National Transportation Safety Board
Office of Research and Engineering
Washington, DC 20594

DCA23LA125

FLIGHT DATA RECORDER

Specialist's Factual Report

July 6, 2023

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A. INCIDENT

Location: Queens, New York
Date: January 13, 2023
Time: 20:44 eastern standard time (EST)
Airplane 1: Boeing 737-900ER, Delta Air Lines[1], N914DU
Airplane 2: Boeing 777-200, American Airlines[2], N754AN

B. FLIGHT DATA RECORDER SPECIALIST

Specialist: Kyle Garner
Sr. Aerospace Engineer – Recorder Specialist
National Transportation Safety Board (NTSB)

C. FEDERAL CARRIAGE REQUIREMENTS

Airplane 1 (Delta)

Airplane 1, manufactured in 2019, was operating under the provisions of Title 14 *Code of Federal Regulations* (CFR) Part 121 and 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(f).

Airplane 2 (American)

Airplane 2, manufactured in 2001, was operating under the provisions of Title 14 CFR Part 121 and was required to be equipped with an FDR that recorded, at a minimum, 57 parameters, as cited in 14 CFR Part 121.344(e).

D. DETAILS OF THE INVESTIGATION

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

Airplane 1 (Delta):

The operator provided an electronic file containing FDR data downloaded from the incident airplane to the NTSB for review.

[1] Referred to as Delta in this report.
[2] Referred to as American in this report.

Airplane 2 (American):

Recorder Manufacturer/Model:	L3Harris FA2100
Part Number:	2100-4043-00
Recorder Serial Number:	00569

1.0 FDR Descriptions

A digital FDR records airplane flight information using solid-state flash memory as the recording medium. FDRs receive data formatted in the ARINC 573/717/747 configurations and are required to record a minimum of 25 hours of flight data. FDRs record 12-bit words of digital information every second. Each grouping of words is called a subframe and is identified with a subframe reference number (SRN). 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. Each data parameter (altitude, heading, and airspeed) has a specifically assigned word number within the subframe.

Airplane 1 (Delta):

The file contained data from an FDR that was configured to record 512 12-bit words of digital information every second.

Airplane 2 (American):

The L3Harris FA2100 FDR was configured to record 256 12-bit words of digital information every second and was designed to meet the crash-survivability requirements of TSO-C124b.

1.1 Airplane 2 FDR Condition

The recorder received from Airplane 2 (American) was in good condition and the data were extracted normally from the recorder using instructions provided by the recorder manufacturer. A photo of the recorder, as received, is provided in figure 1.

Figure 1. FA2100 from airplane 2 (American), as received.

1.2 Recording Descriptions

Airplane 1 (Delta):

The FDR recording contained approximately 101 hours of data. The incident leg, which returned to the gate following the incident, was approximately 1 hour and 7 minutes in duration. Two other uneventful flight legs were present on the recording following the incident leg. The parameters evaluated for this report appeared to be in accordance with federal FDR carriage requirements.

Airplane 2 (American):

The FDR recording contained approximately 56 hours of data. The incident leg, which departed to Heathrow Airport (LHR), London, United Kingdom following the incident, was approximately 6 hours and 50 minutes in duration. Three other uneventful flight legs were present on the recording following the incident leg. The parameters evaluated for this report appeared to be in accordance with federal FDR carriage requirements.

1.2.1 Engineering Unit Conversions

The engineering unit conversions used for the data contained in this report are based on documentation from the airplane manufacturer and operators. 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=+).[3]

[3] 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 = +.

1.3 Time Correlations

Airplane 1 (Delta):

The correlation of the FDR data to local time, EST, 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 EST. The offset is provided in table 1.

Airplane 2 (American):

The correlation of the FDR data to local time, EST, was established by using the recorded Greenwich mean time (GMT) Hours, GMT Minutes, and GMT Seconds and then applying an additional 5 hours offset to change GMT to EST. The offset is provided in table 1.

Table 1. FDR time offset.

Airplane	SRN to EST offset
1 (Delta)	-233606.0
2 (American)	-40344.0

For the remainder of this report, all time is referenced as EST.

1.4 Pressure Altitude

The FDRs record pressure altitude, which is based on a standard altimeter setting of 29.92 inches of mercury (in Hg). The altitude information presented in the FDR plots and the tabular data has not been corrected for the local altimeter setting at the time of the incident.

E. FIGURES AND TABULAR DATA

Figures 2 to 4 contain FDR data recorded during the incident on January 3, 2023, from 20:44:15 to 20:45:15 EST. Figures 2 and 3 contain FDR data sourced from the Delta airplane and figure 4 contains FDR data sourced from the American airplane. Vertical dashed lines on each plot show the time when the Delta airplane pressed the TOGA switch and when it aborted the takeoff sequence.

