

NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division

Washington, D.C. 20594

March 18, 2022

Flight Data Recorder

Specialist's Factual Report

By Kyle Garner

1. EVENT

Location: Atlantic City, New Jersey
Date: October 2, 2021
Aircraft: Airbus A320
Registration: N922NK
Operator: Spirit Airlines
NTSB Number: ENG22LA002

2. FLIGHT DATA RECORDER GROUP

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

3. FDR CARRIAGE REQUIREMENTS

The event aircraft, N922NK, was manufactured in 2019 and was operating such that it was required to be equipped with an FDR that recorded, at a minimum, 88 parameters, as cited in Title 14 *Code of Federal Regulations* (CFR) Part 121.344(f).

4. DETAILS OF INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following FDR:

Recorder Manufacturer/Model: **Honeywell HFR5-D, 1024 wps**
Recorder Serial Number: **FDR-08520**

4.1. Honeywell HFR5-D, 1024 wps Description

The Honeywell 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 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 SSFDR is designed to meet the crash-survivability requirements of TSO-C124a.

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 contained approximately 27 hours of data. The event flight was the last flight on the recording. Timing of the FDR data is measured in subframe reference number (SRN), where each SRN equals one elapsed second. The parameters evaluated for this report appeared to be per federal FDR carriage requirements.

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

4.1.4. Pressure Altitude

This FDR records 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 electronic data has not been corrected for the local altimeter setting at the time of the event.

4.1.5. Non-Computed Data

A non-computed data (NCD) pattern is indicative that the raw data is no longer reliable or not available. An NCD pattern is typically recorded when the aircraft is on the ground, an engine is not running, or a particular mode is not activated. For this investigation, computed airspeed regularly displayed an NCD pattern when the aircraft was on the ground. Multiple engine 2 parameters also displayed NCD patterns intermittently after the event.

4.2. Time Correlation

Correlation of the FDR data from SRN to eastern daylight time (EDT) was established by using the recorded parameters UTC hours, UTC minutes, and UTC seconds and applying an offset from UTC to EDT. Accordingly, the time offset for the event flight from SRN to EDT is the following:

$$\text{EDT} = \text{SRN} - 32251$$

Therefore, for the rest of this report, all times are referenced as EDT, not SRN.

4.3. FDR Plots and Tabular Data

Figures 1 to 5 contain FDR data recorded during the event flight's takeoff roll from 17:43:15 to 17:46:30 EDT on October 2, 2021.

Figure 1 is a plot of basic parameters including air and ground speeds, flap position, longitudinal sidestick inputs, elevator position, accelerations, master warning/cautions, and engine fire indications. Data show that the maximum computed airspeed during the takeoff roll before the abort was approximately 118 knots.

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 = +. The only exception to this convention is that positive left aileron will be indicative of a left turn/roll.

Figure 2 is a plot of parameters related to braking, spoilers, and reverse thrust. Air and ground speeds and engine 2 fire indication are also shown for reference. Data show that the aircraft came to a stop on the runway 16 seconds after reaching the maximum computed airspeed of approximately 118 knots.

Figure 3 is a plot of autopilot (AP) and autothrust (AT) parameters. Air and ground speeds and Engine 1/2 N1 are also shown for reference.

Figures 4 and 5 are plots of engine-related parameters. Air and ground speeds are also shown for reference.

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 tabular data used to create figures 1 to 5 are provided in compressed electronic comma-separated value (*.csv) format as attachment 1 to this report.

