

# NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division

Washington, D.C. 20594

July 23, 2012

## Flight Data Recorder - 10

### Specialist's Factual Report

By Bill Tuccio

#### 1. EVENT SUMMARY

Location: Denver, Colorado  
Date: April 15, 2012  
Aircraft: Airbus A319  
Registration: N808AW  
Operator: US Airways  
NTSB Number: DCA12FA062

On April 15, 2012, at approximately 0549 Universal Coordinated Time (UTC) (April 14, 2012, 2349 mountain daylight time (MDT)), an Airbus Industries A319-132, US registration N808AW, serial number 1088, operated by US Airways as flight 496 from PHX to DEN, encountered severe mountain wave turbulence at flight level 320 in the vicinity of Buena Vista, CO. Two flight attendants were injured during the encounter. There were no pilot reports (PIREPS) of turbulence in the area prior to the encounter. The flight continued to DEN, and landed normally. There was no damage to the aircraft. A solid-state cockpit voice recorder (CVR) was sent to the National Transportation Safety Board's Audio Laboratory for readout.

#### 2. FLIGHT DATA RECORDER GROUP

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

#### 3. FDR Carriage Requirements

The event aircraft, N808AW, was manufactured in September, 1999 and was operating such that it was required to be equipped with an FDR that recorded, at a minimum, 34 parameters, as cited in Title 14 *Code of Federal Regulations* Part 121.344(d).

#### 4. DETAILS OF FLIGHT DATA RECORDER INVESTIGATION

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

Recorder Manufacturer/Model: **Allied Signal SSFDR**  
Recorder Serial Number: **4368**

##### 4.1. Allied Signal SSFDR Description

The Allied Signal 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 128 12-bit words of digital information every second. Each grouping of 128 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 128-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 approximately 27.2 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 approximately 1 hour and 20 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 aircraft manufacturer of the data acquisition unit installed in the aircraft. 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>1</sup>

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, MDT, was established by using the recorded Time GMT<sup>2</sup> hours, Time GMT Minutes, and Time GMT Seconds and then applying an additional 6 hours offset to change GMT to MDT.

Accordingly, the time offset for the event flight data from SRN to local MDT is the following:  $MDT = SRN - 10,114.9$ . Therefore, for the rest of this report, all times are referenced as MDT, not SRN.

#### **4.3. FDR Plots and Corresponding Tabular Data**

The following four figures contain FDR data recorded during the April 15, 2012 event. All times are expressed in MDT.

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<sup>1</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>2</sup> GMT is Greenwich Mean Time which is also known as Coordinated Universal Time (UTC).

Figure 1 shows a plot of basic parameters for the entire flight. The flight departed at about 2250 and climbed to flight level 390 by 2315. At about 2345, the aircraft began a descent, with the upset event occurring about 4 minutes later. The aircraft subsequently landed at about 0007.

Figure 2 shows a plot of flight controls, aircraft attitude, and autopilot for the entire flight. The flight controls show longitudinal and lateral right stick control inputs from the start of the flight until about 2254, when autopilot-2 was engaged. Prior to 2254, there were no inputs recorded from the left stick during the flight. Autopilot-2 remained engaged in various modes until the upset event, and was then re-engaged at about 2351.

Figure 3 shows a plot of flight controls, aircraft attitude, and autopilot around the time of the upset event. At about 2349:16, while the aircraft was descending through about 30,500 feet pressure altitude, the airspeed began to increase from 297 knots reaching a maximum of 318 knots at about 2349:23. At 2349:23, autopilot-2 was sampled as engaged by the flight recorder, and was not sampled as engaged again until about 2351:35 (as shown in figure 2). At about 2349:24, the left stick recorded lateral and longitudinal inputs, joined about a half second later by right stick lateral and longitudinal inputs. The dual stick inputs continued for about 8 seconds. During this time, the master warning was recorded for about 3 seconds.

Further, figure 3 shows that during the period from 2349:23 to 2349:31, the vertical acceleration reached minimum and maximum values of -0.56gs to 2.61gs, and the pitch attitude minimum and maximum values varied from -2.8 to 14.1 degrees. During this time period the aircraft began to climb, and the airspeed decreased.