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

All the parameters shown in table 2 and table 3 are plotted except Latitude-FMC, Longitude-FMC, Time UTC/GMT Hrs, Time UTC/GMT Min, Time UTC/GMT Sec, V1 Speed (Delta only), Eng1 TR Transit (Delta only), and Eng2 TR Transit (Delta only).

The data show that the Delta airplane reached a maximum computed airspeed of about 105 knots before aborting takeoff. The takeoff decision airspeed (V1) for the Delta airplane was recorded as 153 knots.

Table 2 lists the FDR parameters verified and provided in this report for Airplane 1 (Delta). Table 3 lists the FDR parameters verified and provided in this report for Airplane 2 (American). Additionally, table 4 describes the unit and discrete state abbreviations used in this report.

The corresponding tabular data used to create figures 2 to 3 and figure 4, including those parameters not plotted, are provided in electronic comma-separated value (CSV) format as Attachments 1 (Delta) and 2 (American) to this report, respectively.

Submitted by:

Kyle Garner
Sr. Aerospace Engineer – Recorder Specialist

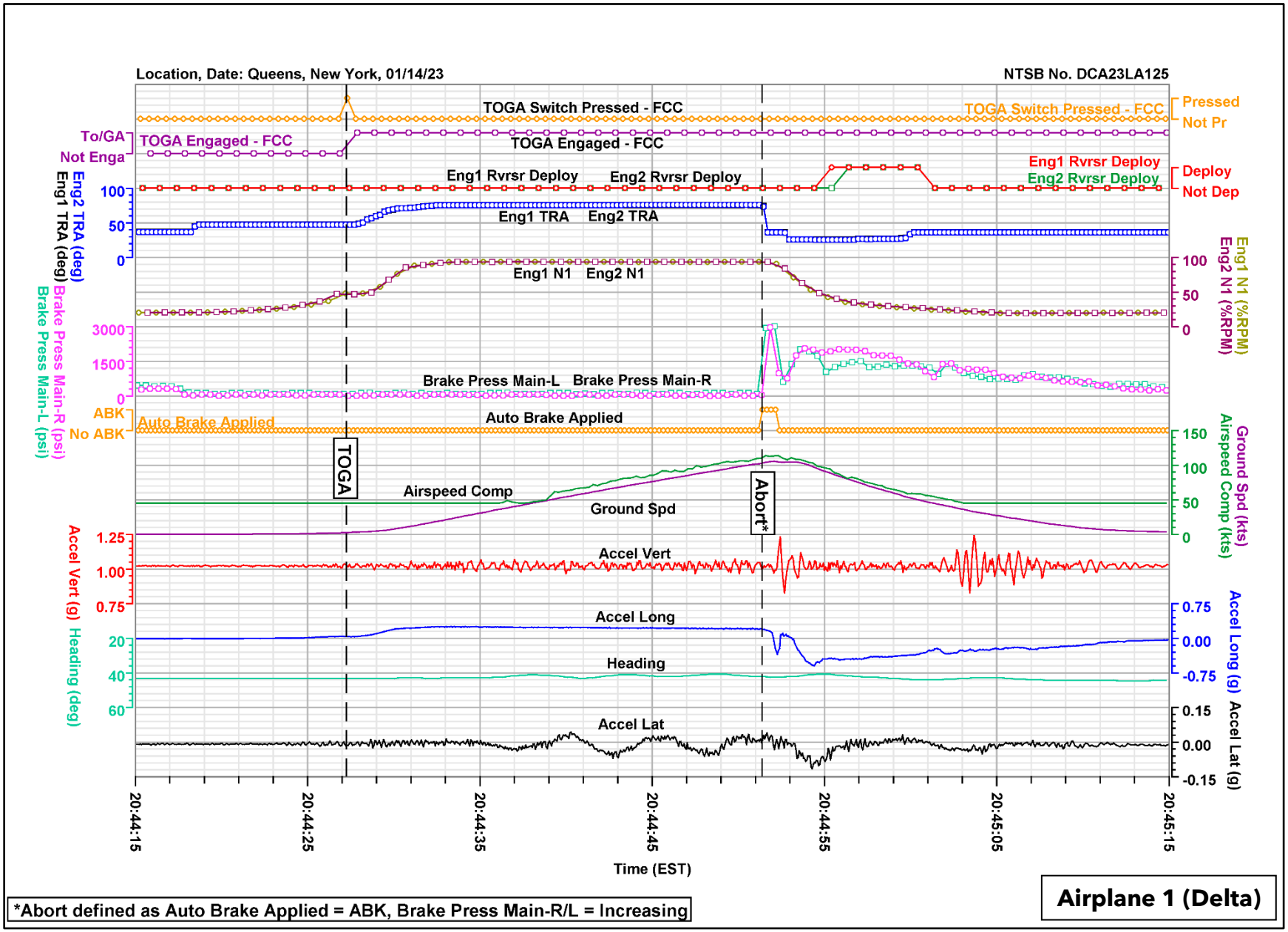

Figure 2. Basic parameters during the incident – airplane 1 (Delta).