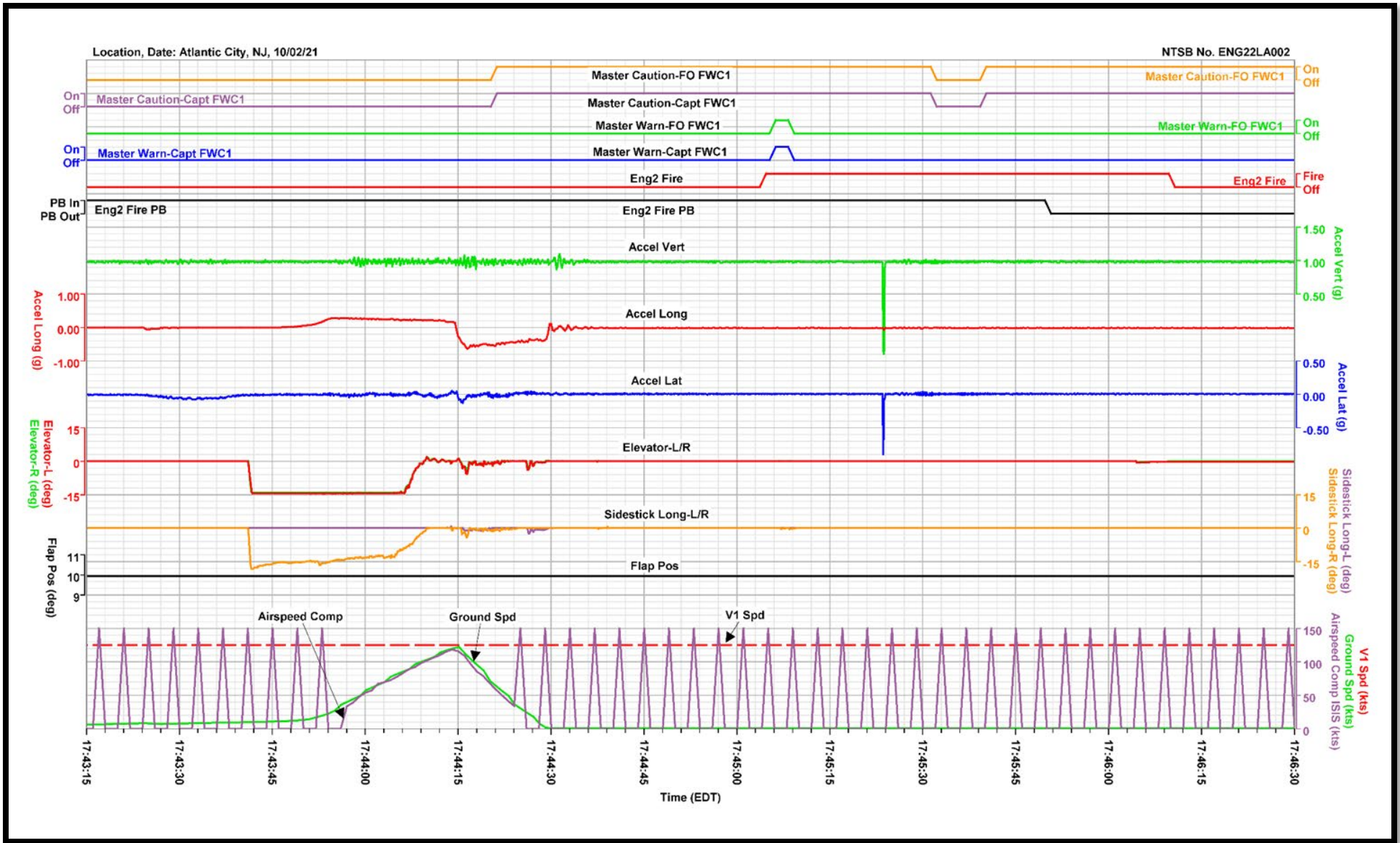


Figure 1. Plot of basic parameters.

