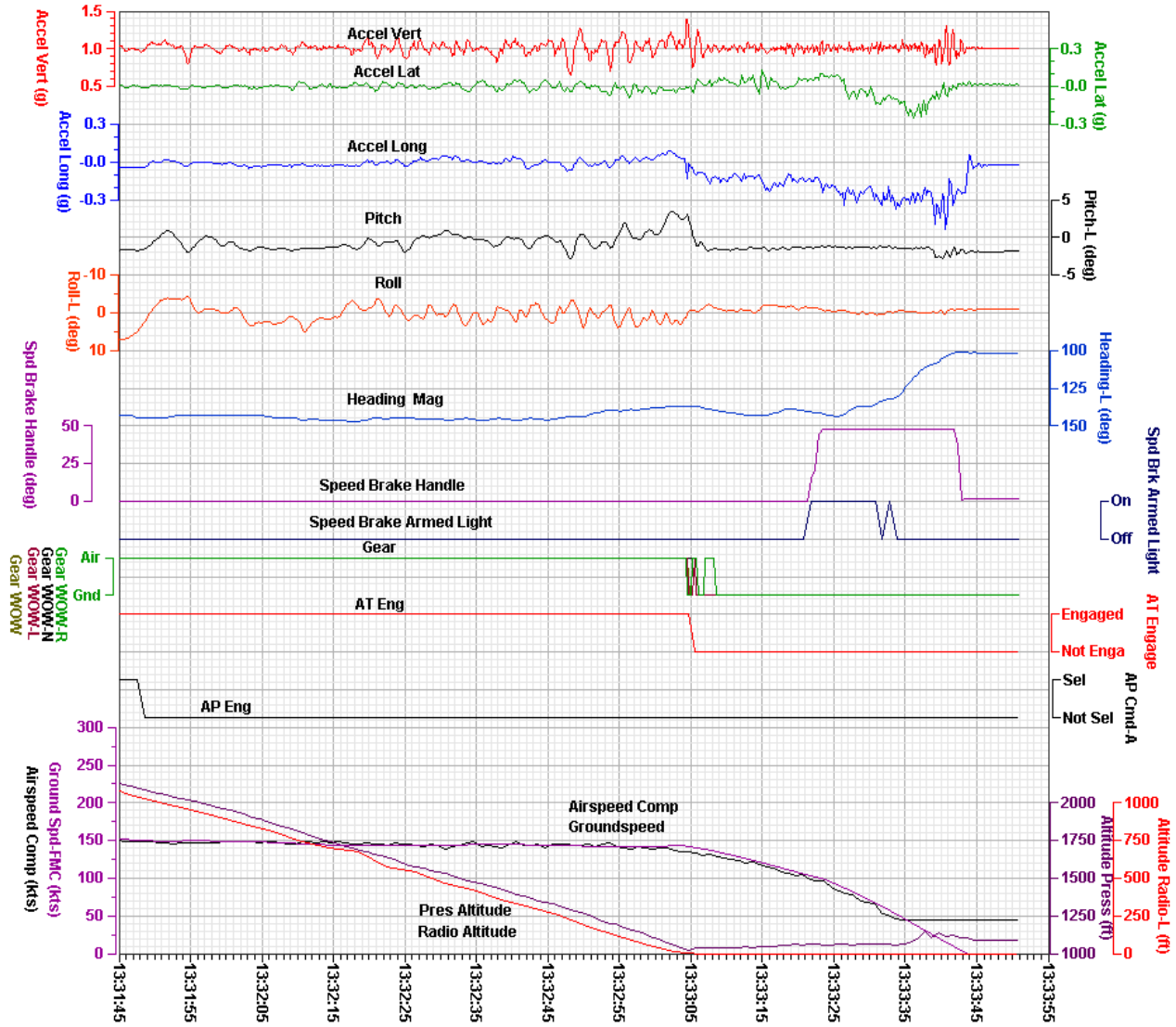NTSB No. DCA11IA047

Revised: 2 August 2011

Basic Entire Flight

National Transportation Safety Board

Figure 2. Plot of basic parameters during landing

Southwest Airlines, Boeing B737-700, Flight #1919, N799SW

Location, Date: Chicago, Illinois, 04/26/11

NTSB No. DCA11IA047

Revised: 2 August 2011

