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

November 1, 2012

Flight Data Recorder - 10

Specialist's Factual Report
By Bill Tuccio

1. EVENT SUMMARY

Location:	Pawnee, Nebraska
Date:	February 23, 2012
Aircraft:	Boeing 737-700
Registration:	N915WN
Operator:	Southwest Airlines
NTSB Number:	WPR12LA119

On February 23, 2012, about 1430 central standard time (CST), a Southwest Airlines Boeing 737-7H4, N915WN, encountered a pocket of moderate turbulence about 12 miles north of Pawnee, Nebraska. The captain and the first officer, both of whom were airline transport pilots, were not injured, nor were the 136 passengers, and 2 of the 3 flight attendants. One flight attendant sustained a serious injury to her right hand. The airplane was not damaged. The 14 Code of Federal Regulations Part 121 scheduled domestic passenger flight, which departed Chicago Midway Airport about 65 minutes prior to the turbulence encounter, was en route to Los Angeles International Airport, Los Angeles, California. At the time of the event, the airplane was in visual meteorological conditions on an Instrument Flight Rules flight plan.

2. FLIGHT DATA RECORDER GROUP

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

3. FDR Carriage Requirements

The event aircraft, N915WN, was manufactured on March 17, 2008, 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(d).

4. DETAILS OF FLIGHT DATA RECORDER INVESTIGATION

On March 2, 2012, the Safety Board's Vehicle Recorder Division received an electronic file from a solid-state FDR. The recorder had been downloaded by the operator and was a 256 word per second FDR.

4.1. FDR Data File 256 wps Description

The FDR data in the electronic file was configured such that 256 12-bit words of digital information every second was recorded. Each grouping of 256 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 256-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 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 7th flight out of 15 flights on the recording. The event flight was approximately 4 hours and 28 minutes in duration. The parameters evaluated for the purpose of this report appeared to be in accordance with the federal FDR carriage requirements.

4.1.2. Engineering Units Conversions

The engineering units conversions used for the data contained in this report are based on 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=+).[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 GMT[2] was established by using the recorded Time GMT hours, Time GMT Minutes, and Time GMT Seconds. Accordingly, the time offset for the event flight data from SRN to GMT is the following: GMT = SRN + 22272.0. Therefore, for the rest of this report, all times are referenced as GMT not SRN.

4.3. FDR Plots and Corresponding Tabular Data

The following four figures contain FDR data recorded during the February 23, 2012 event.

Figure 1 shows basic information about the entire accident flight from 1924:30 through 2354:30 GMT. The aircraft initially climbed to flight level 340 and then continued to flight level 360. Based upon crew reports of the event time, the upset event was assumed to occur at about 2030 at flight level 360 in level, cruise flight, about 1 hour after take-off.

Figure 2 shows the same information as figure 1, with an expanded scale around the crew reported upset time of 2030. In the 20 minute period surrounding the event, the vertical acceleration varied between +0.98g and +1.06g.

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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 = +.

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

Figure 3 shows flight control parameters for the entire flight, providing baseline values and parameter validation.

Figure 4 shows the same information as figure 3, with an expanded scale around the crew reported upset time of 2030. The control wheel shows a maximum control wheel position of about +/- 3.5 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[3]) format as Attachment 1 to this report.

[3] Comma Separated Value format.

Figure 1. Plot of basic parameters during event flight.

