

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



DCA23LA468

FLIGHT DATA RECORDER

Specialist's Factual Report

April 24, 2024

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A. ACCIDENT

Location: Denver, Colorado
Date: September 30, 2023
Time: 1500 mountain daylight time (MDT)
Airplane: Boeing 737-9, United Airlines, N37560

B. FLIGHT DATA RECORDER SPECIALIST

Specialist Cassandra Johnson
Mechanical Engineer
National Transportation Safety Board (NTSB)

C. FEDERAL CARRIAGE REQUIREMENTS

The event aircraft, N37560, was operating under Title 14 *Code of Federal Regulations* (CFR) Part 121. The event aircraft was manufactured in 2023 and was operating such that it was required to be equipped with a flight data recorder (FDR) that recorded, at a minimum, 91 parameters, as cited in 14 CFR Part 121.344(f).

D. DETAILS OF THE INVESTIGATION

An FDR group was not convened. The NTSB Vehicle Recorder Division received the following FDR:

Recorder Manufacturer/Model: Honeywell Connected Recorder-25 (HCR-25)
Part Number: D51728-1-0
Recorder Serial Number: A28335-002

1.0 Recorder Description

The Honeywell Connected Recorder-25 (HCR-25) records airplane flight information in a digital format using solid-state flash memory as the recording medium. The HCR-25 can receive data in the ARINC 717 and ARINC 747 configurations and can record a minimum of 25 hours of flight data. It is configured to record 1024 12-bit words of digital information every second. Each grouping of 1024 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 1024-word intervals. Each data parameter (for example, altitude, heading, and airspeed) has a specifically assigned word number within the subframe. The HCR-25 is designed to meet the crash-survivability requirements of ETSO-C124c.

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 104 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 recorded at the end of the FDR data. 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

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

1.3.1 Computed Airspeed

The left and right computed airspeed parameters (Airspeed Comp-L and Airspeed Comp-R) are only valid above 45 knots (kts).

1.4 Time Correlation

Correlation of the FDR data from SRN to MDT was established by using the recorded coordinated universal time (UTC) Hours, UTC Minutes, and UTC Seconds and then applying an additional 6 hours offset to change UTC to MDT.

Accordingly, the time offset for the event flight data from SRN to MDT is the following: MDT = SRN - 319,328. Therefore, for the rest of this report, all times are referenced as MDT, not SRN.

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 = +.

E. FIGURES AND TABULAR DATA

Figures 1 and 2 contain FDR data recorded during the event on September 30, 2023. All the parameters listed in table 1 are plotted except UTC Hours, UTC Minutes, and UTC Seconds.

Figure 1 covers from the time the FDR started recording before the rejected takeoff to the end of the FDR data. Figure 2 focuses on the rejected takeoff.

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 FDR started recording at 14:28:33 MDT. About 4.6 minutes later at 14:33:09 MDT, the aircraft started moving. Then about 20 minutes later at 14:53:12 MDT, the aircraft began its takeoff roll and 43 seconds later at 14:53:55 MDT came to a complete stop. During this time, the computed airspeed peaked at 59 kts.

The corresponding tabular data used to create figures 1 and 2, including UTC Hours, UTC Minutes, and UTC Seconds, are provided in electronic comma-separated value (CSV) format as attachment 1 to this report.

Submitted by:

Cassandra Johnson
Mechanical Engineer

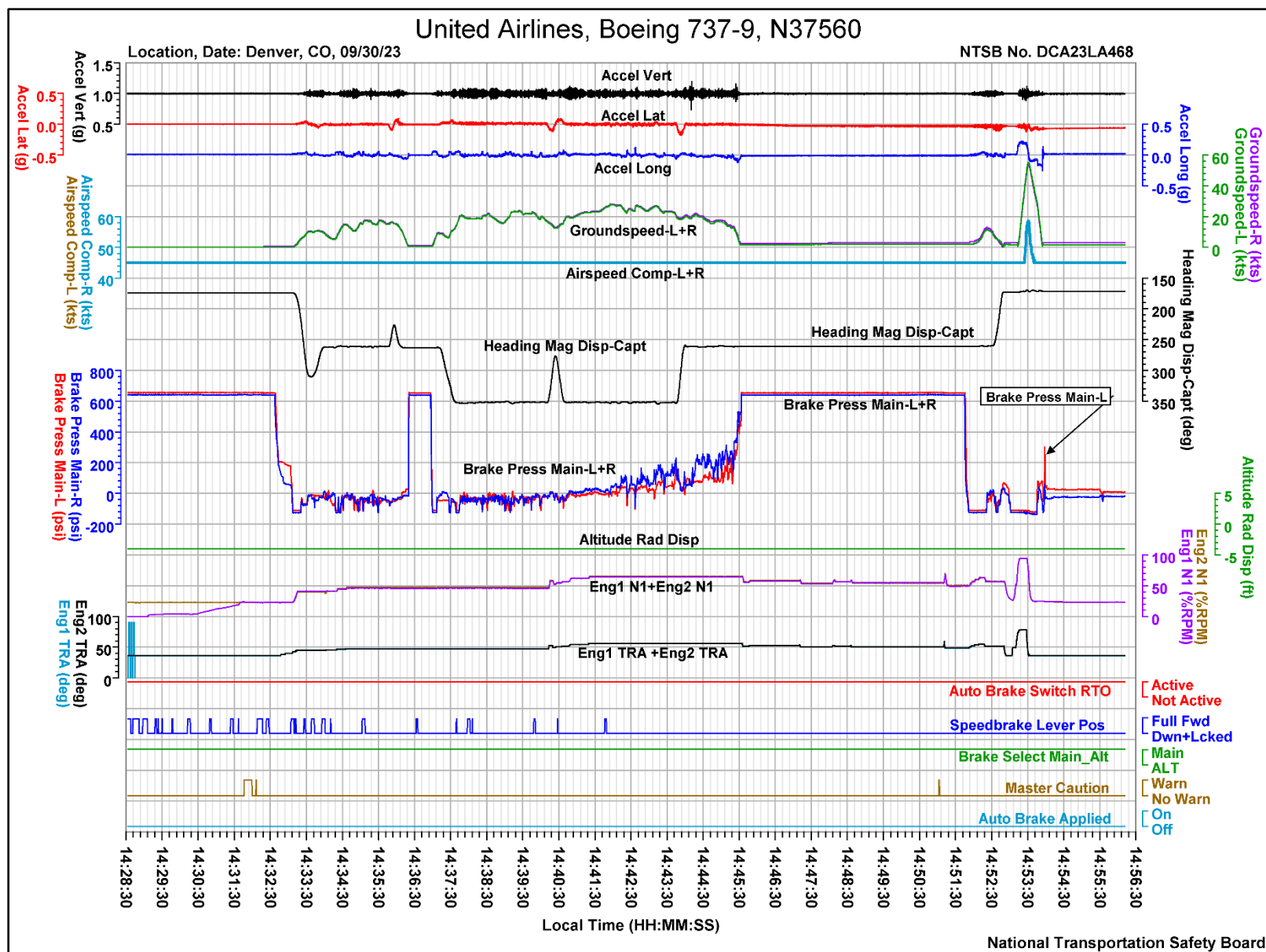


Figure 1. Plot of parameters from the time the FDR started recording before the rejected takeoff to the end of the FDR data.