Basic Landing

National Transportation Safety Board

Figure 3. Plot of select slat and flap parameters during landing

Southwest Airlines, Boeing B737-700, Flight #1919, N799SW

Location, Date: Chicago, Illinois, 04/26/11

NTSB No. DCA11IA047

Revised: 29 July 2011

Flaps Slats
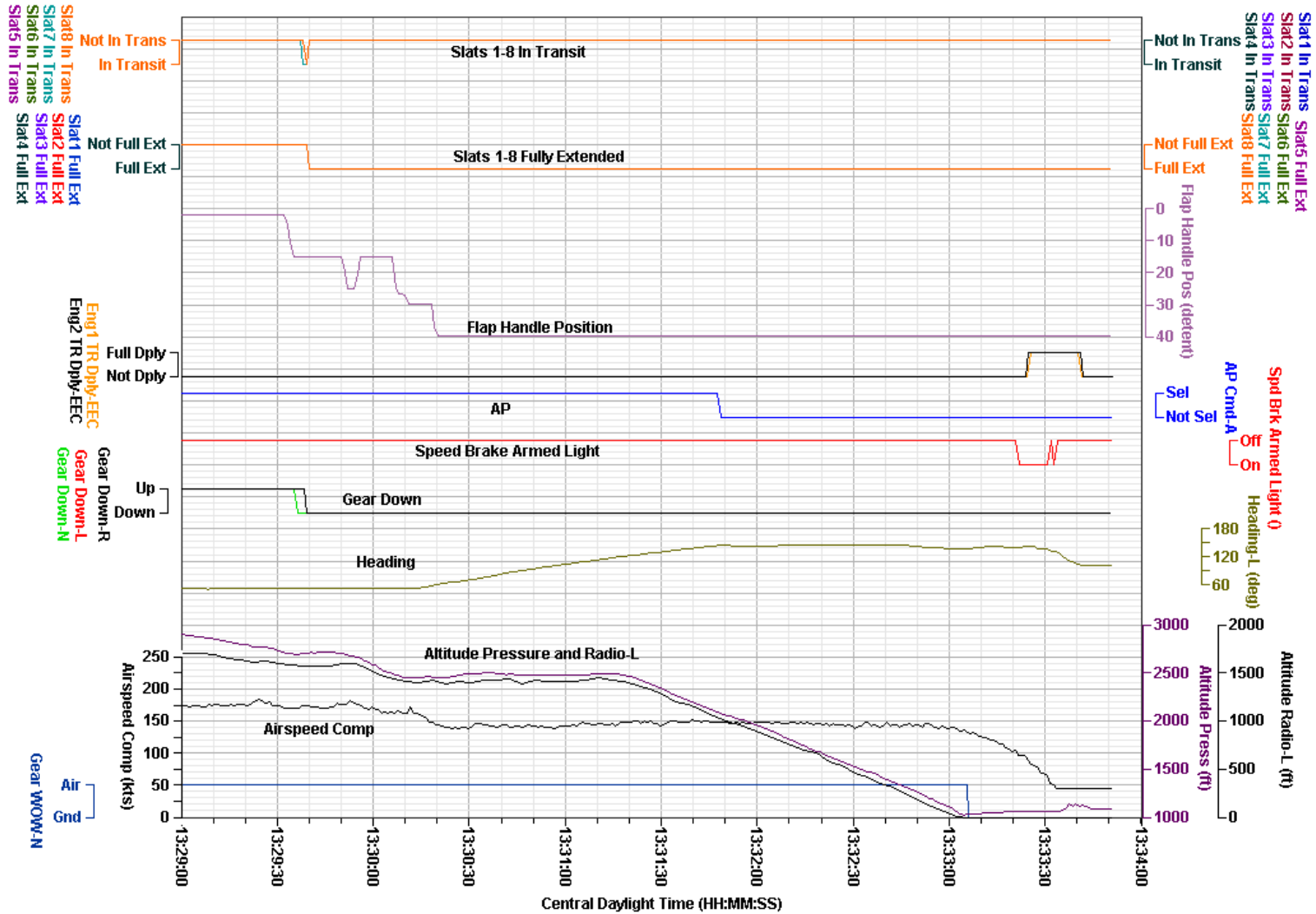
National Transportation Safety Board