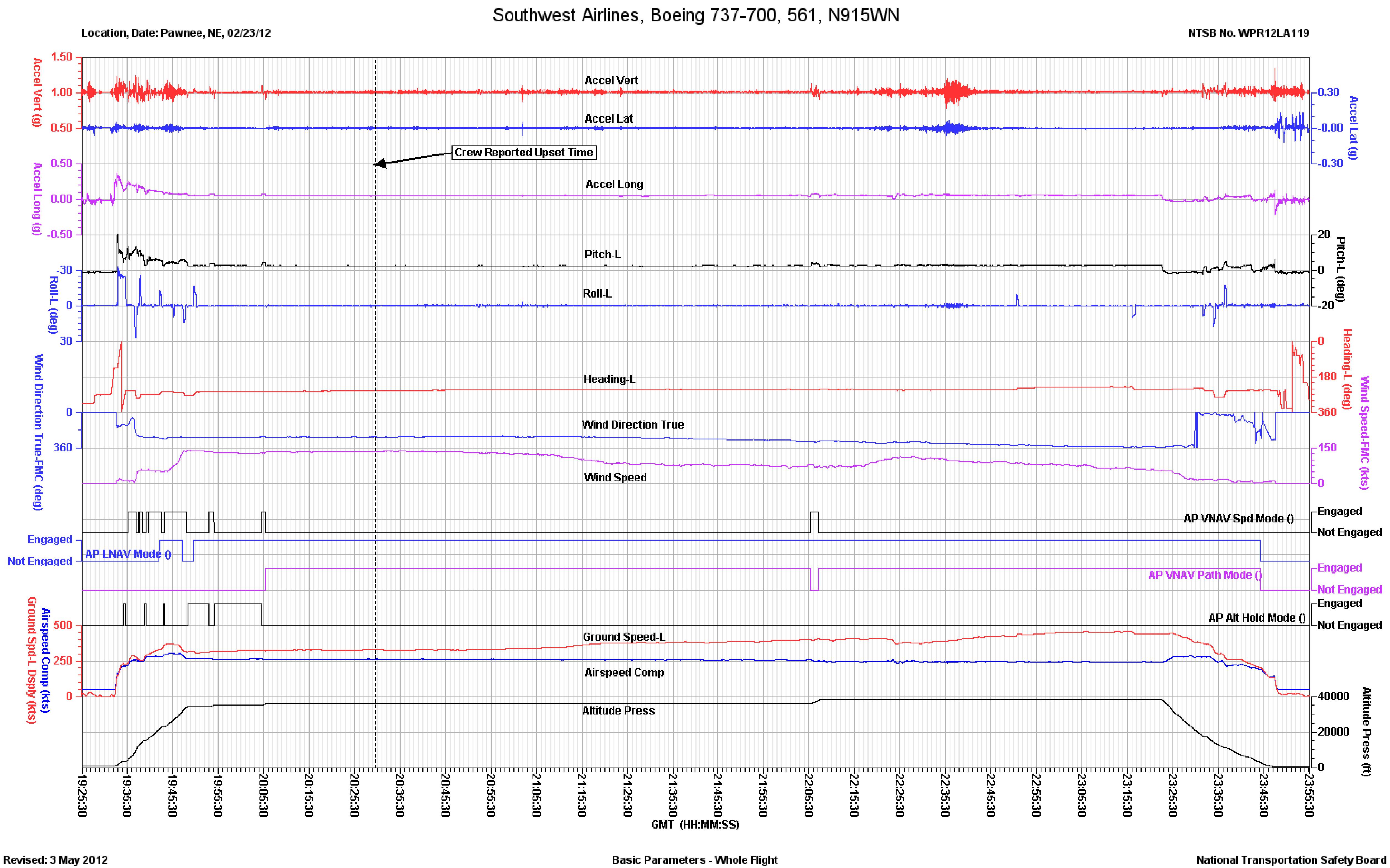
