National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594

DCA24LA065

FLIGHT DATA RECORDER

Specialist's Factual Report

March 14, 2024

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A. ACCIDENT

Location: Houston, Texas
Date: January 10, 2024
Time: 1109 central standard time (CST)
Airplane: Boeing 737-900, United Airlines, N62883

B. FLIGHT DATA RECORDER SPECIALIST

Specialist   Charles Cates
                            Mechanical Engineer/Recorder Specialist
                            National Transportation Safety Board (NTSB)

C. FEDERAL CARRIAGE REQUIREMENTS

The event aircraft, N62883, was operating under Title 14 *Code of Federal Regulations* (CFR) Part 121. The event aircraft was operating such that it was required to be equipped with a flight data recorder (FDR) that recorded, at a minimum, 88 parameters, as cited in 14 CFR Part 121.344.

D. DETAILS OF THE INVESTIGATION

An FDR group was not convened.

Recorder Manufacturer/Model: L3 FA2100
Part Number: 2100-4045-22
Recorder Serial Number: 001039236

1.0 L3 FA2100 Description

The L3 FA2100 records airplane flight information in a digital format using solid-state flash memory as the recording medium. The FA2100 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 512 12-bit words of digital information every second. Each grouping of 512 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 512-word intervals. Each data parameter (for example, altitude, heading, and airspeed) has a specifically assigned word number within the subframe. The FA2100 is designed to meet the crash-survivability requirements of TSO-C124b

1.1 Recorder Condition

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

1.2 Recording Description

The FDR recording contained approximately 118 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 2 hours and 2 minutes. The parameters evaluated for the purpose of this report appeared to be in accordance with federal FDR carriage requirements.

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. 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]

Table 1 lists the FDR parameters verified and provided in this report. Additionally, table 2 describes the unit and discrete state abbreviations used in this report.

1.4 Time Correlation

Correlation of the FDR data from SRN to the event local time, central standard time, was established by using the recorded coordinated universal time (UTC) Hours, UTC Minutes, and UTC Seconds and then applying an additional 5 hours offset to change UTC to CST.

Accordingly, the time offset for the event flight data from SRN to CST is the following: CST = SRN – 383763.5. Therefore, for the rest of this report, all times are referenced as CST, not SRN.

E.   FIGURES AND TABULAR DATA

Figures 1 to 3 contain FDR data recorded during the event on January 10, 2024. All the parameters listed in table 1 are plotted.

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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 = +, Left Aileron Trailing Edge Down = -, Right Aileron Trailing Edge Up = +, Pitch Up = +, Elevator Trailing Edge Up = +, Right Rudder = +.

Figure 1 contains basic parameters including accelerations, attitudes, altitude, and airspeed for the time of the full flight.

Figure 2 contains flight control parameters and surface deflections for the time of the full flight.

Figure 3 contains parameters related to the landing and deceleration of the aircraft from the time that the aircraft passed 1000 feet above ground level until the end of the ground rollout.

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 data show that the aircraft main gear touched down on the runway with a 6.5-degree nose-up attitude at 1109:52 CST while traveling about 149 knots. Vertical acceleration showed the initial touchdown peaking at >1.87g. The speedbrakes deployed two seconds after the initial touchdown and the aircraft became airborne again at the same time and began to derotate. As the speedbrakes were retracting about 2 seconds after becoming airborne again, pitch began to increase, and the main gear touched down a second time with a vertical acceleration of about 2.87g. Pitch reached a peak of 7.2 degrees. The aircraft became airborne again for another second before the main gear touched down for the final time. The nose lowered to the ground and the speedbrakes were extended again. Following nose gear touchdown, wheel brakes and thrust reversers were also employed as the aircraft slowed.

The corresponding tabular data used to create figures 1 to 3 are provided in electronic comma-separated value (CSV) format as attachment 1 to this report.

Submitted by:

Charles Cates
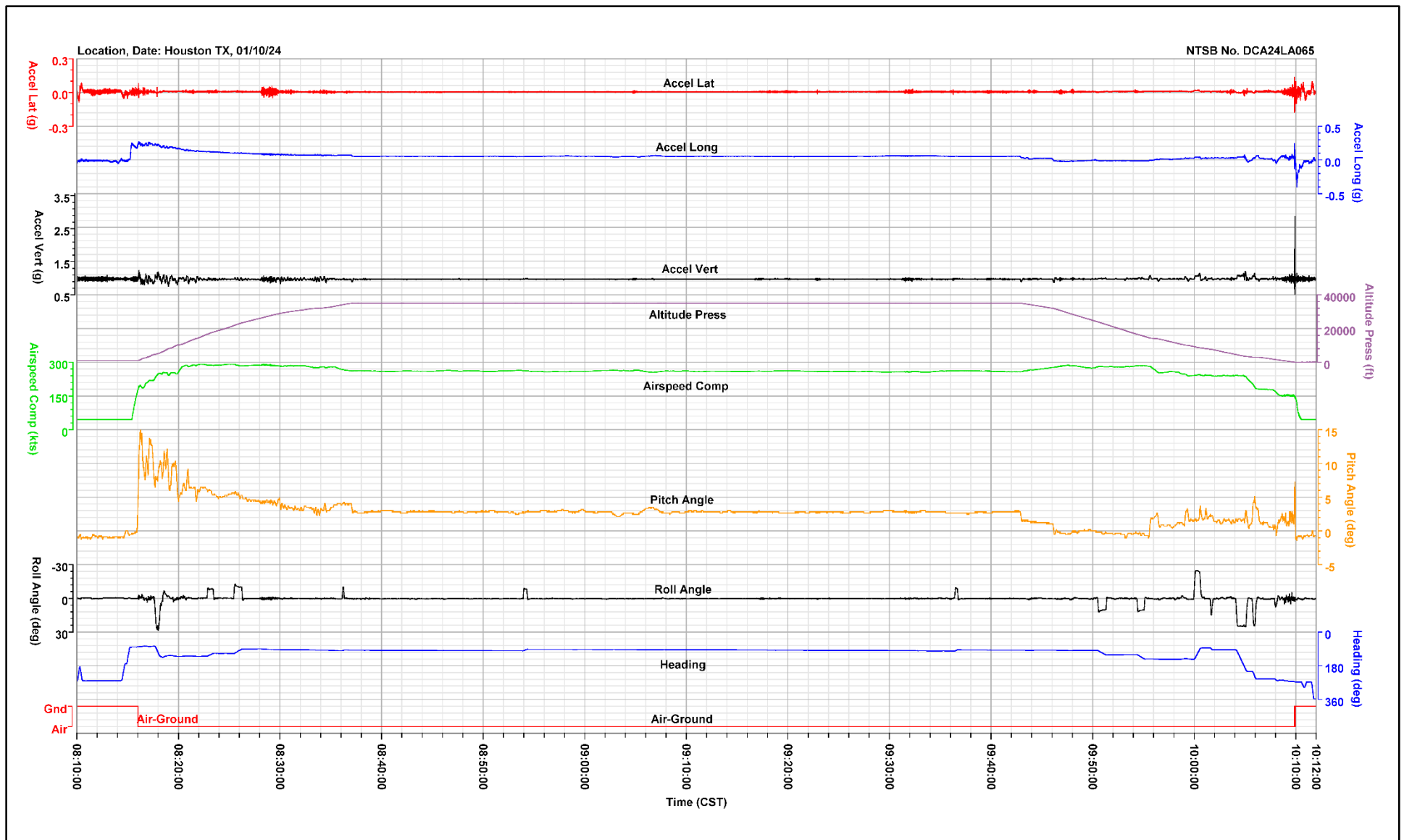Mechanical Engineer/Recorder Specialist
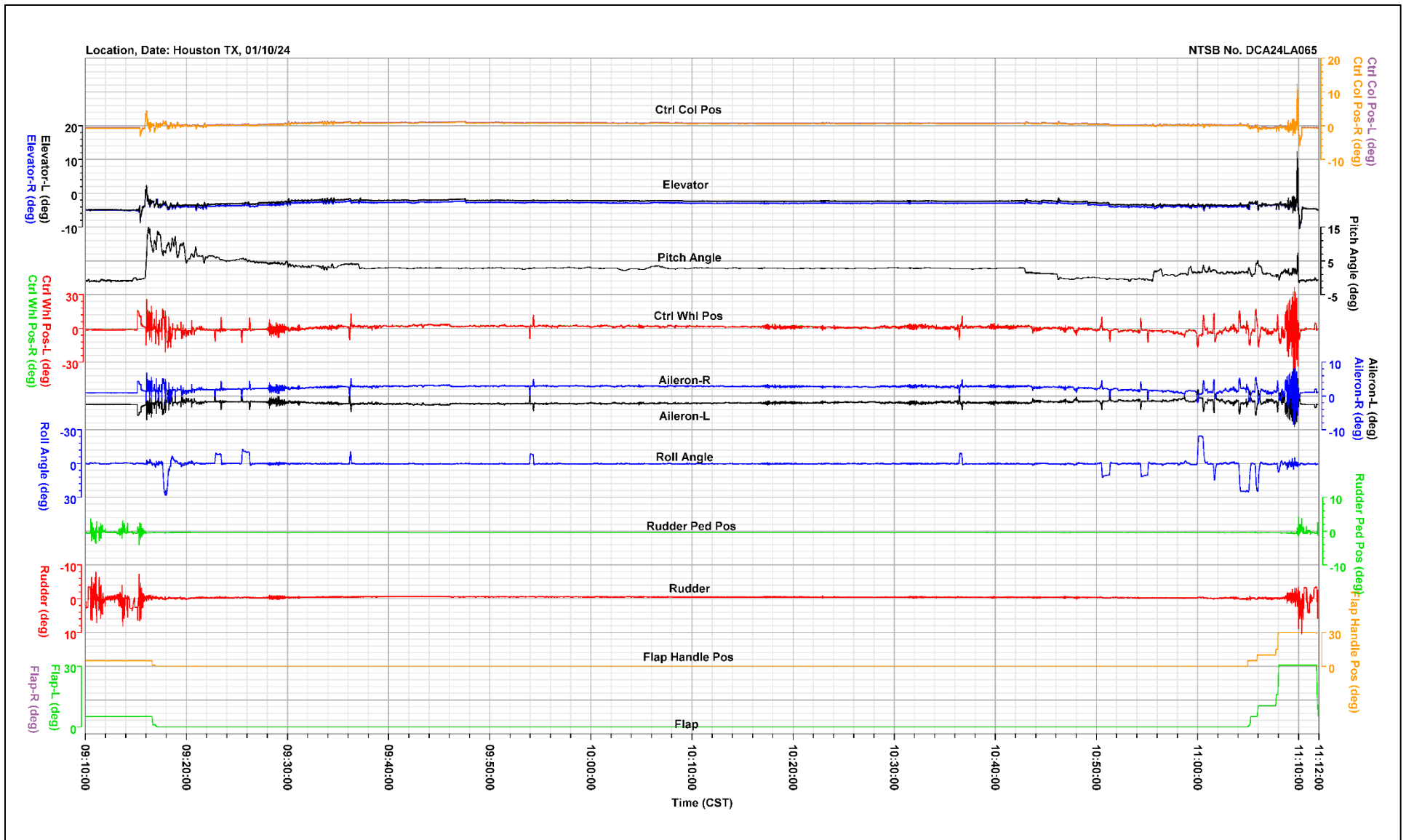
Figure 1. Plot of basic parameters.