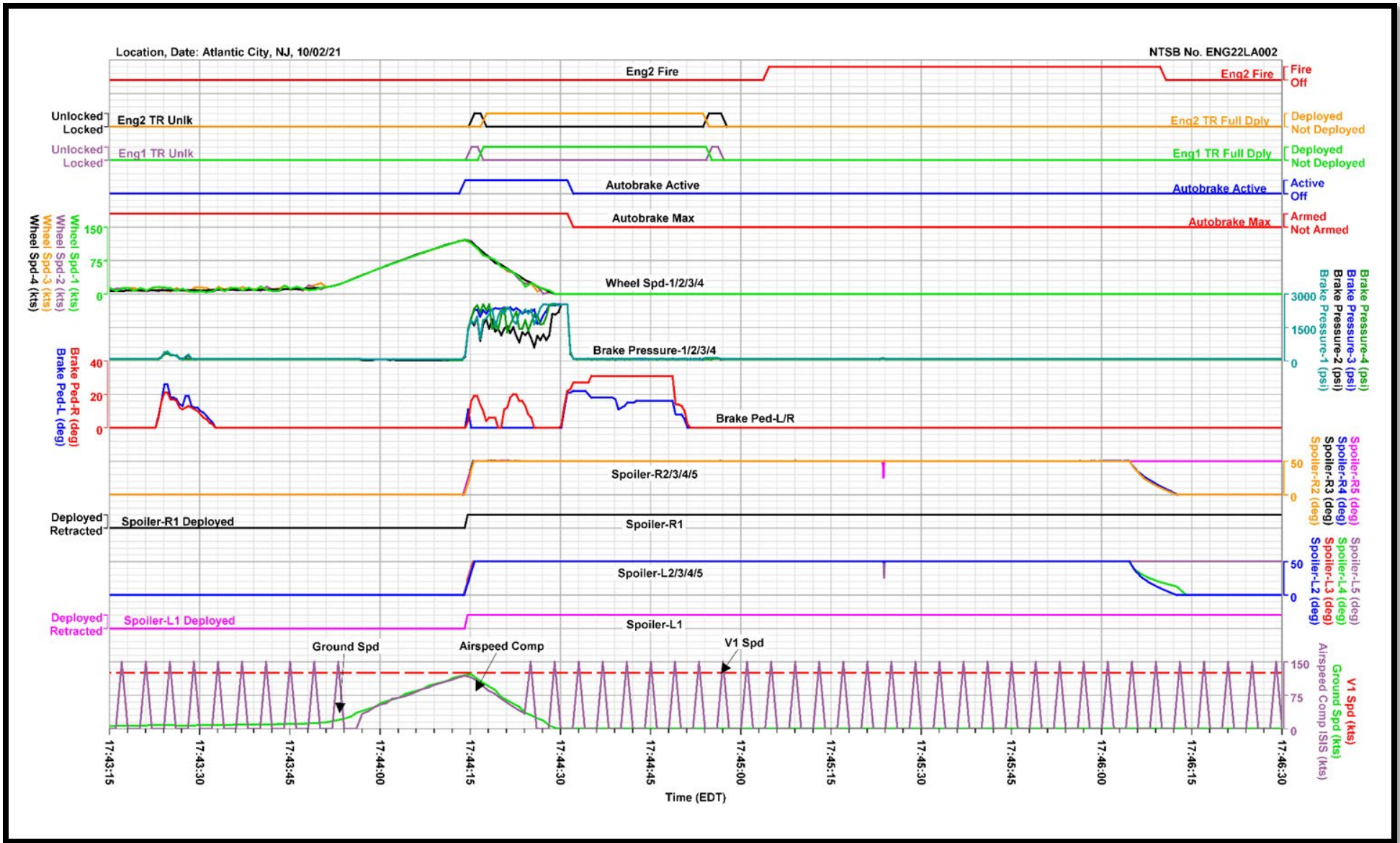


Figure 2. Plot of braking, thrust reverser, and spoiler parameters.