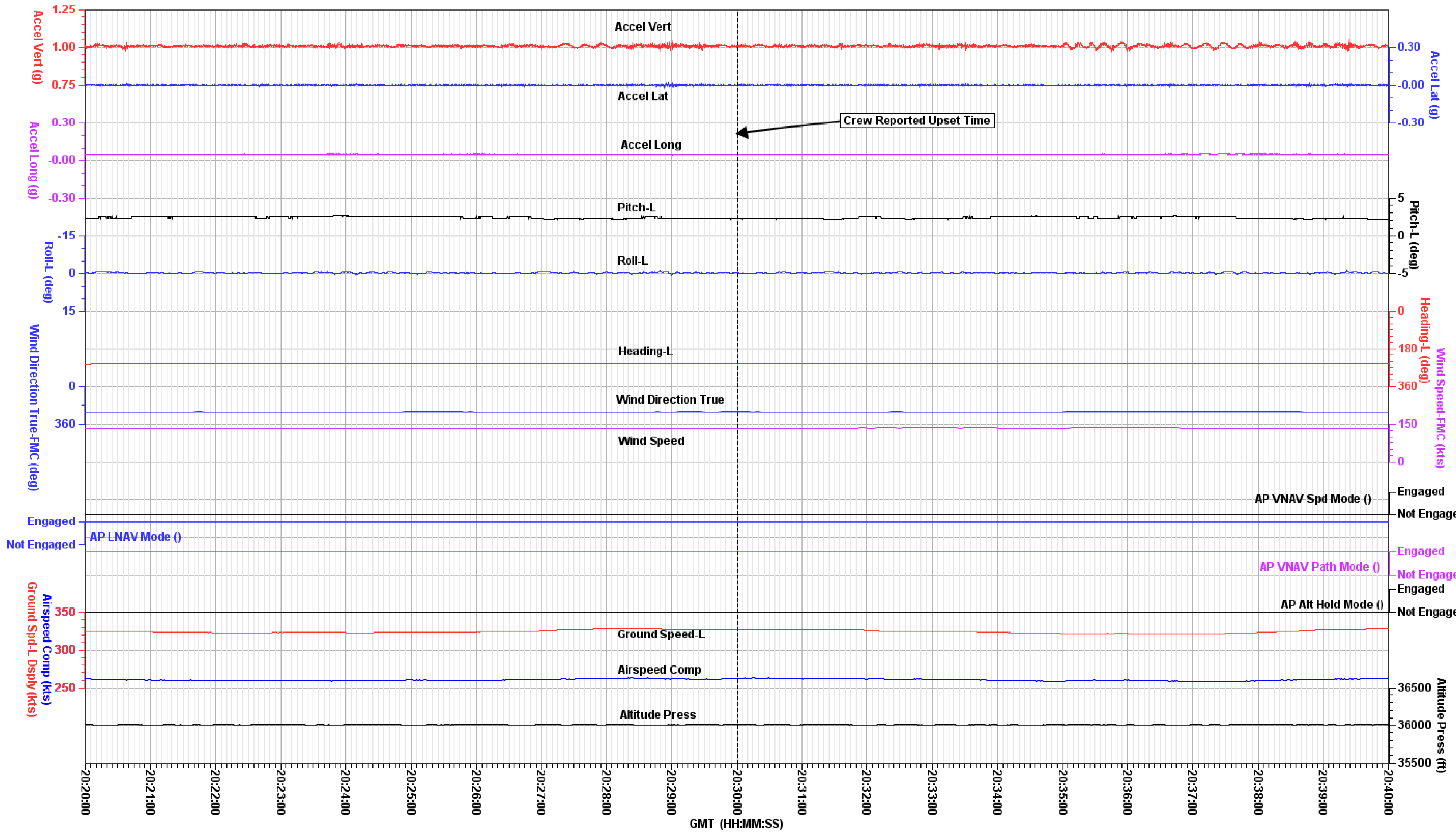