Figure 4 shows a plot of spoilers, engines, autothrottles, and control law states. The autothrottles remained engaged throughout the event. At about 2349:30, the pitch law switched from normal to alternate and remained so until about 2350:19, when it reverted to normal pitch law. During the period 2349:23 until about 2349:38, the angle of attack minimum and maximum values were about -3.5 to 18.9 degrees.

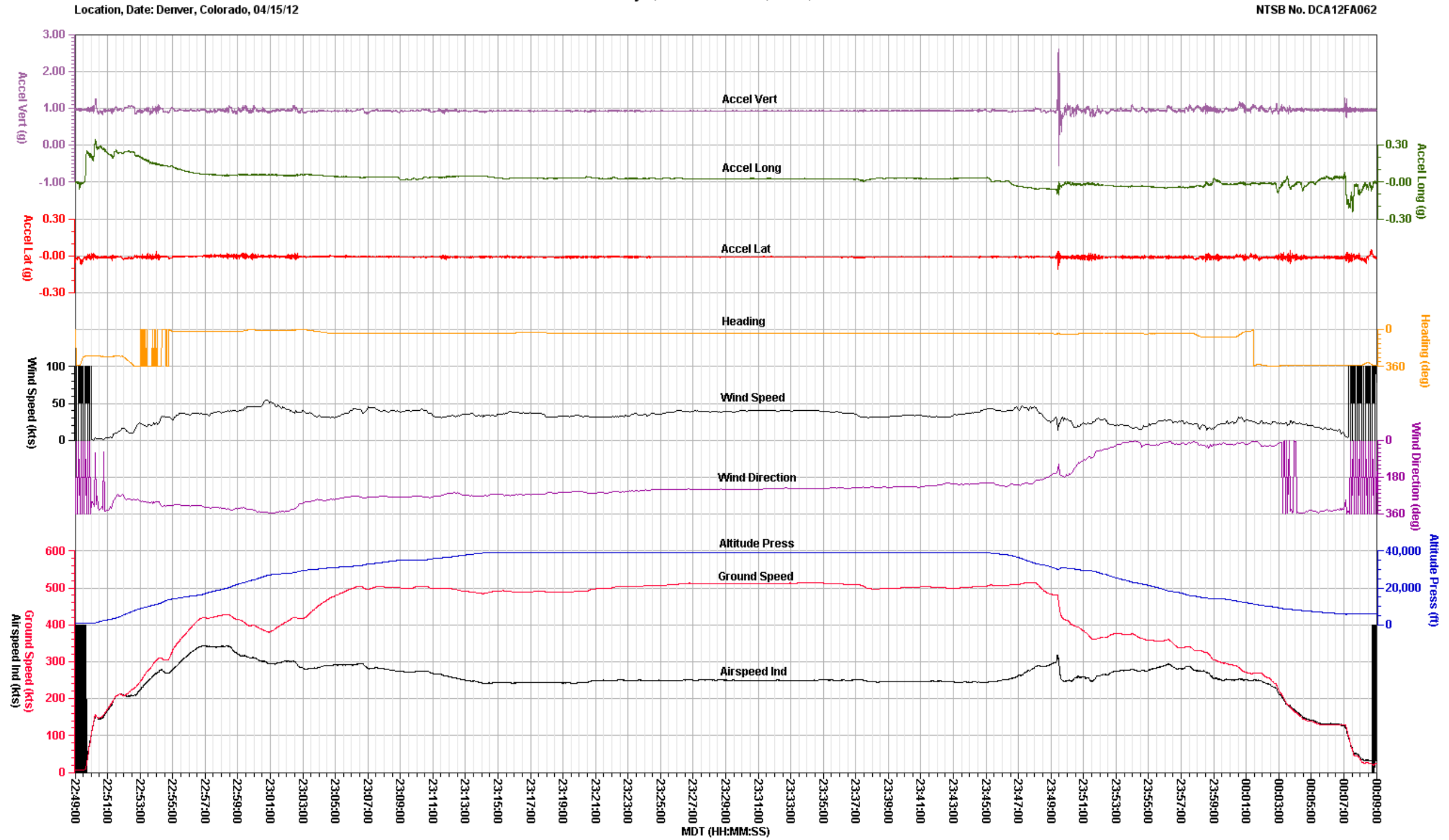
These figures are configured such that right turns are indicated by the trace moving toward the bottom of the page, left turns towards the top of the page, and nose up attitudes towards the top of the page.