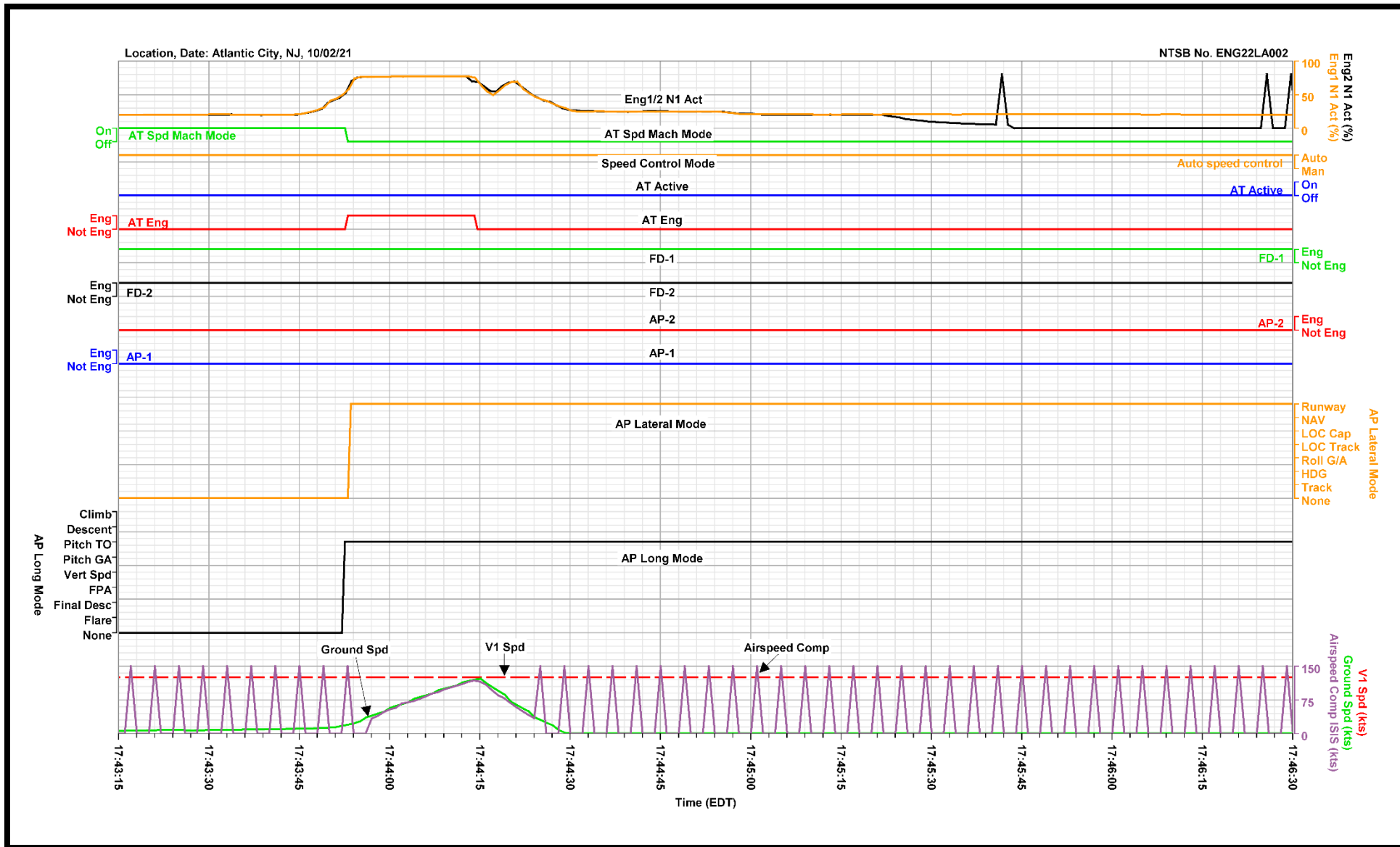


Figure 3. Plot of AP and AT parameters².

² Note that from 17:45:40 to 17:45:45 and 17:46:25 to 17:46:30, engine 2 N1 displayed a NCD pattern following the event.

