

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



ENG24FA003

FLIGHT DATA RECORDER

Specialist's Factual Report

November 21, 2024

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A. INCIDENT

Location: Memphis, TN
Date: October 18, 2023
Time: 1615 central daylight time (CDT)
Airplane: Boeing 767-300F, FedEx Express, N287FE

B. FLIGHT DATA RECORDER SPECIALIST

Specialist Kyle Garner
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C. FEDERAL CARRIAGE REQUIREMENTS

The incident aircraft, N287FE, operated under Title 14 *Code of Federal Regulations* (CFR) Part 121: Air carrier. The incident aircraft was manufactured in 2022 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 Part 121.344.

D. DETAILS OF THE INVESTIGATION

The NTSB Vehicle Recorder Division received an electronic file containing the FDR data from the N287FE aircraft.

1.1 Recording Description

The FDR recording contained approximately 54 hours of data. Timing of the FDR data is measured in subframe reference number (SRN), where each SRN equals one elapsed second. The incident flight was the last flight of the recording, and its duration was approximately 12 minutes and 30 seconds. The parameters evaluated for this report appeared to be in accordance with federal FDR carriage requirements.

1.2 Engineering Unit Conversions

The engineering unit conversions used for the data contained in this report are based on documentation from the aircraft manufacturer and operator. 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 for the incident flight. Table 2 lists the FDR parameters verified and provided in this report for the three flights preceding the incident flight. Additionally, table 3 describes the unit and discrete state abbreviations used in this report.

1.3 Time Correlation

Correlation of the FDR data from SRN to the incident local time, CDT, 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 CDT.²

Accordingly, the time offset for the incident flight data from SRN to CDT is the following: CDT = SRN - 124811. The timing for the incident flight is in CDT, while the timing for all previous flights is in SRN.

E. FIGURES AND TABULAR DATA

Figures 1 to 6 contain FDR data recorded during the incident flight on October 18, 2023. Figures 7 and 8, 9, and 10 contain FDR data recorded during the first, second, and third flights preceding the incident flight, respectively. All the parameters listed in table 1 and table 2 are plotted or provided in the tabular data.³

Note that in the figures some parameters record a non-computed data (NCD) pattern. An NCD pattern is indicative that the raw data is not reliable or not available at that time.

During the incident flight, the flight data recorder lost synchronization, likely due to a momentary power loss, at 15:38:25 and 15:43:09 CDT for less than one second. The incomplete subframes were removed from the data and are not plotted or provided in the tabular data.⁴

The data show that during taxi and before departure from Memphis International Airport (MEM) in Memphis, Tennessee, the recorded fuel pressure value

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 = +.

² GMT is Greenwich mean time which is also known as coordinated universal time (UTC).

³ The parameters Eng1N2-Eng2N2, Eng1FF-Eng2FF, and Eng1FP-Eng2FP plotted in figures 6 and 8 are derived based on the recorded engine N2, fuel flow, and fuel pressure parameters, respectively.

⁴ The removed subframes were not padded with blank data, as the recorded GMT seconds parameter indicated that the loss of synchronization occurred for less than one second.

from the left engine was higher than the recorded fuel pressure value in the right engine. Following departure from MEM, at about 15:36:10, the recorded fuel pressure values from the left engine started to decrease, with no corresponding change in throttle resolver angle. At 15:37:49, the left engine had a fire indication, and simultaneously a master warning occurred. At 15:39:09, the data indicated that fuel had been cut off from the left engine. At 15:39:26, the FIRE EXT SWITCH L indicated PULLED.⁵ At 15:42:00, the left engine no longer had a fire indication. The airplane landed at MEM at about 15:49:00 without further incident.

The corresponding tabular data used to create figures 1 to 6 and 7 to 10 are provided in electronic comma-separated value (CSV) format as attachment 1 and attachment 2 to this report, respectively.

Submitted by:

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⁵ The FIRE EXT SWITCH L parameter is sampled at a rate of ¼ Hz, or once every four seconds.