Figure 2. Plot of basic parameters near time of event.

Southwest Airlines, Boeing 737-700, 561, N915WN

Location, Date: Pawnee, NE, 02/23/12 **NTSB No. WPR12LA119**



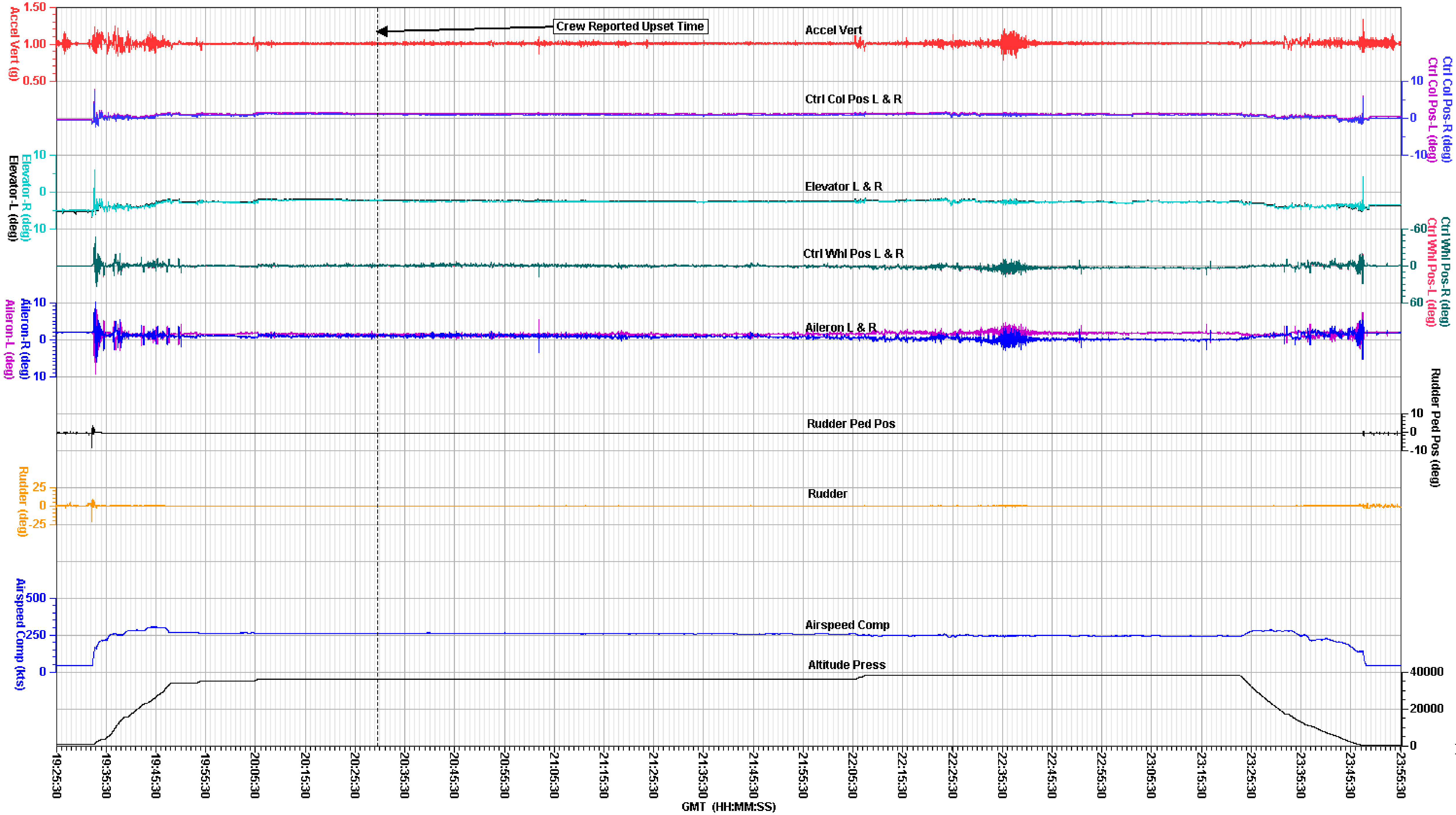
Revised: 1 November 2012 **Basic Parameters - Upset Event** **National Transportation Safety Board**

Figure 3. Plot of flight control parameters during event flight.