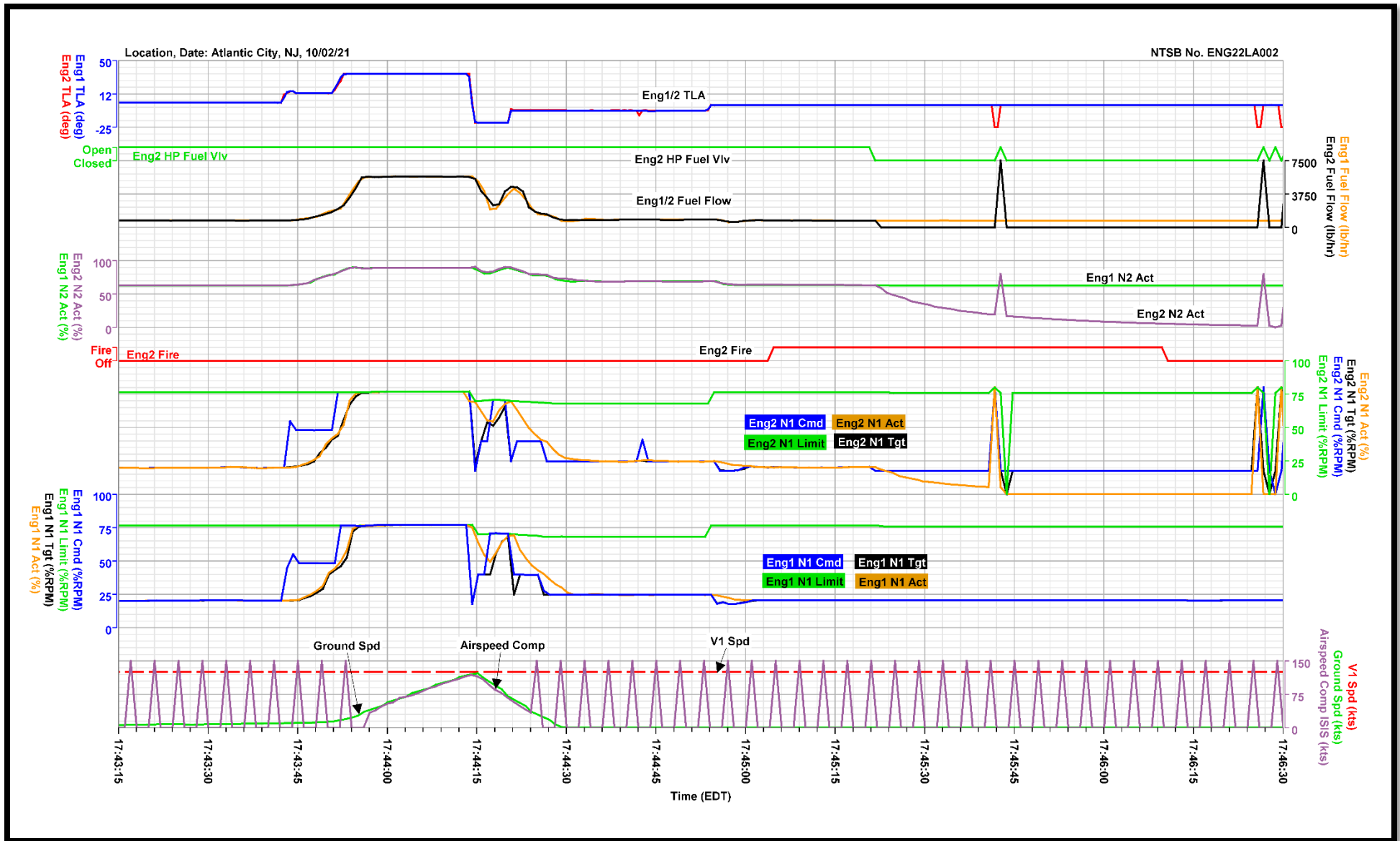


Figure 4. Plot of engine parameters (1 of 2)³.

³ Note that from 17:45:40 to 17:45:45 and 17:46:25 to 17:46:30, some engine 2 parameters displayed a NCD pattern following the event.