Figure 2. Plot of flight control and surface parameters.
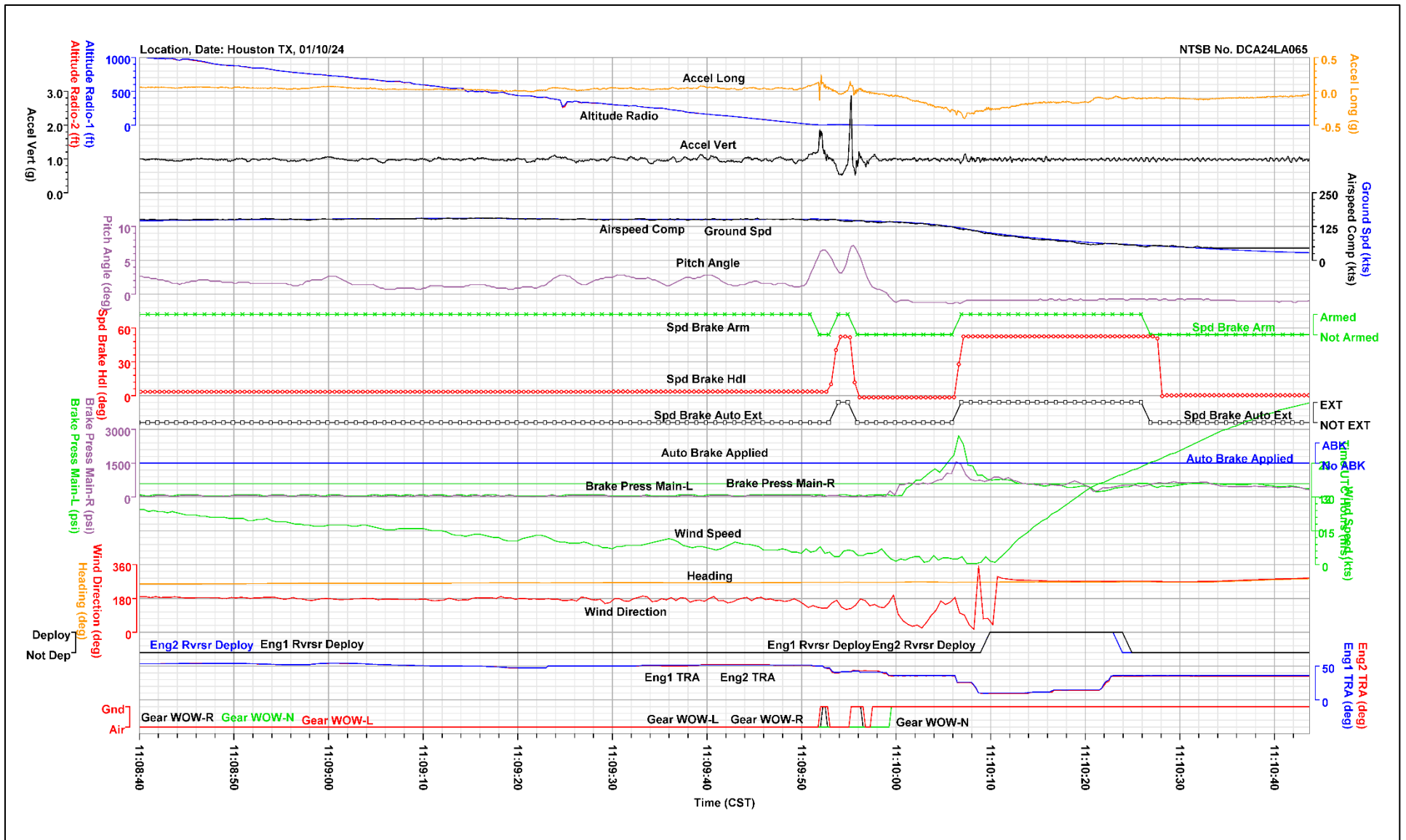
Figure 3. Parameters related to aircraft landing and deceleration.