The corresponding tabular data used to create these four plots are provided in electronic (\*.csv<sup>3</sup>) format as Attachment 1 to this report.

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<sup>3</sup> Comma Separated Value format.

Figure 1. Plot of basic parameters during entire flight.  
 US Airways, Airbus A319, 496, N808AW



Revised: 25 July 2012

Event Flight - Basic Parameters

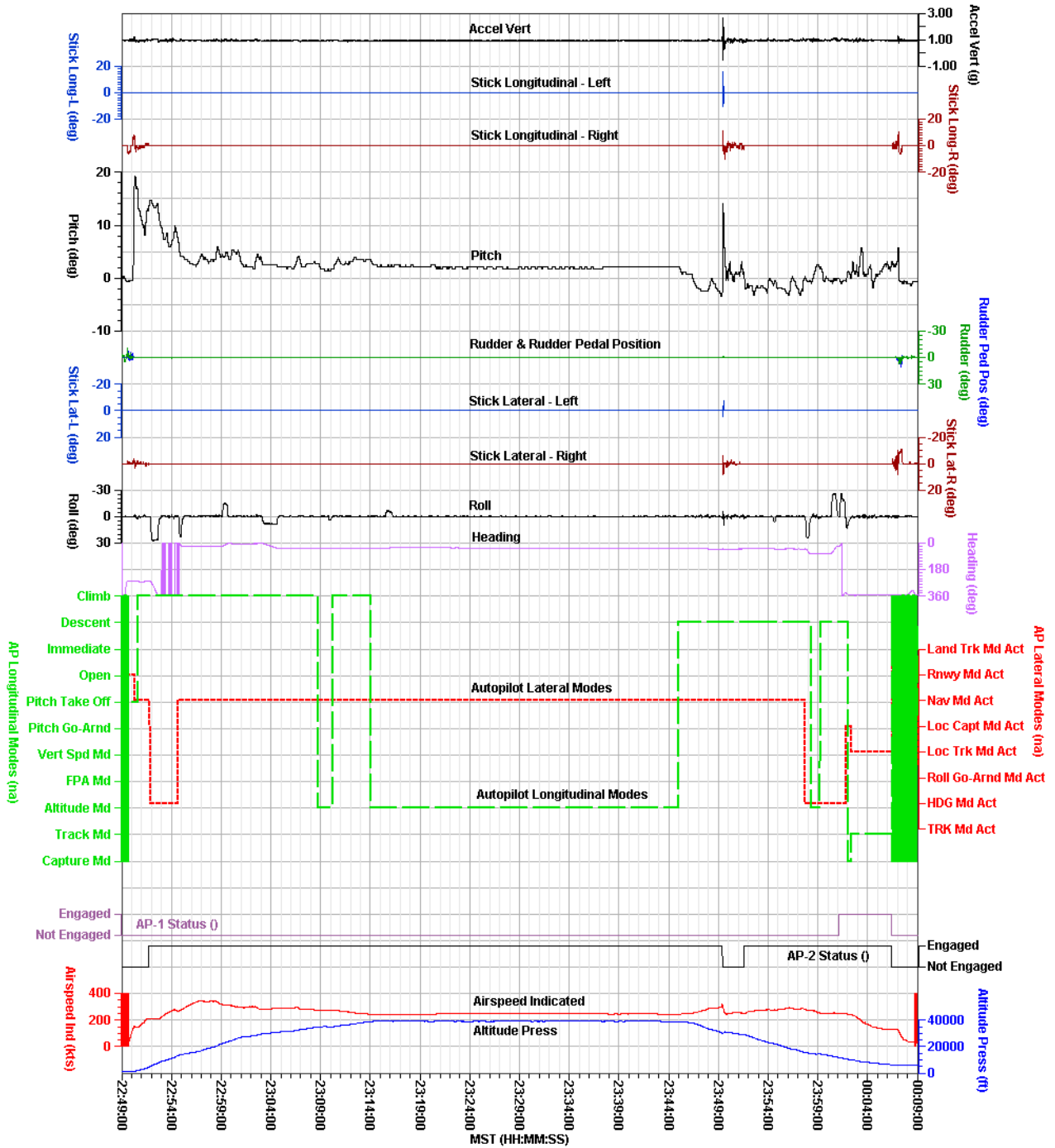
National Transportation Safety Board

Figure 2. Plot of flight controls and autopilot during entire flight.