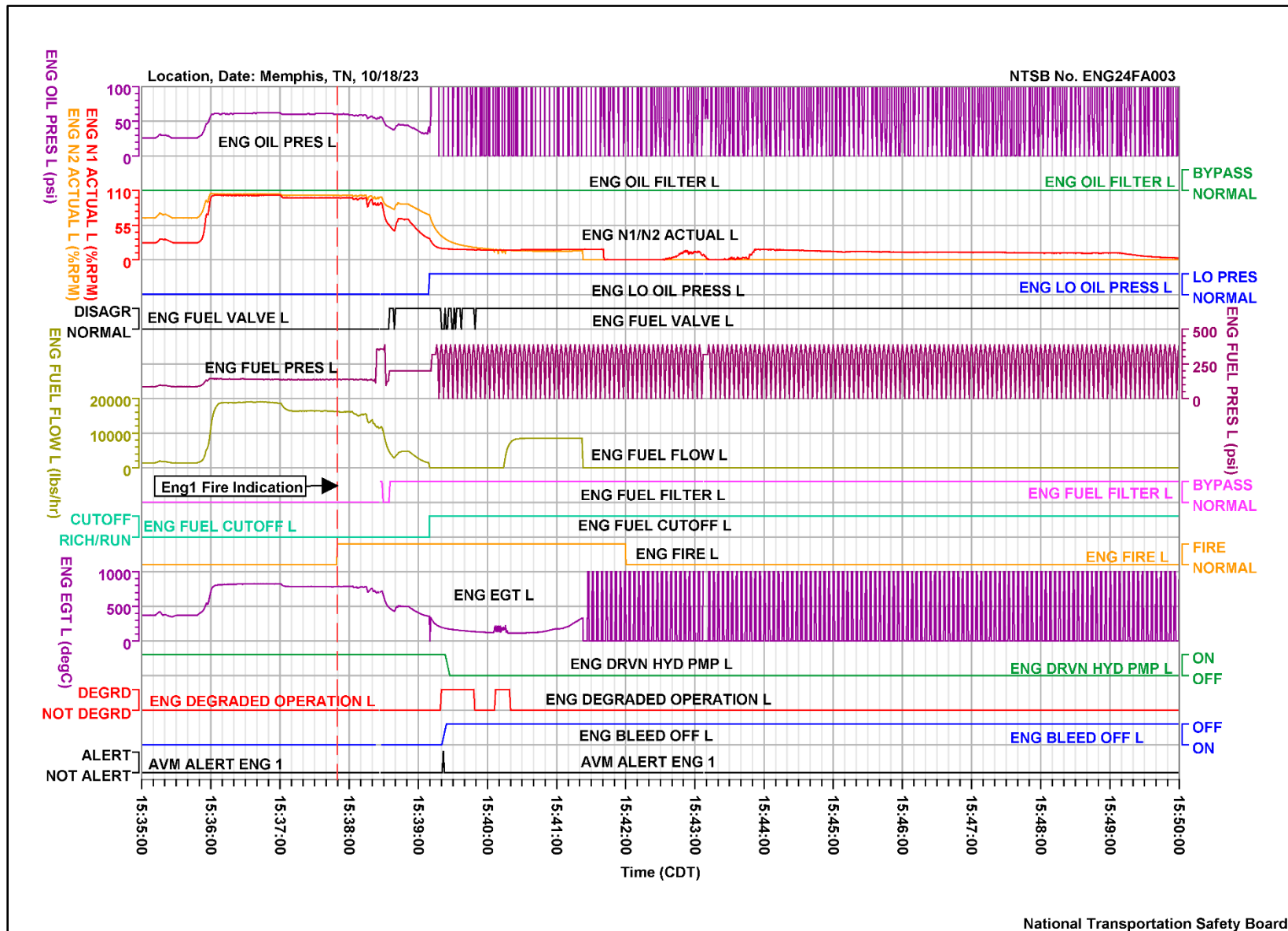


Figure 1. Plot of engine 1 (left) parameters for the full incident flight.

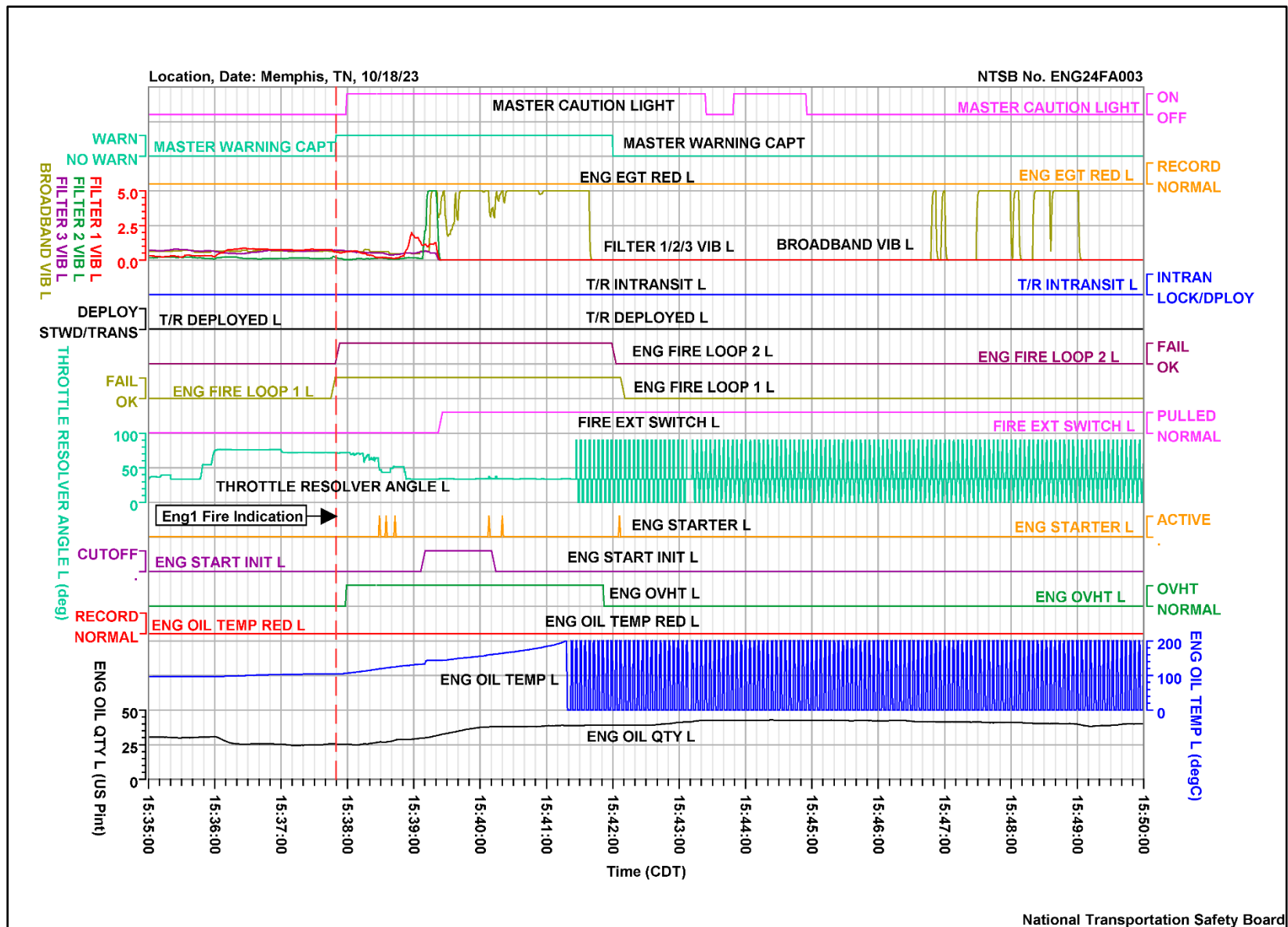


Figure 2. Plot of additional engine 1 (left) parameters for the full incident flight.