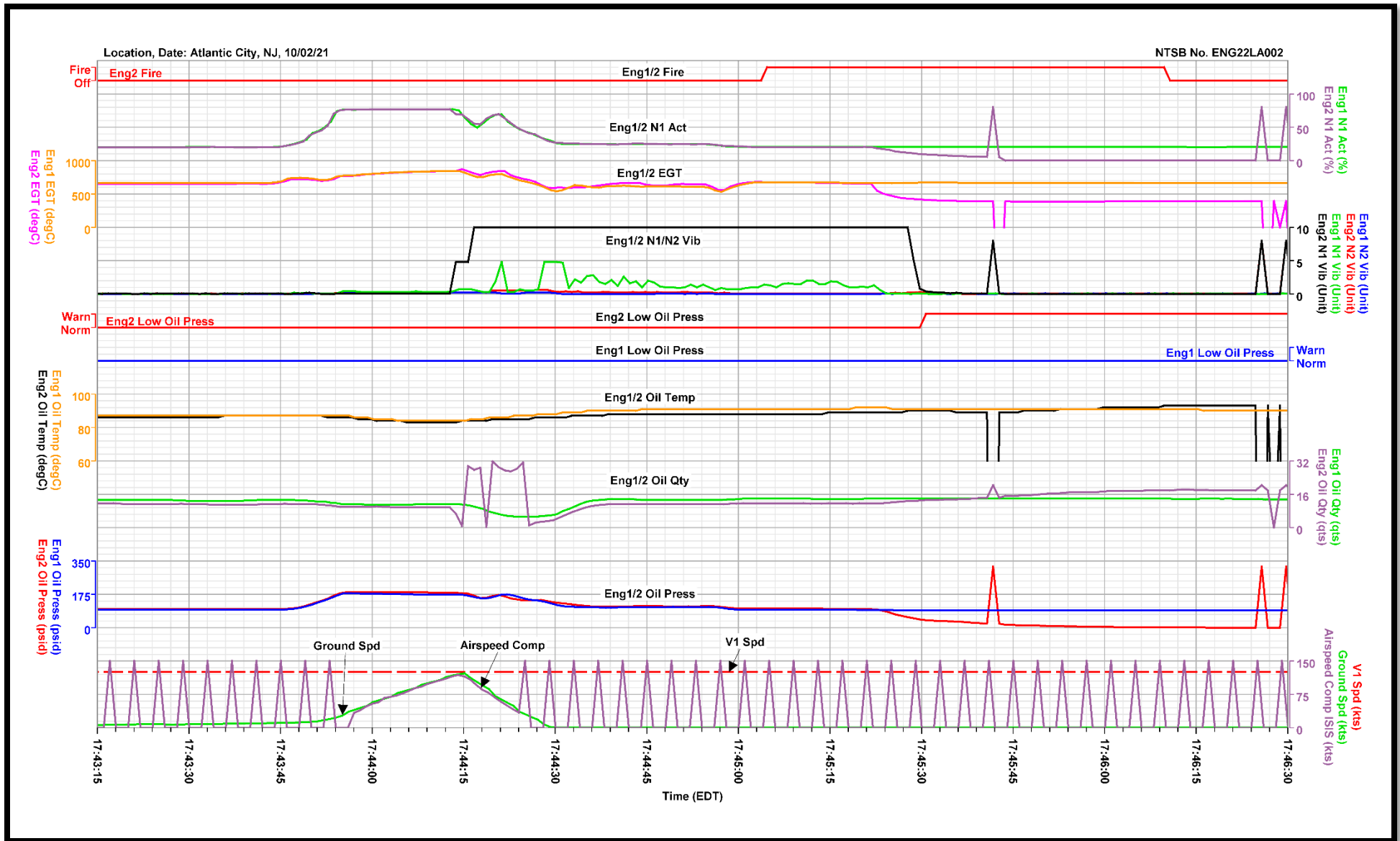


Figure 5. Plot of engine parameters (2 of 2)⁴.

⁴ Note that from 17:45:40 to 17:45:45 and 17:46:25 to 17:46:30, some parameters displayed a NCD pattern following the event. The values for engine 2 oil temperature and engine 2 EGT during this time were clipped for readability.

APPENDIX A

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

Table A-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/Normal Acceleration	g
Airspeed Comp ISIS	Computed Airspeed	kts
Altitude Press-L	Pressure Altitude-Left	ft
Altitude Press-R	Pressure Altitude-Right	ft
AP Lateral Mode	Autopilot Lateral Mode	
AP Long Mode	Autopilot Longitudinal Mode	
AP-1	Autopilot 1 Engaged	
AP-2	Autopilot 2 Engaged	
AT Active	Autothrust Active	
AT Eng	Autothrust Engaged	
AT Spd Mach Mode	Autothrust Speed Mach Mode	
Auto speed control	Auto Speed Control	
Autobrake Active	Autobrake Active	
Autobrake Max	Autobrake Maximum	
Brake Ped-L	Brake Pedal Position-Left	deg
Brake Ped-R	Brake Pedal Position-Right	deg
Brake Pressure-1	Brake Pressure-1	psi
Brake Pressure-2	Brake Pressure-2	psi
Brake Pressure-3	Brake Pressure-3	psi
Brake Pressure-4	Brake Pressure-4	psi
Elevator-L	Elevator Position-Left	deg
Elevator-R	Elevator Position-Right	deg
Eng1/2 EGT	Engine 1/2 Exhaust Gas Temperature	degC
Eng1/2 Fire	Engine 1/2 Fire	
Eng1/2 Fire PB	Engine 1/2 Fire Pushbutton	
Eng1/2 Fuel Fire Vlv	Engine 1/2 Fuel Fire Valve	
Eng1/2 Fuel Flow	Engine 1/2 Fuel Flow	lb/hr
Eng1/2 HP Fuel Vlv	Engine 1/2 High-Pressure Fuel Valve	
Eng1/2 Low Oil Press	Engine 1/2 Low Oil Pressure	
Eng1/2 N1 Act	Engine 1/2 N1 Actual	%
Eng1/2 N1 Cmd	Engine 1/2 N1 Command	%RPM
Eng1/2 N1 Tgt	Engine 1/2 N1 Target	%RPM
Eng1/2 N1 Vib	Engine 1/2 N1 Vibration	Unit
Eng1/2 N2 Act	Engine 1/2 N2 Actual	%
Eng1/2 N2 Vib	Engine 1/2 N2 Vibration	Unit
Eng1/2 Oil Press	Engine 1/2 Oil Pressure	psid
Eng1/2 Oil Qty	Engine 1/2 Oil Quantity	qts
Eng1/2 Oil Temp	Engine 1/2 Oil Temperature	degC
Eng1/2 TLA	Engine 1/2 Throttle Lever Angle	deg
Eng1/2 TR Full Dply	Engine 1/2 Thrust Reverser-Full Deploy	
Eng1/2 TR Unlk	Engine 1/2 Thrust Reverser-Unlock	
FD-1	Flight Director-1	
FD-2	Flight Director-2	
Flap Pos	Flap Position	deg
Gear WOW-L	Gear Weight-on-Wheels-Left	