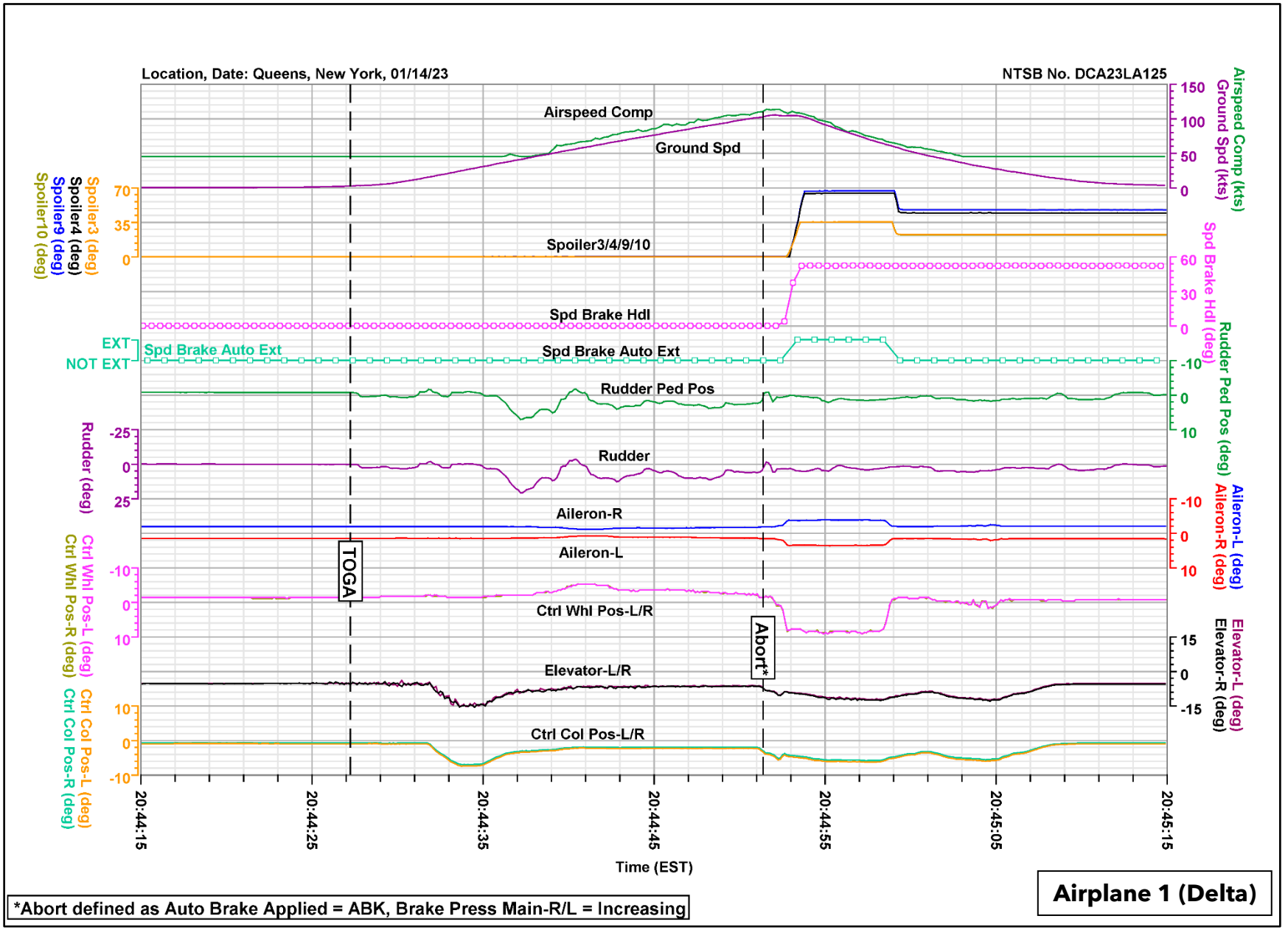

Figure 3. Flight control input and surface position parameters during the incident – airplane 1 (Delta).