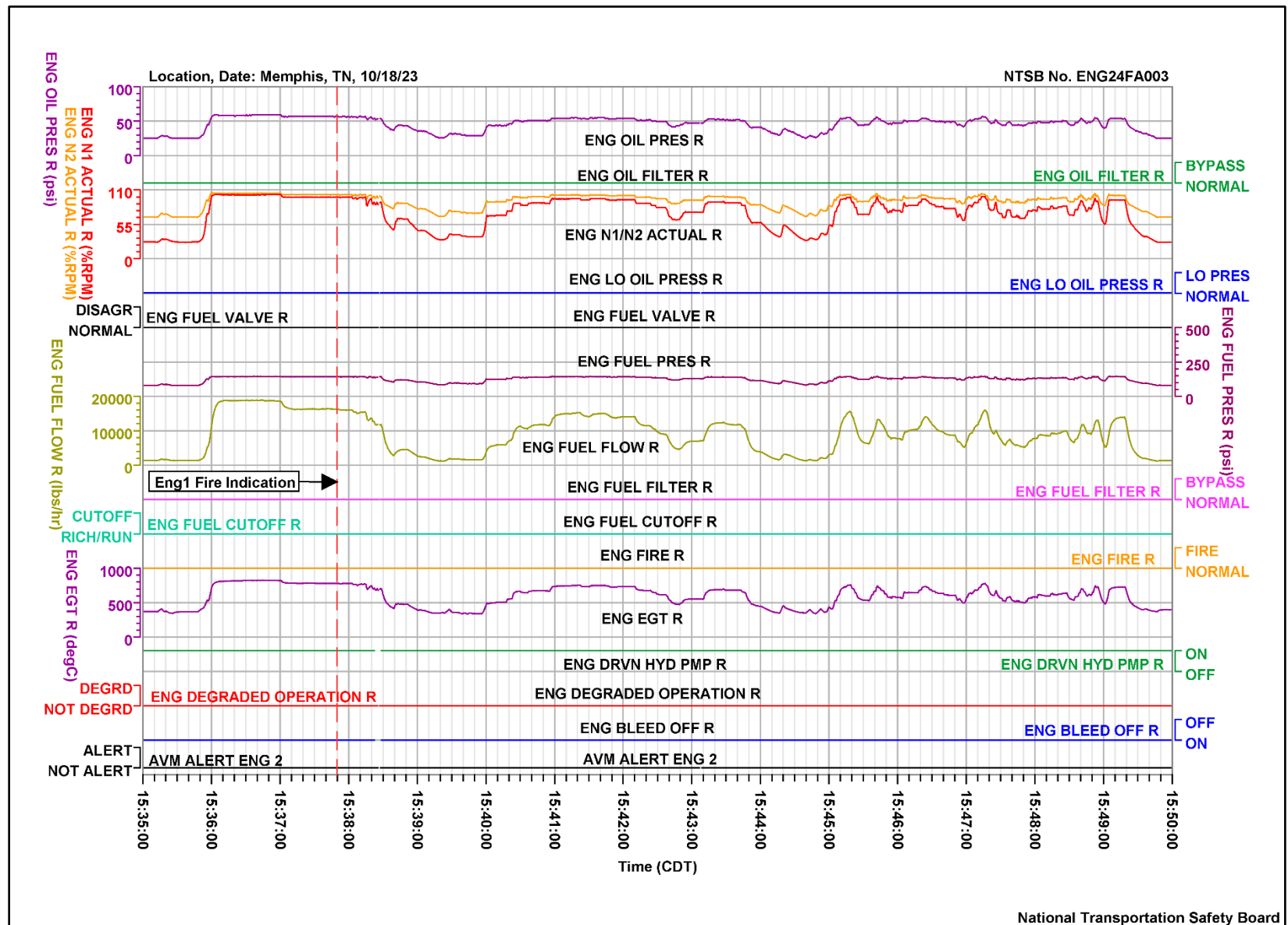


Figure 3. Plot of engine 2 (right) parameters for the full incident flight.

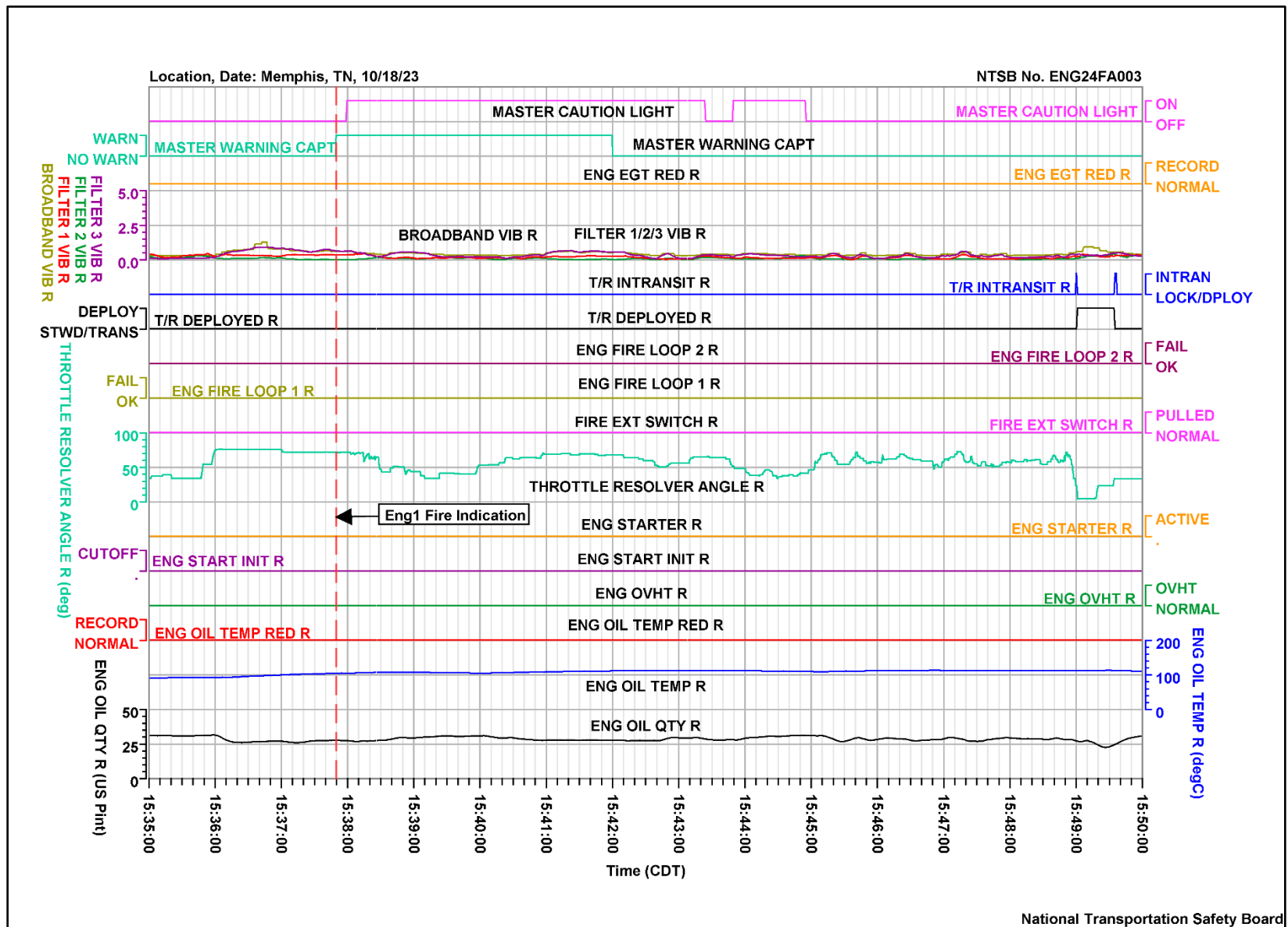


Figure 4. Plot of additional engine 2 (right) parameters for the full incident flight.