US Airways, Airbus A319, 496, N808AW

Location, Date: Denver, Colorado, 04/15/12

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Revised: 25 July 2012

Flight Controls - Event Flight

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Figure 3. Plot of flight controls and autopilot during event.

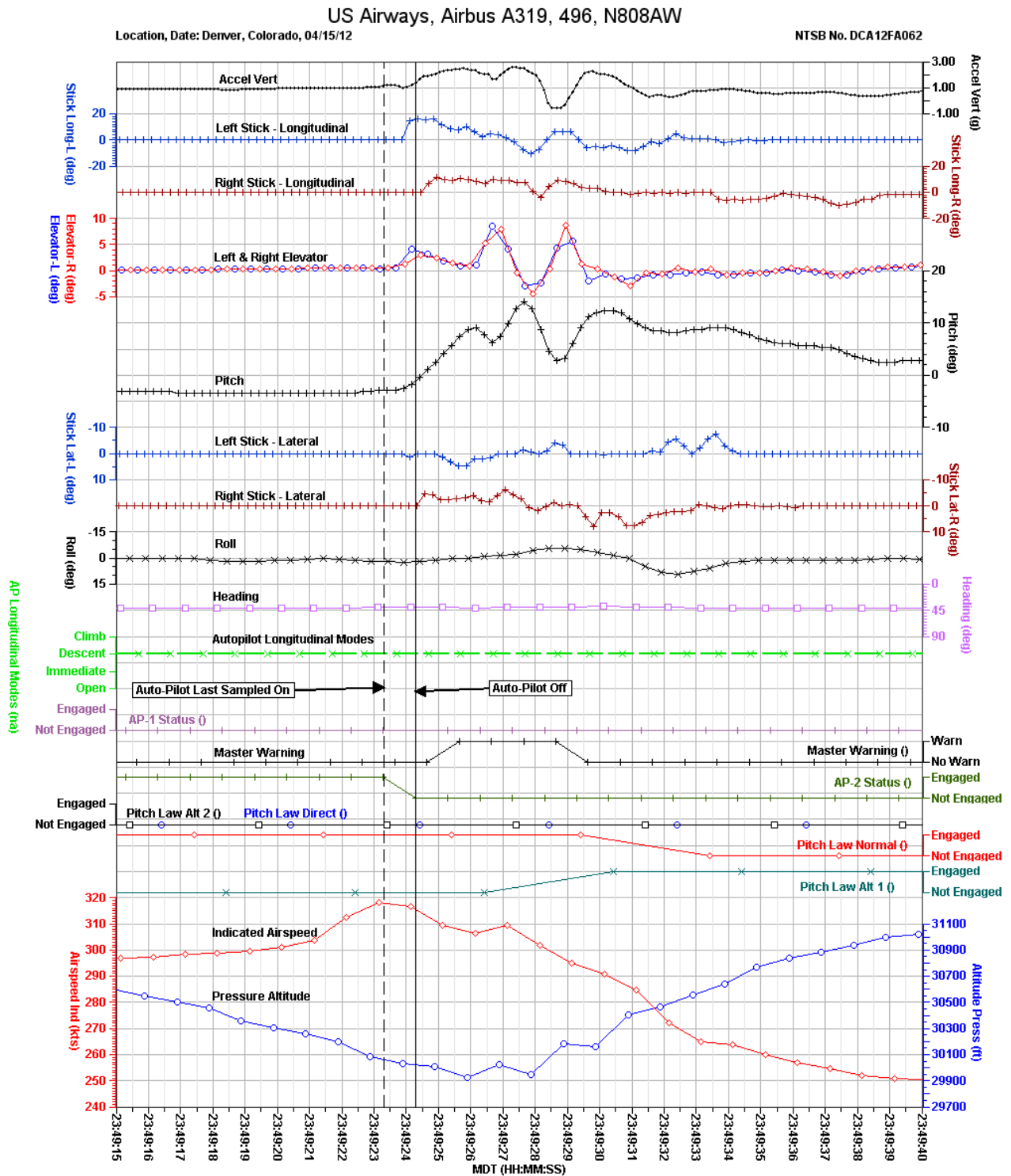
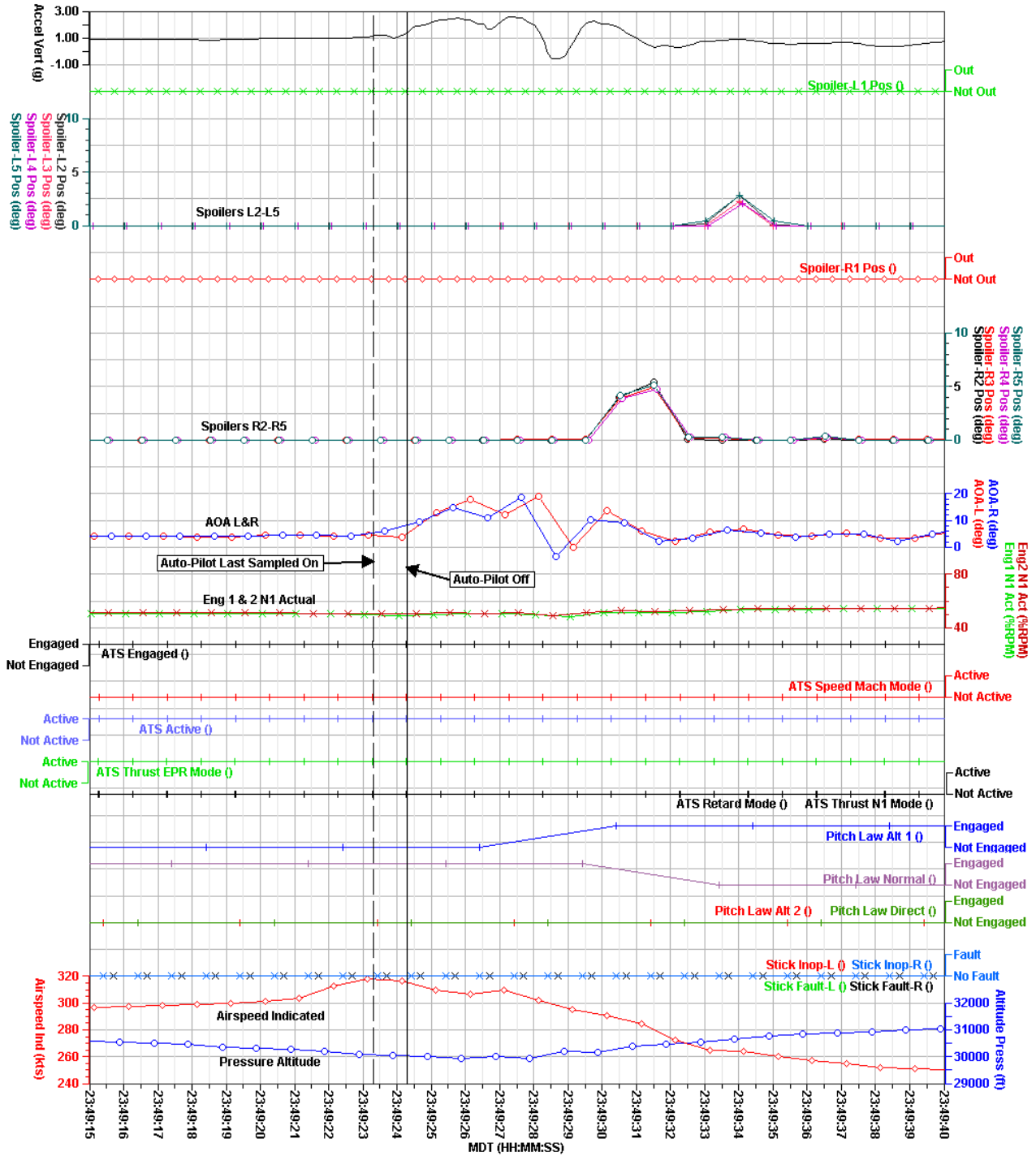