Figure 4. Plot of select flight control parameters during landing

Southwest Airlines, Boeing B737-700, Flight # 1919, N799SW

Location, Date: Chicago, Illinois, 04/26/11

NTSB No. DCA11IA047

Revised: 29 July 2011

Flight Controls
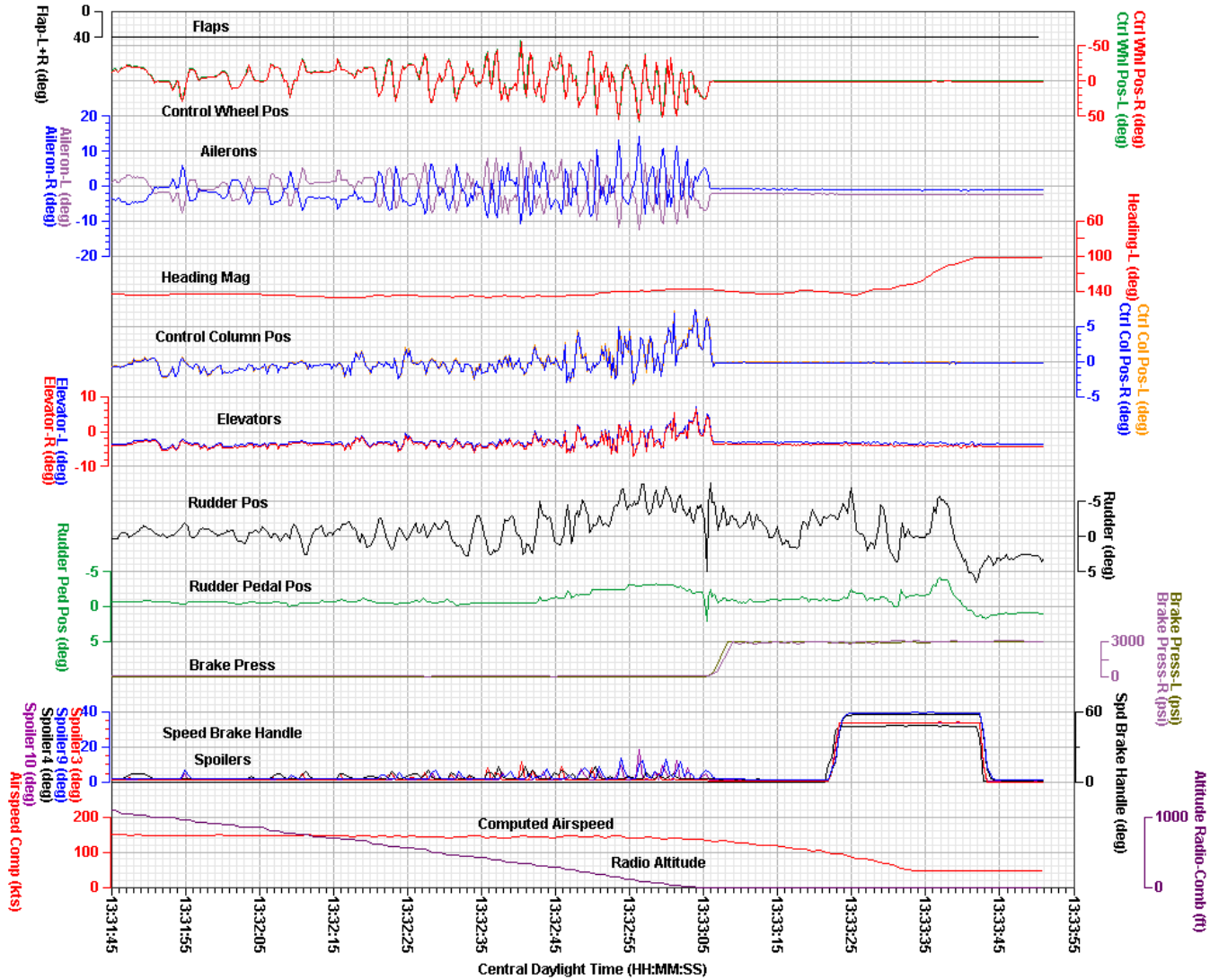
National Transportation Safety Board