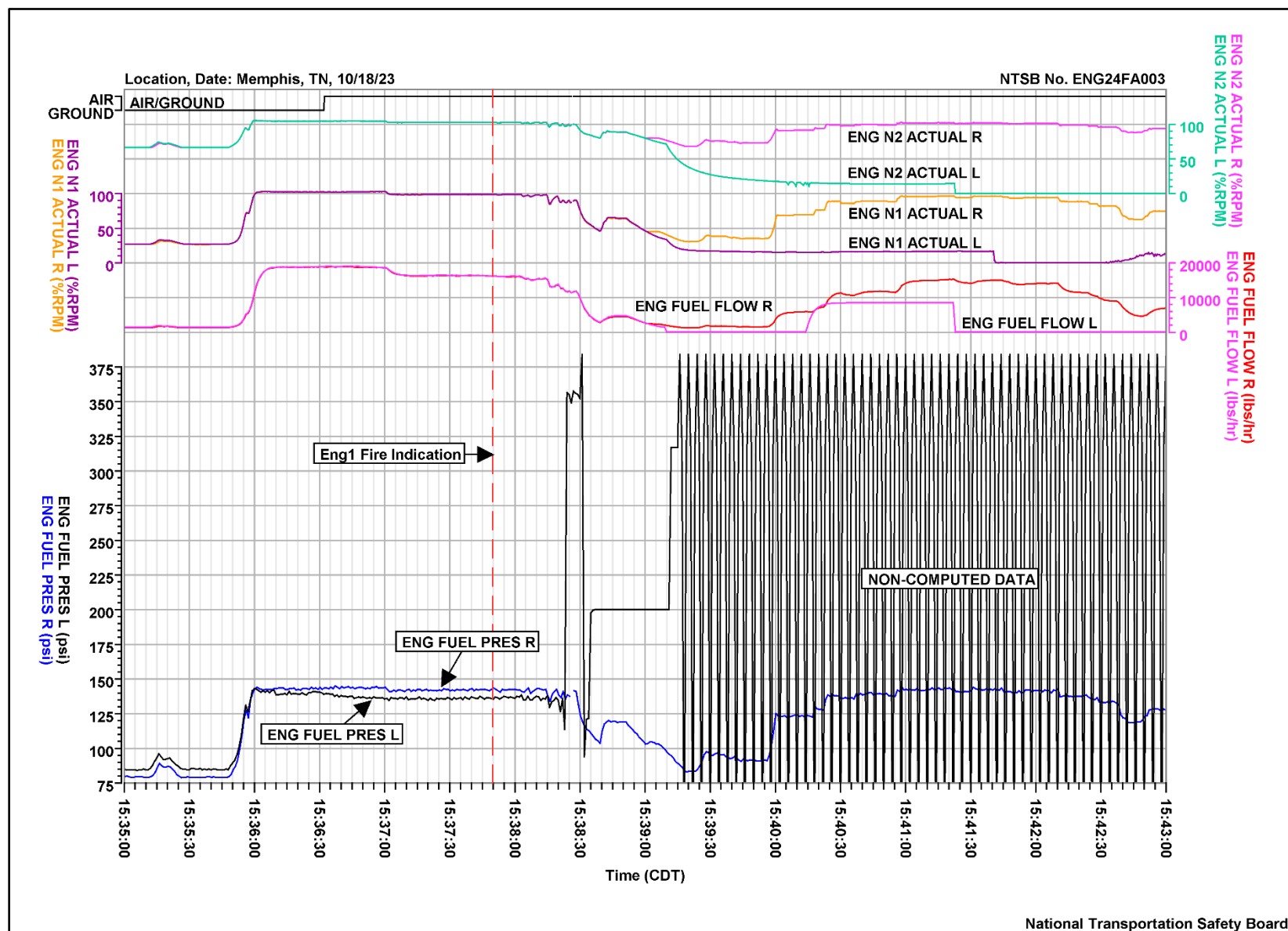


Figure 5. Plot of engine 1 (left) and engine 2 (right) parameters during the incident flight - zoom to takeoff.