Figure 4. Plot of engine, spoilers, and angle of attack during event.

US Airways, Airbus A319, 496, N808AW

Location, Date: Denver, Colorado, 04/15/12

NTSB No. DCA12FA062



Revised: 24 July 2012

Engine, Spoilers, AOA - Event

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## 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.**

Parameter Name	Parameter Description
1. Accel Lat (g)	Lateral Acceleration
2. Accel Long (g)	Longitudinal Acceleration
3. Accel Vert (g)	Vertical Acceleration
4. Airspeed Ind (kts)	Indicated Airspeed
5. Altitude Press (ft)	Pressure Altitude
6. AP (discrete)	Autopilot
7. AP Lateral Modes (discrete)	Autopilot Lateral Mode
8. AP Longitudinal Modes (discrete)	Autopilot Longitudinal Mode
9. AP-1 Status (discrete)	Autopilot-1 Status
10. AP-2 Status (discrete)	Autopilot-2 Status
11. ATS Active (discrete)	Autothrottle Active
12. ATS Engaged (discrete)	Autothrottle Engaged
13. ATS Retard Mode (discrete)	Autothrottle Retard Mode
14. ATS Speed Mach Mode (discrete)	Autothrottle Mach Mode
15. ATS Thrust EPR Mode (discrete)	Autothrottle EPR Mode
16. ATS Thrust N1 Mode (discrete)	Autothrottle Thrust N1 Mode
17. Ctrl Col Pos-L (deg)	Left Control Column Position
18. Ctrl Whl Pos-L (deg)	Left Control Wheel Position
19. Elevator-L (deg)	Left Elevator Position
20. Elevator-R (deg)	Right Elevator Position
21. Eng1 N1 Act (%rpm)	Left Engine N1 Actual
22. Eng2 N1 Act (%rpm)	Right Engine N1 Actual
23. Ground Speed (kts)	Ground Speed
24. Heading (deg)	Heading
25. Key VHF (discrete)	VHF Keying
26. Master Warning (discrete)	Master Warning
27. Pitch (deg)	Pitch Angle
28. Pitch Law Alt 1 (discrete)	Alternate Pitch Law-1
29. Pitch Law Alt 2 (discrete)	Alternate Pitch Law-2
30. Pitch Law Direct (discrete)	Pitch Law Direct
31. Pitch Law Normal (discrete)	Pitch Law Normal
32. Roll (deg)	Roll Angle
33. Rudder (deg)	Rudder Position
34. Rudder Ped Pos (deg)	Rudder Pedal Position
35. Spoiler 1 Status (discrete)	Spoiler 1 Status
36. Spoiler 2 Status (discrete)	Spoiler 2 Status
37. Spoiler 3 Status (discrete)	Spoiler 3 Status
38. Spoiler 4 Status (discrete)	Spoiler 4 Status
39. Spoiler 5 Status (discrete)	Spoiler 5 Status
40. Spoiler-L1 Pos (deg)	Left Spoiler 1 Position
41. Spoiler-L2 Pos (deg)	Left Spoiler 2 Position
42. Spoiler-L3 Pos (deg)	Left Spoiler 3 Position
43. Spoiler-L4 Pos (deg)	Left Spoiler 4 Position
44. Spoiler-L5 Pos (deg)	Left Spoiler 5 Position
45. Spoiler-R1 Pos (deg)	Right Spoiler 1 Position

46. Spoiler-R2 Pos (deg)	Right Spoiler 2 Position
47. Spoiler-R3 Pos (deg)	Right Spoiler 3 Position
48. Spoiler-R4 Pos (deg)	Right Spoiler 4 Position
49. Spoiler-R5 Pos (deg)	Right Spoiler 5 Position
50. Stick Fault-L (discrete)	Left Stick Fault
51. Stick Fault-R (discrete)	Right Stick Fault
52. Stick Inop-L (discrete)	Left Stick Inop
53. Stick Inop-R (discrete)	Right Stick Inop
54. Stick Lat-L	Left Stick Lateral Input
55. Stick Lat-R	Right Stick Lateral Input
56. Stick Long-L	Left Stick Longitudinal Input
57. Stick Long-R	Right Stick Longitudinal Input
58. Time Day (day)	Day of Month
59. Time GMT Hrs (hrs)	Time GMT Hours
60. Time GMT Min (min)	Time GMT Minutes
61. Time GMT Sec (sec)	Time GMT Seconds
62. Time Month (month)	Month of Year
63. Wind Direction (deg)	Wind Direction
64. Wind Speed (kts)	Wind Speed

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.**

<b>Units Abbreviation</b>	<b>Description</b>
deg	degrees
kts	knots
g	g
discrete	discrete
day	day
degC	degrees Celsius
ft	feet
hrs	hours
min	minutes
month	month
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.