APPENDIX A

Plot/Table Labels	Parameter Names	Units
Gear WOW-N	Gear Weight-on-Wheels-Nose	
Gear WOW-R	Gear Weight-on-Wheels-Right	
Ground Spd	Ground Speed	kts
Heading	Heading	deg
Latitude	Latitude	deg
Longitude	Longitude	deg
Master Caution-Capt FWC1	Master Caution-Captain-Flight Warning Computer 1	
Master Caution-Capt FWC2	Master Caution-Captain-Flight Warning Computer 2	
Master Caution-FO FWC1	Master Caution-First Officer-Flight Warning Computer 1	
Master Caution-FO FWC2	Master Caution-First Officer-Flight Warning Computer 2	
Master Warn-Capt FWC1	Master Warning-Captain-Flight Warning Computer 1	
Master Warn-Capt FWC2	Master Warning-Captain-Flight Warning Computer 2	
Master Warn-FO FWC1	Master Warning-First Officer-Flight Warning Computer 1	
Master Warn-FO FWC2	Master Warning-First Officer-Flight Warning Computer 2	
Sidestick Long-L	Longitudinal Sidestick Position-Left	deg
Sidestick Long-R	Longitudinal Sidestick Position-Right	deg
Spoiler-L1 Deployed	Spoiler Deployed-L1	
Spoiler-L2	Spoiler Position-L2	deg
Spoiler-L3	Spoiler Position-L3	deg
Spoiler-L4	Spoiler Position-L4	deg
Spoiler-L5	Spoiler Position-L5	deg
Spoiler-R1 Deployed	Spoiler Deployed-R1	
Spoiler-R2	Spoiler Position-R2	deg
Spoiler-R3	Spoiler Position-R3	deg
Spoiler-R4	Spoiler Position-R4	deg
Spoiler-R5	Spoiler Position-R5	deg
Time UTC-Hr	Coordinated Universal Time-Hours	hrs
Time UTC-Min	Coordinated Universal Time-Minutes	min
Time UTC-Sec	Coordinated Universal Time-Seconds	sec
V1 Spd	V1 Speed	kts
Wheel Spd-1	Wheel Speed-Left Outboard	kts
Wheel Spd-2	Wheel Speed-Left Inboard	kts
Wheel Spd-3	Wheel Speed-Right Inboard	kts
Wheel Spd-4	Wheel Speed-Right Outboard	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 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 A-1 are discrettes. 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 A-2. Unit and discrete abbreviations.

Unit and discrete abbreviations	Descriptions
%	percent
%RPM	percent revolutions per minute
deg	degrees
degC	degrees Celsius
ft	feet
g	gravitational constant
hrs	hours
kts	knots

APPENDIX A

Unit and discrete abbreviations	Descriptions
lb/hr	pounds per hour
min	minutes
psi	pounds per square inch
psid	pounds per square inch differential
qts	quarts
sec	seconds