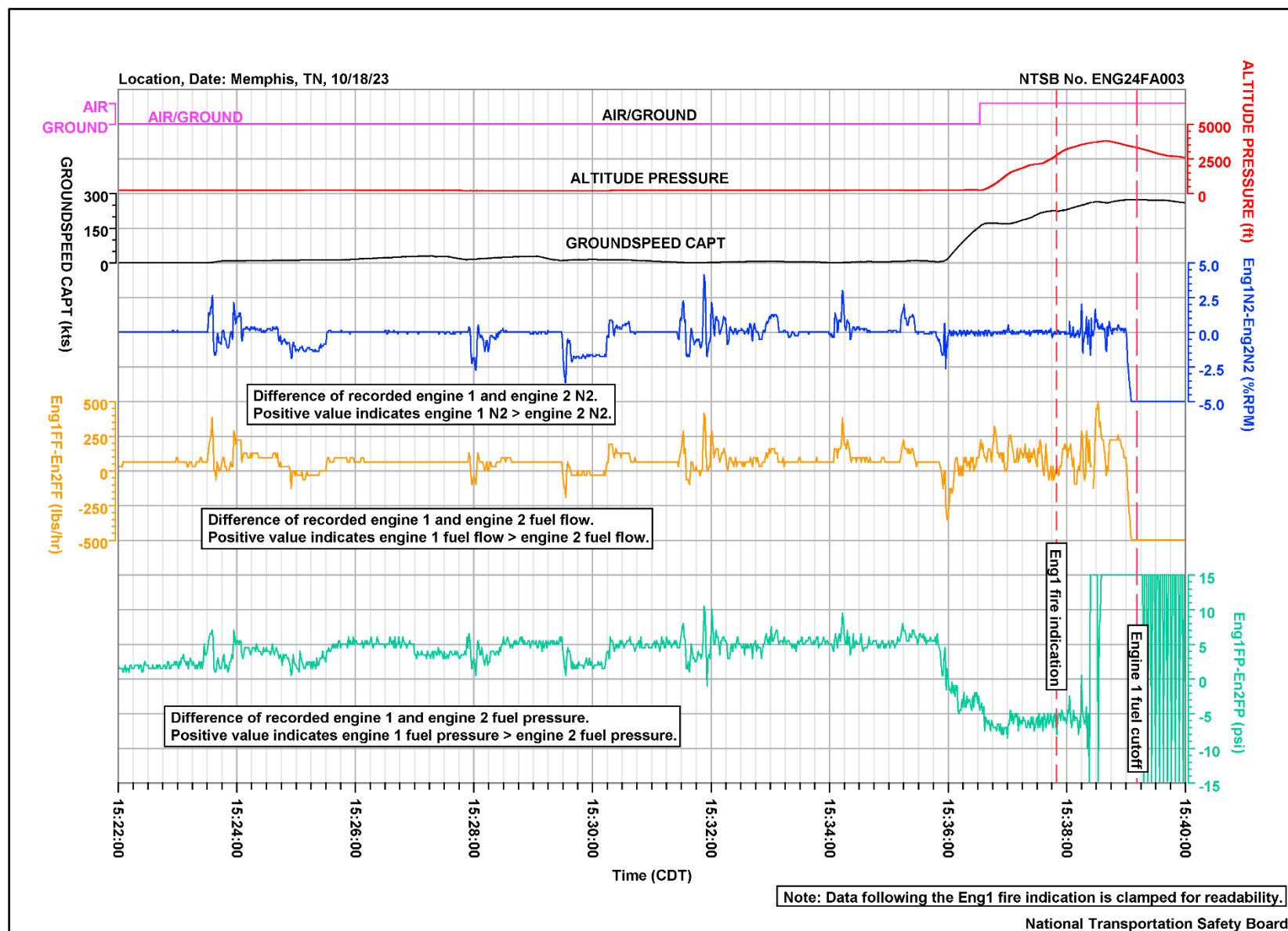


Figure 6. Plot of engine 1 (left) and engine 2 (right) fuel pressure, fuel flow, and N2 differences for the incident flight.

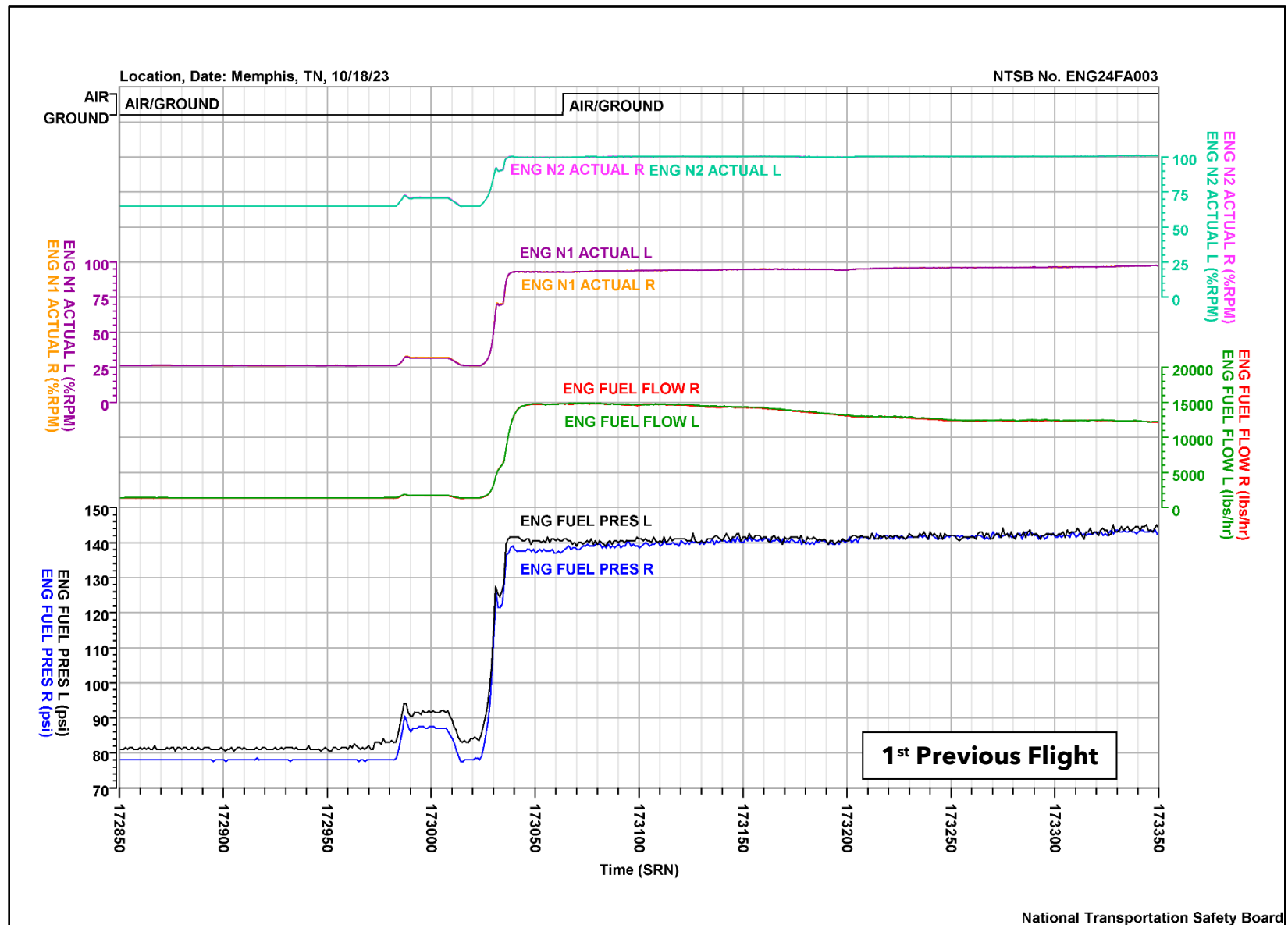


Figure 7. Plot of engine 1 (left) and engine 2 (right) parameters for the flight prior to the incident flight - zoom to takeoff.