Southwest Airlines, Boeing 737-700, 561, N915WN

Location, Date: Pawnee, NE, 02/23/12

NTSB No. WPR12LA119



Revised: 3 May 2012

Flight Controls - Whole Flight

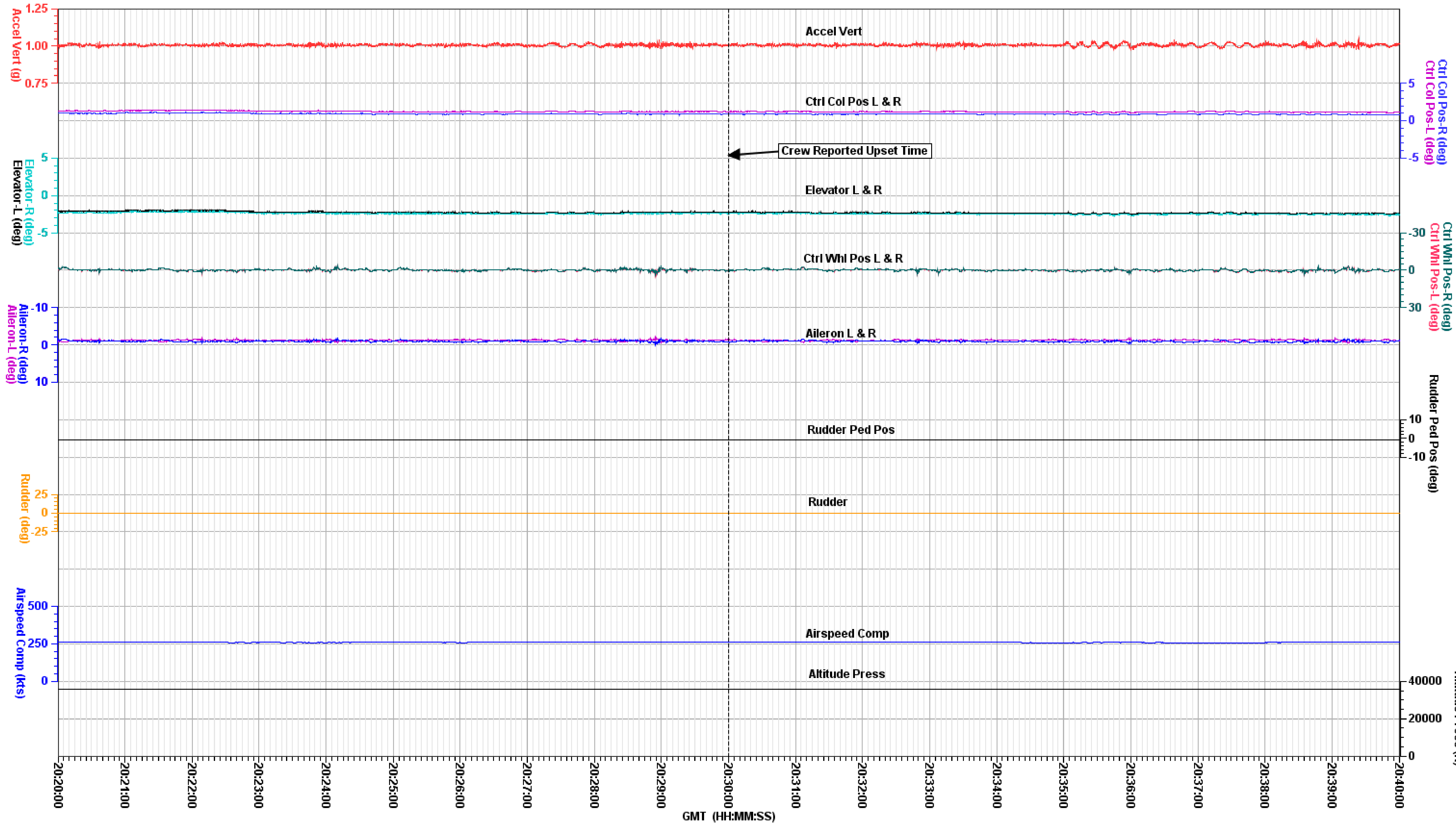
National Transportation Safety Board

Figure 4. Plot of flight control parameters near time of event.

Southwest Airlines, Boeing 737-700, 561, N915WN

Location, Date: Pawnee, NE, 02/23/12

NTSB No. WPR12LA119



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. 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 Alt Hold Mode (discrete)	Autopilot Altitude Hold Mode
9. AP LNAV Mode (discrete)	Autopilot Lateral Navigation Mode
10. AP VNAV Path Mode (discrete)	Autopilot Vertical Navigation Mode
11. AP VNAV Spd Mode (discrete)	Autopilot Vertical Speed Mode
12. Ctrl Col Pos-L (deg)	Left Control Column Position
13. Ctrl Col Pos-R (deg)	Right Control Column Position
14. Ctrl Whl Pos-L (deg)	Left Control Wheel Position
15. Ctrl Whl Pos-R (deg)	Right Control Wheel Position
16. Elevator-L (deg)	Left Elevator Position
17. Elevator-R (deg)	Right Elevator Position
18. Ground Spd-L (kts)	Left Ground Speed Display
19. Heading-L (deg)	Left Heading
20. Pitch-L (deg)	Left Pitch Angle
21. Roll-L (deg)	Left Roll Angle
22. Rudder (deg)	Rudder Position
23. Rudder Ped Pos (deg)	Rudder Pedal Position
24. Time Clock GMT Hrs (hrs)	Time Clock GMT Hours
25. Time Clock GMT Min (min)	Time Clock GMT Minutes
26. Time Clock GMT Sec (sec)	Time Clock GMT Seconds
27. Wind Direction True-FMC (deg)	Flight Management Computer Wind Direction
28. Wind Speed-FMC (kts)	Flight Management Computer 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.

Units Abbreviation	Description
deg	degrees
kts	knots
g	g
discrete	discrete
in	inches

Units Abbreviation	Description
ft	feet
hrs	hours
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.