Figure 5. Plot of select engine and brake parameters during landing

Southwest Airlines, Boeing B737-700, Flight #1919, N799SW

Location, Date: Chicago, Illinois, 04/26/11

NTSB No. DCA11IA047

Revised: 29 July 2011

Engine Brakes
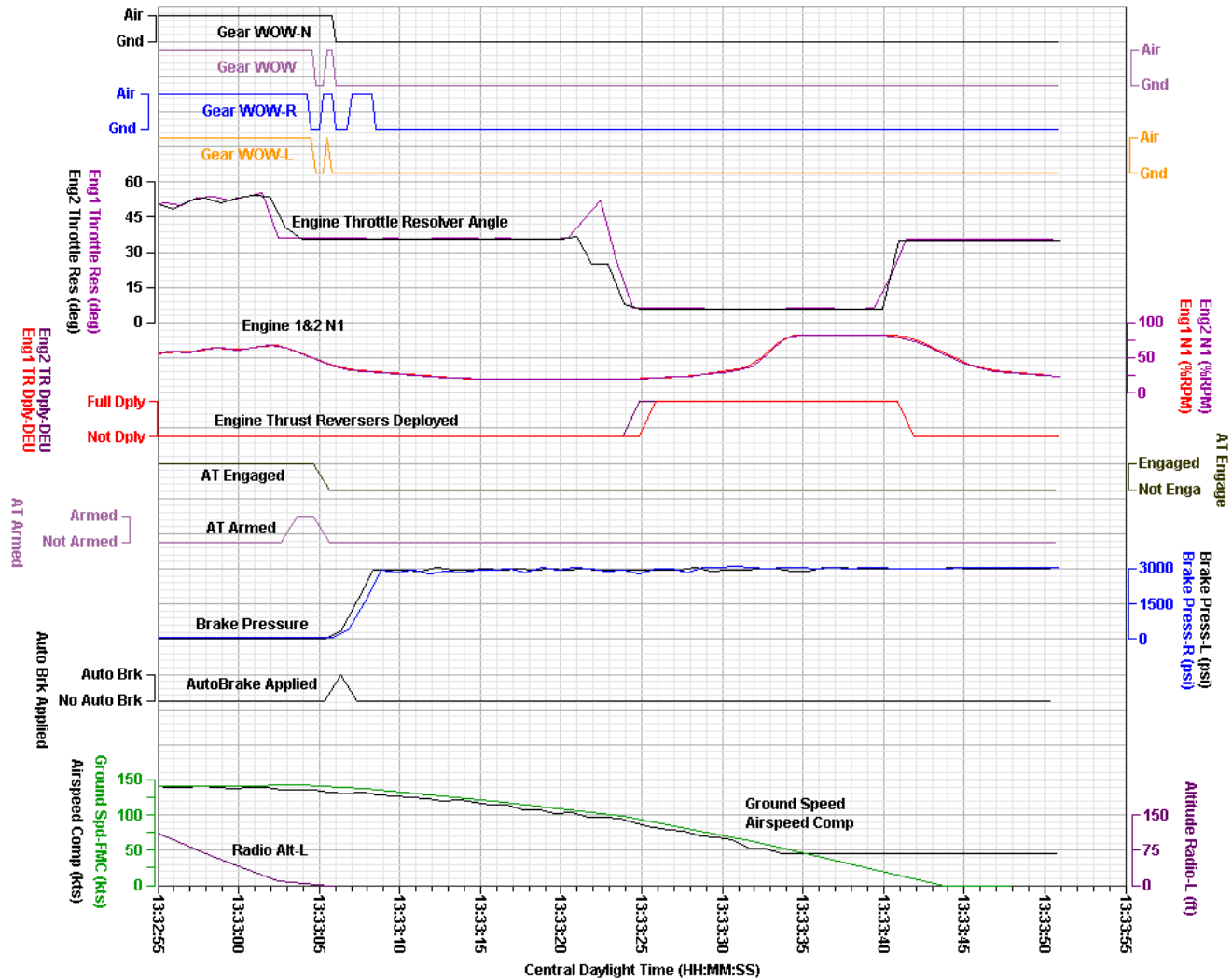
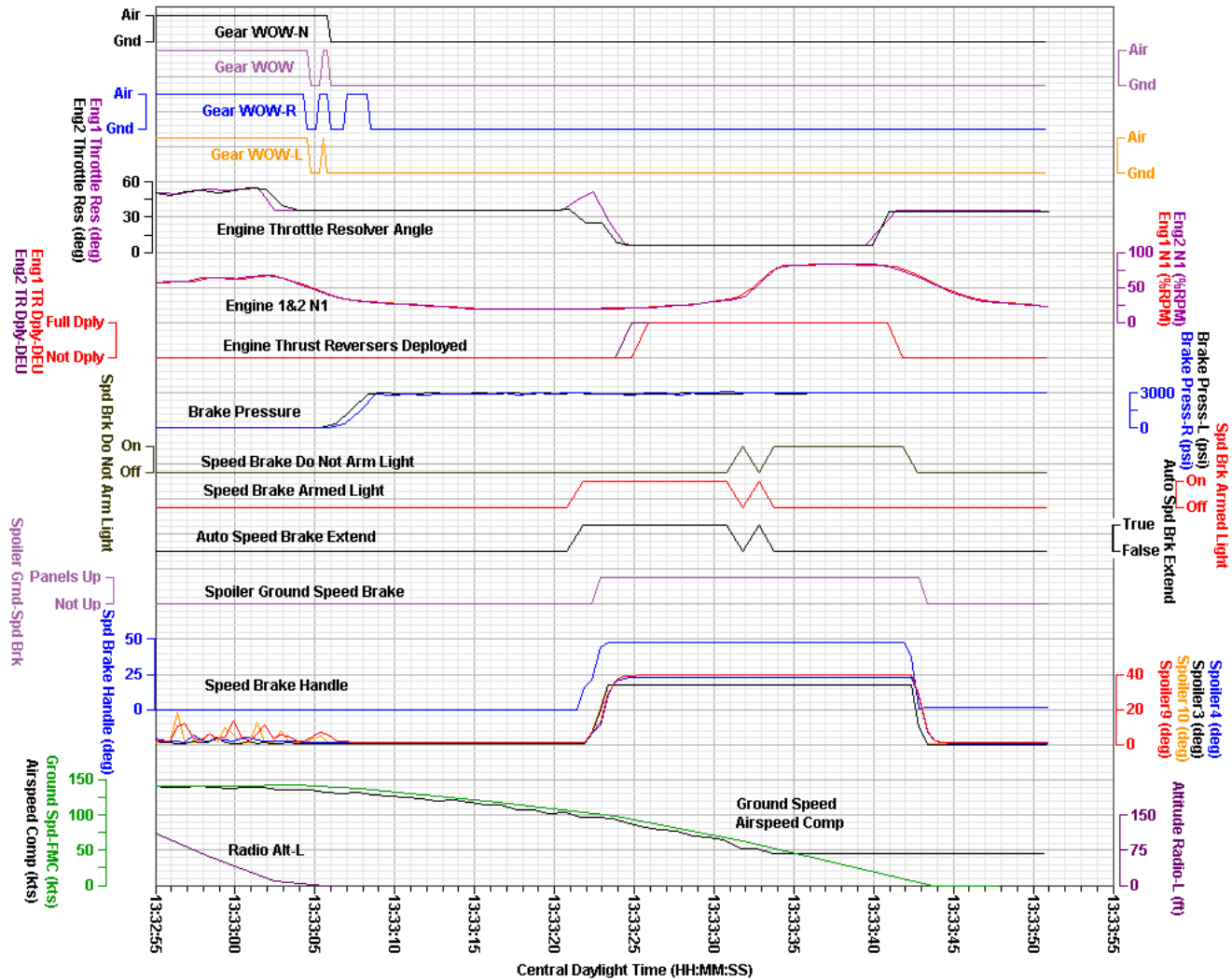National Transportation Safety Board