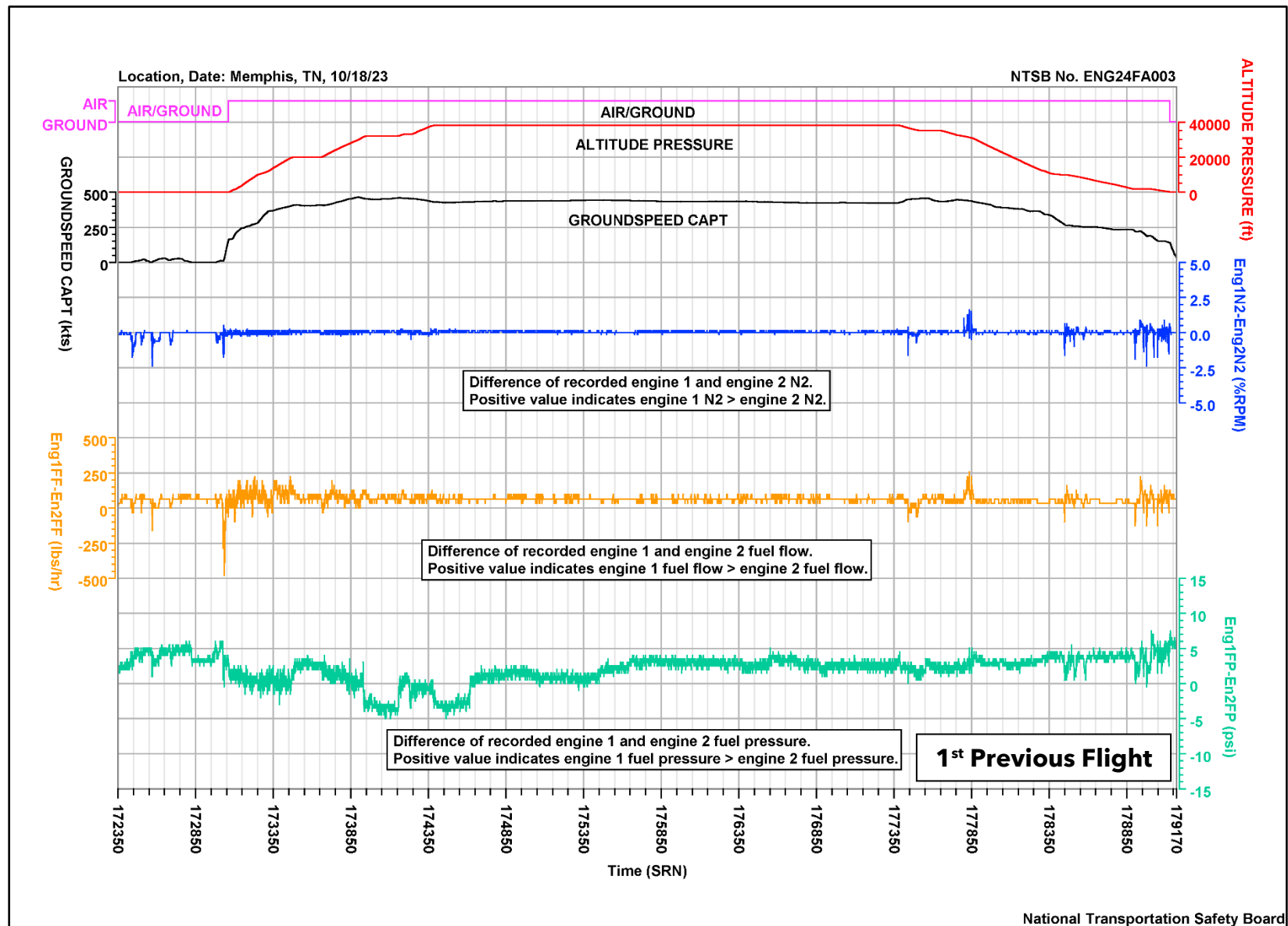


Figure 8. Plot of engine 1 (left) and engine 2 (right) fuel pressure, fuel flow, and N2 differences for the flight prior to the incident flight.