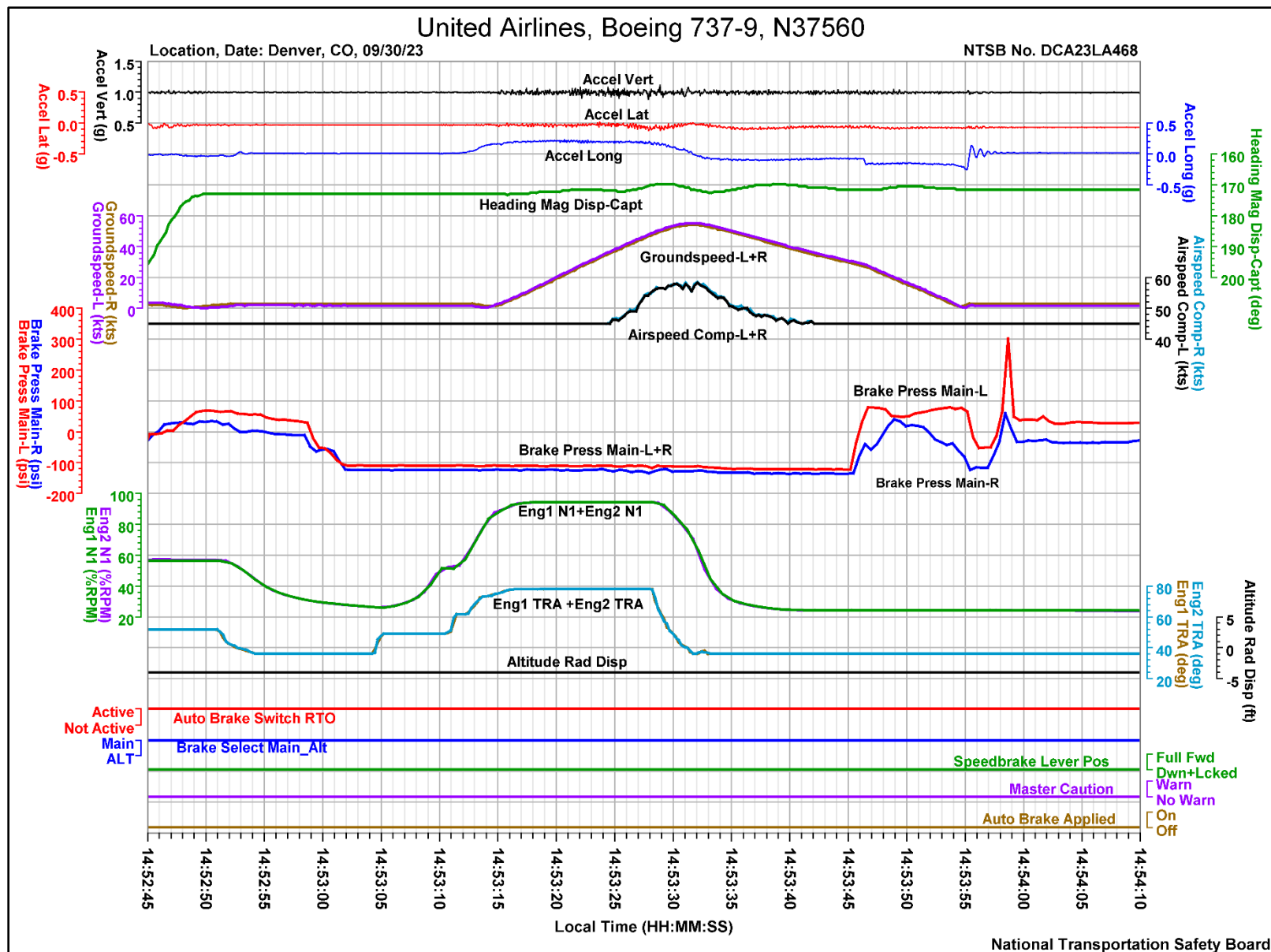


Figure 2. Plot of parameters focusing on the rejected takeoff.

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
Accel Lat	Lateral Acceleration	g
Accel Long	Longitudinal Acceleration	g
Accel Vert	Vertical Acceleration	g
Airspeed Comp-L	Computed Airspeed-Left	kts
Airspeed Comp-R	Computed Airspeed-Right	kts
Altitude Rad Disp	Radio Altitude Displayed	ft
Auto Brake Applied	Auto Brake Applied status	
Auto Brake Switch RTO	Auto Brake Switch Rejected Takeoff	
Brake Pressure Main-L	Brake Pressure Main-Left	
Brake Pressure Main-R	Brake Pressure Main-Right	
Brake Select Main_Alt	Brake Select Main or Alternate	
Eng1 N1	Engine 1 Fan Speed	%RPM
Eng1 TRA	Engine 1 Throttle Resolver Angle	deg
Eng2 N1	Engine 2 Fan Speed	%RPM
Eng2 TRA	Engine 2 Throttle Resolver Angle	deg
Ground Spd-L	Ground Speed-Left	kts
Ground Spd-R	Ground Speed-Right	kts
Heading Mag Disp-Capt	Magnetic Heading Displayed-Captain	deg
Master Caution	Master Caution status	
Speedbrake Lever Pos	Speedbrake Lever Position	
Time UTC-Hrs	Coordinated Universal Time Hours	hrs
Time UTC-Min	Coordinated Universal Time Minutes	min
Time UTC-Sec	Coordinated Universal Time Seconds	sec

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 and Discrete State Abbreviations	Descriptions
%RPM	percent revolutions per minute
ALT	Alternate
deg	degrees
Dwn+Lcked	Down and Locked
ft	feet
Fwd	Forward
g	unit of gravitation acceleration
hrs	hours
kts	knots
min	minutes
sec	seconds