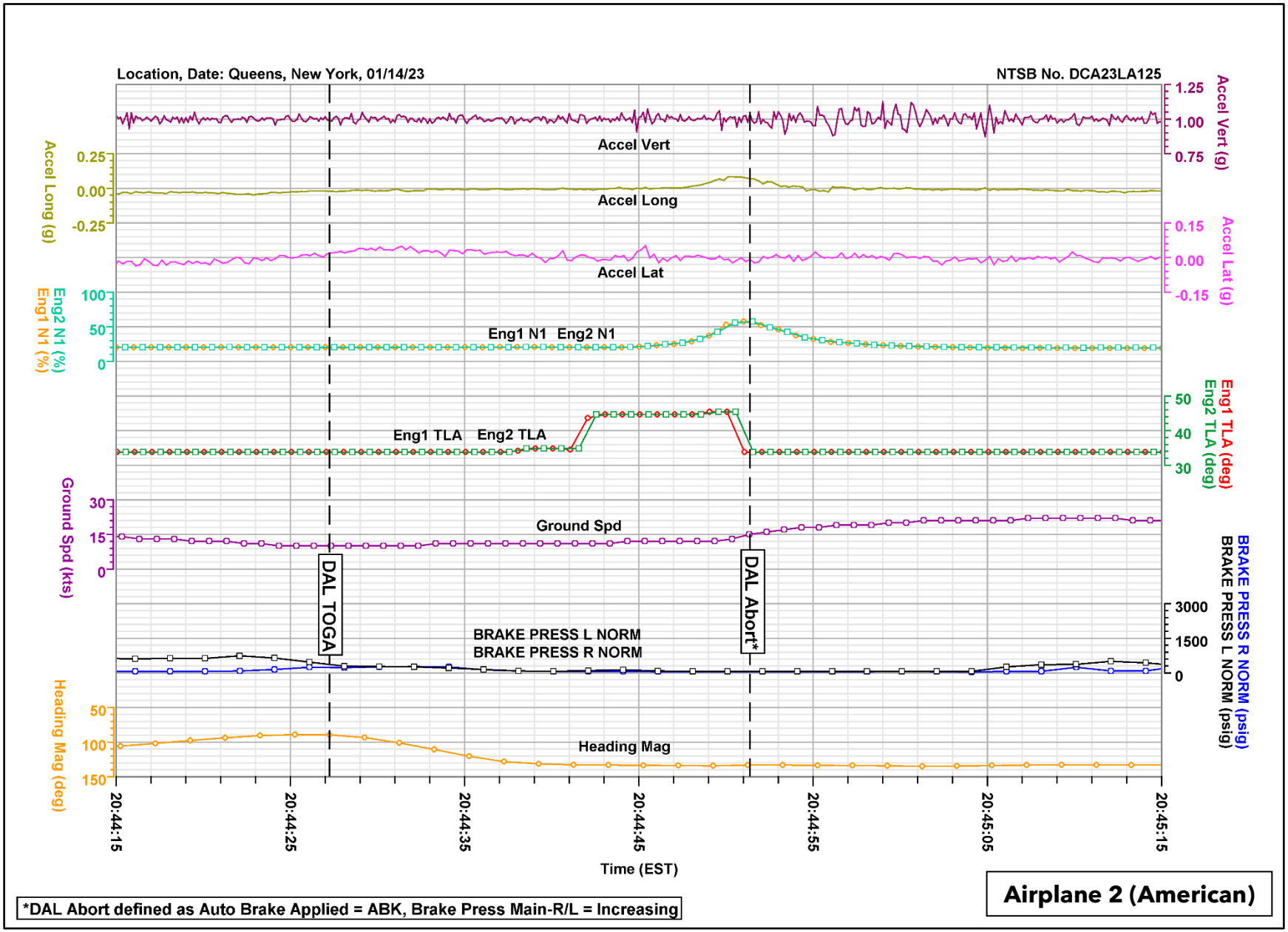

Figure 4. Basic parameters during the incident – airplane 2 (American).

APPENDIX A. VERIFIED AND PROVIDED PARAMETERS

This appendix describes the parameters provided and verified in this report.

Table 2 and Table 3 list the plot/table labels, parameter names, and units for Airplane 1 (Delta) and Airplane 2 (American), respectively. Parameters that do not have units are discretes[4]. Not all parameters shown in Table 2 and Table 3 are plotted, however, all are provided as tabular data in attachment 1 and 2 to this report.