Figure 6. Plot of select spoiler and configuration parameters during landing

Southwest Airlines, Boeing B737-700, Flight #1919, N799SW

Location, Date: Chicago, Illinois, 04/26/11

NTSB No. DCA11IA047

Revised: 29 July 2011

Spoilers

National Transportation Safety Board

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 abbreviations used in this report.

Table A-1. Verified and provided FDR parameters.

	Label	Description
1	Accel Lat (g)	Lateral Acceleration
2	Accel Long (g)	Longitudinal Acceleration
3	Accel Vert (g)	Vertical Acceleration
4	Aileron-L/R (deg)	Left/Right Aileron Position
5	Airspeed Comp (kts)	Computed Airspeed
6	Altitude Press (ft)	Pressure Altitude
7	Altitude Radio-L (ft)	Radio Altitude Left System
8	AP Cmd-A/B (discrete)	Autopilot Command A/B
9	AT Armed (discrete)	Autothrust Armed
10	AT Engaged (discrete)	Autothrust Engaged
11	Auto Brk Applied (discrete)	AutoBrake Applied
12	Auto Spd Brk Extend (discrete)	Auto Speed Brake Extend
13	Brake Pressure L/R (psi)	Left/Right Brake Pressure
14	Ctrl Col Pos-L/R (deg)	Lef/Right Control Column Position
15	Ctrl Whl Pos-L/R (deg)	Left/Right Control Wheel Position
16	Elevator-L/R (deg)	Left/Right Elevator Position
17	Eng1/2 N1 (%rpm)	Left/Right Engine N1
18	Eng 1/2 Throttle Res (deg)	Left/Right Engine Throttle Resolver Angle
19	Eng 1/2 TR Dply	Left/Right Engine Thrust Reverser Deploy
20	Flap Handle Pos (deg)	Flap Handle Position
21	Flap-L+R (deg)	Left/Right Trailing Edge Flap Position
22	Gear Down L/R/N (discrete)	Gear Down Left/Right/Nose
23	Gear WOW L/R/N (discrete)	Gear Weight On Wheels Right/Left/Nose
24	Ground Spd-FMC (kts)	Groundspeed
25	Heading-L (deg)	Magnetic Heading
26	Pitch-L (deg)	Pitch Angle
27	Roll-L (deg)	Roll Angle
28	Rudder (deg)	Rudder Position
29	Rudder Ped Pos (deg)	Rudder Pedal Position
30	Slat# In Transit (discrete)	Slat(1-8) In Transit
31	Slat# Full Ext (discrete)	Slat(1-8) Full Ext
32	Spoiler 3/4/9/10 (deg)	Spoiler 3/4/9/10 Position
33	Spoiler Grnd-Spd Brk (discrete)	Spoiler Ground Speed Brake
34	Spd Brk Armed Light (discrete)	Speed Brake Armed Light
35	Spd Brk Do Not Arm Light (discrete)	Speed Brake Do Not Arm Light
36	Spd Brake Handle (deg)	Speed Brake Handle

| 37 | Time Clock GMT Hrs/Min/Sec | Greenwich Mean Time hours, minutes 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.

Table A-2. Unit abbreviations.

Units Abbreviation	Description
deg	degrees
kts	knots
g	g
discrete	discrete
ft	feet
hrs	hours
min	minutes
psi	pounds per square inch
sec	seconds
%rpm	percent revolutions per minute

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.