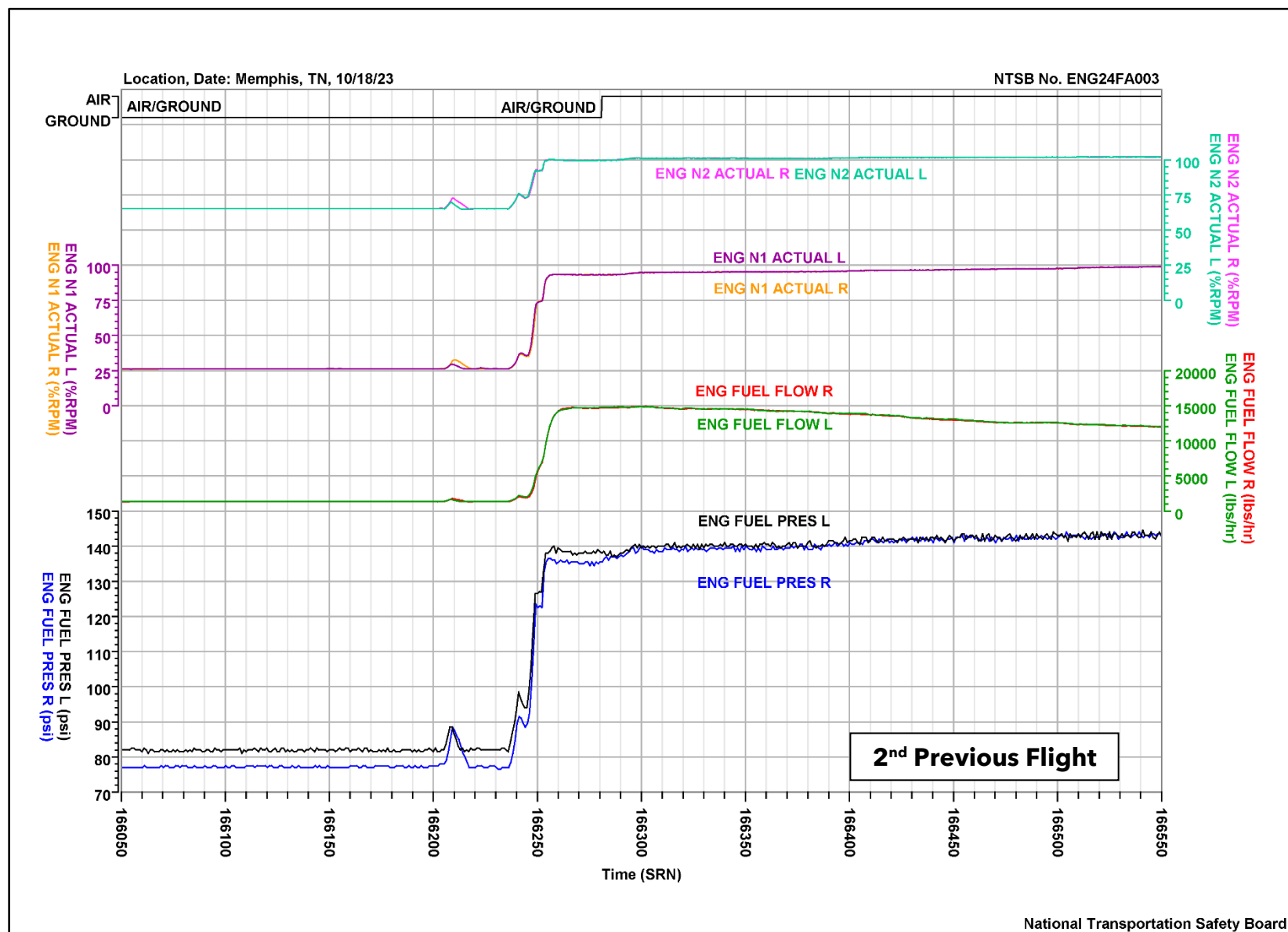


Figure 9. Plot of engine 1 (left) and engine 2 (right) parameters for the second previous flight - zoom to takeoff.

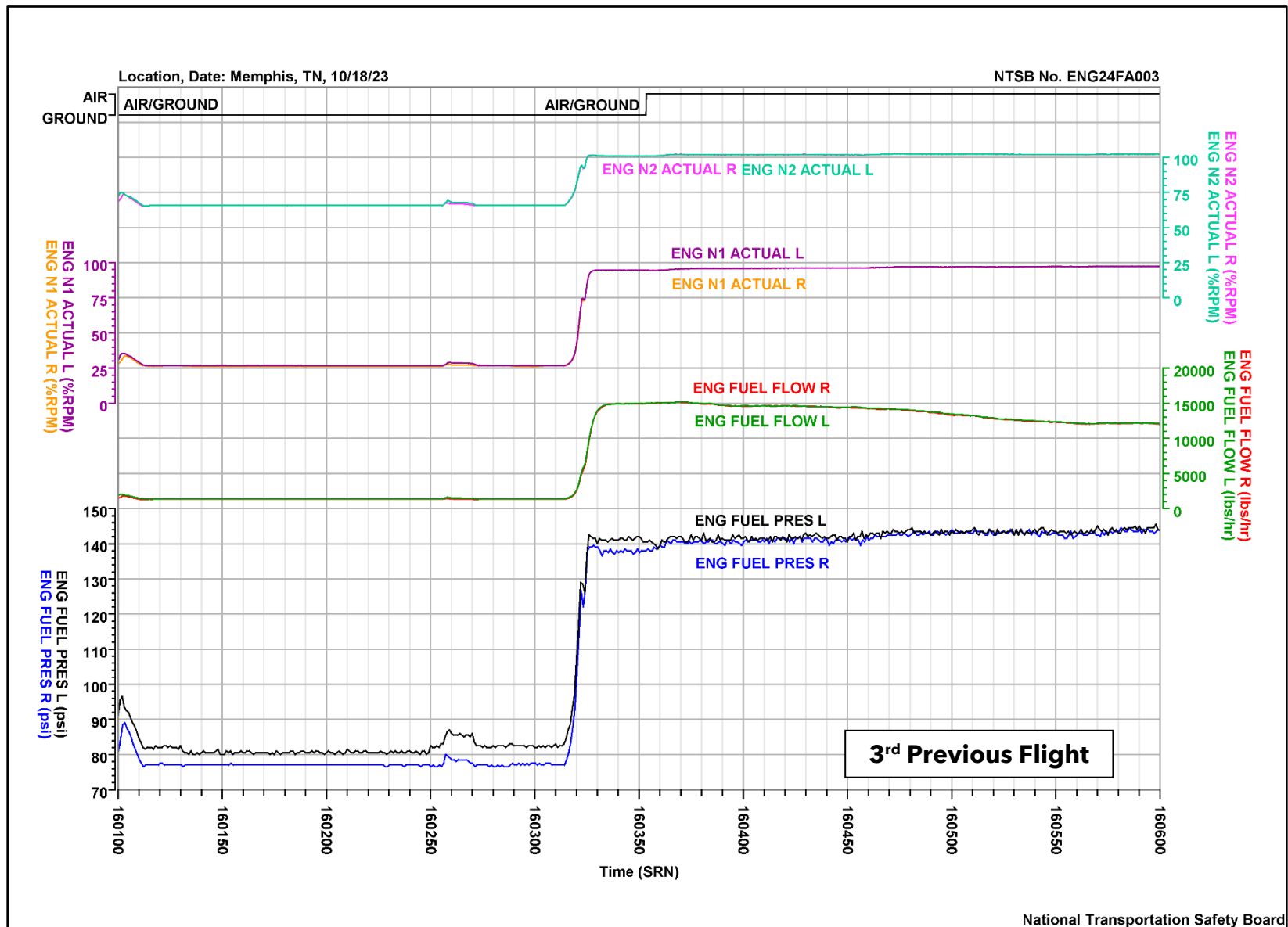


Figure 10. Plot of engine 1 (left) and engine 2 (right) parameters for the third previous flight - zoom to takeoff.

APPENDIX A. Verified and provided parameters

This appendix describes the parameters provided and verified in this report. Table 1 and table 2 list the plot/table labels, parameter names, and units for the incident and the three flights preceding the incident flight, respectively. Additionally, table 3 describes the unit and discrete state abbreviations used in this report.

Table 1. Verified and provided FDR parameters for the incident flight.