APPENDIX A. VERIFIED AND PROVIDED PARAMETERS

This appendix describes the parameters provided and verified in this report. Table 1 lists the plot/table labels, parameter names, and units. Additionally, table 2 describes the unit and discrete state abbreviations used in this report.

Table 1. Verified and provided FDR parameters.

Plot/Table Labels	Parameter Names	Units
1. Accel Lat	Lateral Acceleration	g
2. Accel Long	Longitudinal Acceleration	g
3. Accel Vert	Vertical Acceleration	g
4. Aileron-L	Left Aileron Position	deg
5. Aileron-R	Right Aileron Position	deg
6. Air-Ground	Air/Ground Sensor	
7. Airspeed Comp	Computed Airspeed	kts
8. Altitude Press	Pressure Altitude	ft
9. Altitude Radio	Height Above Ground Level	ft
10. Auto Brake Applied	Auto Brake Applied	
11. Brake Press Main-L	Left Main Brake Pressure	psi
12. Brake Press Main-R	Right Main Brake Pressure	psi
13. Ctrl Col Pos-L	Left Control Column Position	deg
14. Ctrl Col Pos-R	Right Control Column Position	deg
15. Ctrl Whl Pos-L	Left Control Wheel Position	deg
16. Ctrl Whl Pos-R	Right Control Wheel Position	deg
17. Elevator-L	Left Elevator Position	deg
18. Elevator-R	Right Elevator Position	deg
19. Eng1 Rvsr Deploy	Engine 1 Thrust Reverser Deployed	
20. Eng1 TRA	Engine 1 Throttle Resolver Angle	deg
21. Eng2 Rvsr Deploy	Engine 2 Thrust Reverser Deployed	
22. Eng2 TRA	Engine 2 Throttle Resolver Angle	deg
23. Flap Handle Pos	Flap Handle Position	deg
24. Flap-L	Left Flaps Position	deg
25. Flap-R	Right Flaps Position	deg
26. Gear WOW-L	Weight on Left Main Gear	
27. Gear WOW-N	Weight on Nose Gear	
28. Gear WOW-R	Weight on Right Main Gear	
29. Ground Speed	Ground Speed	kts
30. Heading	Magnetic Heading	deg
31. Pitch Angle	Aircraft Pitch	deg
32. Roll Angle	Aircraft Roll	deg
33. Rudder	Rudder Surface Position	deg

Plot/Table Labels	Parameter Names	Units
34. Rudder Ped Pos	Rudder Pedal Position	deg
35. Spd Brake Arm	Speed Brake Armed	
36. Spd Brake Auto Ext	Speed Brake Extended Automatically	
37. Spd Brake Hdl	Speed Brake Handle Position	deg
38. Wind Direction	Wind Direction	deg
39. Wind Speed	Wind Speed	kts

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 1 are discretes. 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 2. Unit and discrete state abbreviations.

Unit/Discrete State Abbreviations	Descriptions
ABK	Autobrake
deg	degrees
Dep	Deploy
EXT	Extended
ft	feet
Gnd	Ground
kts	knots
psi	pounds per square inch