Table 2. Verified and provided FDR parameters for airplane 1 (Delta)[5].

Plot/Table Labels	Parameter Names	Units
Accel Lat	Lateral Acceleration	g
Accel Long	Longitudinal Acceleration	g
Accel Vert	Vertical Acceleration	g
Aileron-L	Aileron Position-Left	deg
Aileron-R	Aileron Position-Right	deg
Airspeed Comp	Computed Airspeed	kts
Altitude Press	Pressure Altitude	ft
Auto Brake Applied	Auto Brake Applied	
Brake Press Main-L	Main Brake Pressure-Left	psi
Brake Press Main-R	Main Brake Pressure-Right	psi
Ctrl Col Pos-L	Control Column Position-Left	deg
Ctrl Col Pos-R	Control Column Position-Right	deg
Ctrl Whl Pos-L	Control Wheel Position-Left	deg
Ctrl Whl Pos-R	Control Wheel Position-Right	deg
Elevator-L	Elevator Position-Left	deg
Elevator-R	Elevator Position-Right	deg
Eng1 N1	Engine 1 Fan Speed	%RPM
Eng1 TR Deploy	Engine 1 Thrust Reverser Deployed	
Eng1 TR Transit	Engine 1 Thrust Reverser In-Transit	
Eng1 TRA	Engine 1 Throttle Resolver Angle	deg
Eng2 N1	Engine 2 Fan Speed	%RPM
Eng2 TR Deploy	Engine 2 Thrust Reverser Deployed	
Eng2 TR Transit	Engine 2 Thrust Reverser In-Transit	
Eng2 TRA	Engine 2 Throttle Resolver Angle	deg
Ground Spd	Ground Speed	kts
Heading	Heading	deg
Latitude-FMC	Latitude-Flight Management Computer	deg
Longitude-FMC	Longitude-Flight Management Computer	deg
Rudder	Rudder Position	deg
Rudder Ped Pos	Rudder Pedal Position	deg
Spd Brake Arm	Speed Brake Armed	
Spd Brake Auto Ext	Speed Brake Auto Extend	
Spd Brake Hdl	Speed Brake Handle Position	deg
Spoiler10	Spoiler 10 Position	deg

[4] 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.

Plot/Table Labels	Parameter Names	Units
Spoiler3	Spoiler 3 Position	deg
Spoiler4	Spoiler 4 Position	deg
Spoiler9	Spoiler 9 Position	deg
Time UTC Hours	Time UTC Hours	hrs
Time UTC Minutes	Time UTC Minutes	min
Time UTC Seconds	Time UTC Seconds	sec
TOGA Eng-FCC	Takeoff/Go Around Engaged-Flight Control Computer	
TOGA Switch-FCC	Takeoff/Go Around Switch Pressed-Flight Control Computer	
V1 Speed	Takeoff Decision Speed	kts

Table 3 lists the plot/table labels, parameter names, and units for Airplane 2 (American).

Table 3. Verified and provided FDR parameters for airplane 2 (American).

Plot/Table Labels	Parameter Names	Units
Accel Lat	Lateral Acceleration	g
Accel Long	Longitudinal Acceleration	g
Accel Vert	Vertical Acceleration	g
Altitude Press	Pressure Altitude	ft
BRAKE PRESS L NORM	Normal Brake Pressure-Left	psig
BRAKE PRESS R NORM	Normal Brake Pressure-Right	psig
Eng1 N1	Engine 1 Fan Speed	%
Eng1 TLA	Engine 1 Thrust Lever Angle	deg
Eng2 N1	Engine 2 Fan Speed	%
Eng2 TLA	Engine 2 Thrust Lever Angle	deg
Ground Spd	Ground Speed	kts
Heading Mag	Magnetic Heading	deg
Latitude FMC	Latitude Flight Management Computer	deg
Longitude FMC	Longitude Flight Management Computer	deg
Time GMT Hrs	Time GMT Hours	hrs
Time GMT Min	Time GMT Minutes	min
Time GMT Sec	Time GMT Seconds	sec

Table 4 describes the unit and discrete state abbreviations used in this report.

Table 4. Unit and discrete state abbreviations used in this report.

Abbreviation	Description
%RPM	percent revolutions per minute
deg	degrees
FCC	flight control computer
FMC	flight management computer
ft	feet
g	unit of acceleration
hrs	hours
kts	knots
min	minutes
N1	fan speed
psi	pounds per square inch

Abbreviation	Description
psig	pounds per square in gauge
sec	seconds
TLA	thrust lever angle
TOGA	takeoff/go around
TRA	throttle resolver angle
V1	takeoff decision speed