Plot/Table Labels	Parameter Names	Units
AIR/GROUND	Air/Ground Indication	
ALTITUDE PRESSURE	Pressure Altitude	ft
AVM ALERT ENG 1	Left Engine Airborne Vibration Monitor	
AVM ALERT ENG 2	Right Engine Airborne Vibration Monitor	
BROADBAND VIB L	Left Engine Broadband Vibration	
BROADBAND VIB R	Right Engine Broadband Vibration	
ENG BLEED OFF L	Left Engine Bleed Off	
ENG BLEED OFF R	Right Engine Bleed Off	
ENG DEGRADED OPERATION L	Left Engine Degraded Operation	
ENG DEGRADED OPERATION R	Right Engine Degraded Operation	
ENG DRVN HYD PMP L	Left Engine Driven Hydraulic Pump Status	
ENG DRVN HYD PMP R	Right Engine Driven Hydraulic Pump Status	
ENG EGT L	Left Engine Exhaust Gas Temperature	degC
ENG EGT R	Right Engine Exhaust Gas Temperature	degC
ENG EGT RED L	Left Engine Exhaust Gas Temperature Red	
ENG EGT RED R	Right Engine Exhaust Gas Temperature Red	
ENG FIRE L	Left Engine Fire Indication	
ENG FIRE LOOP 1 L	Left Engine Fire Indication Loop 1	
ENG FIRE LOOP 1 R	Right Engine Fire Indication Loop 1	
ENG FIRE LOOP 2 L	Left Engine Fire Indication Loop 2	
ENG FIRE LOOP 2 R	Right Engine Fire Indication Loop 2	
ENG FIRE R	Right Engine Fire Indication	
ENG FUEL CUTOFF L	Left Engine Fuel Cutoff	
ENG FUEL CUTOFF R	Right Engine Fuel Cutoff	
ENG FUEL FILTER L	Left Engine Fuel Filter Status	
ENG FUEL FILTER R	Right Engine Fuel Filter Status	
ENG FUEL FLOW L	Left Engine Fuel Flow	lbs/hr
ENG FUEL FLOW R	Right Engine Fuel Flow	lbs/hr
ENG FUEL PRES L	Left Engine Fuel Pressure	psi
ENG FUEL PRES R	Right Engine Fuel Pressure	psi
ENG FUEL VALVE L	Left Engine Fuel Valve Status	
ENG FUEL VALVE R	Right Engine Fuel Valve Status	
ENG LO OIL PRESS L	Left Engine Low Oil Pressure Indication	
ENG LO OIL PRESS R	Right Engine Low Oil Pressure Indication	
ENG N1 ACTUAL L	Left Engine Fan Speed	%RPM
ENG N1 ACTUAL R	Right Engine Fan Speed	%RPM
ENG N2 ACTUAL L	Left Engine Core Speed	%RPM
ENG N2 ACTUAL R	Right Engine Core Speed	%RPM
ENG OIL FILTER L	Left Engine Oil Filter Status	
ENG OIL FILTER R	Right Engine Oil Filter Status	
ENG OIL PRES L	Left Engine Oil Pressure	psi

Plot/Table Labels	Parameter Names	Units
ENG OIL PRES R	Right Engine Oil Pressure	psi
ENG OIL QTY L	Left Engine Oil Quantity	US Pint
ENG OIL QTY R	Right Engine Oil Quantity	US Pint
ENG OIL TEMP L	Left Engine Oil Temperature	degC
ENG OIL TEMP R	Right Engine Oil Temperature	degC
ENG OIL TEMP RED L	Left Engine Oil Temperature Red	
ENG OIL TEMP RED R	Right Engine Oil Temperature Red	
ENG OVHT L	Left Engine Overheat	
ENG OVHT R	Right Engine Overheat	
ENG START INIT L	Left Engine Start Cutoff	
ENG START INIT R	Right Engine Start Cutoff	
ENG STARTER L	Left Engine Starter Active	
ENG STARTER R	Right Engine Starter Active	
FILTER 1 VIB L	Left Engine Filter 1 Vibration	
FILTER 1 VIB R	Right Engine Filter 1 Vibration	
FILTER 2 VIB L	Left Engine Filter 2 Vibration	
FILTER 2 VIB R	Right Engine Filter 2 Vibration	
FILTER 3 VIB L	Left Engine Filter 3 Vibration	
FILTER 3 VIB R	Right Engine Filter 3 Vibration	
FIRE EXT SWITCH L	Left Engine Fire Handle	
FIRE EXT SWITCH R	Right Engine Fire Handle	
GMT HOURS	GMT Hours	hrs
GMT MINUTES	GMT Minutes	min
GMT SECONDS	GMT Seconds	sec
MASTER CAUTION LIGHT	Master Caution Light Illuminated	
MASTER WARNING CAPT	Master Warning Light Illuminated - Captain	
T/R DEPLOYED L	Left Engine Thrust Reverser Deployed	
T/R DEPLOYED R	Right Engine Thrust Reverser Deployed	
T/R INTRANSIT L	Left Engine Thrust Reverser In Transit	
T/R INTRANSIT R	Right Engine Thrust Reverser In Transit	
THROTTLE RESOLVER ANGLE L	Left Engine Throttle Resolver Angle	deg
THROTTLE RESOLVER ANGLE R	Right Engine Throttle Resolver Angle	deg

Table 2. Verified and provided parameters for the three flights preceding the incident flight.

Plot/Table Labels	Parameter Names	Units
AIR/GROUND	Air/Ground Indication	
ALTITUDE PRESSURE	Pressure Altitude	ft
ENG FUEL FLOW L	Left Engine Fuel Flow	lbs/hr
ENG FUEL FLOW R	Right Engine Fuel Flow	lbs/hr
ENG FUEL PRES L	Left Engine Fuel Pressure	psi
ENG FUEL PRES R	Right Engine Fuel Pressure	psi
ENG N1 ACTUAL L	Left Engine Fan Speed	%RPM
ENG N1 ACTUAL R	Right Engine Fan Speed	%RPM
ENG N2 ACTUAL L	Left Engine Core Speed	%RPM
ENG N2 ACTUAL R	Right Engine Core Speed	%RPM
Eng1FF-Eng2FF	Difference of Left and Right Engine Fuel Flow Values	lbs/hr
Eng1FP-Eng2FP	Difference of Left and Right Engine Fuel Pressure Values	psi
Eng1N2-Eng2N2	Difference of Left and Right Engine N2 Values	%RPM
GROUNDSPED CAPT	Displayed Groundspeed - Captain	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 incident.

Note: Parameters with a blank unit description in table 1 and table 2 are discretes or unitless. 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 3. Unit and discrete state abbreviations.

Abbreviations	Descriptions
%RPM	percent revolutions per minute
degC	degrees Celsius
ft	feet
hrs	hours
kts	knots
lbs/hr	pounds per hour
min	minutes
psi	pounds per square inch
sec	seconds
US Pint	US pints