

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



ERA23FA352

MATERIALS LABORATORY

Factual Report 24-032

March 13, 2025

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A. ACCIDENT INFORMATION

Location: Pompano Beach, Florida
Date: August 28, 2023
Vehicle: Airbus EC135T1 CDS
Investigator: Chihoon Shin
AS-40

B. COMPONENTS EXAMINED

Aircraft examination to determine origin and cause of inflight fire. Chemical analysis of residue removed from accident aircraft.

C. EXAMINATION PARTICIPANTS

Specialist	Nancy B McAtee National Transportation Safety Board Washington, DC
Group Chair	Chihoon Shin National Transportation Safety Board Washington, DC
Group Member	Dave Keenan Federal Aviation Administration Washington, DC
Group Member	Paul-Etienne Jactat Safran Helicopter Engines Bordes, France
Group Member	Bryan Larimore Safran Helicopter Engines Grand Prairie, TX
Group Member	Axel Rokohl Bundesstelle für Flugunfalluntersuchung Braunschweig, Germany
Group Member	Seth Buttner Airbus Grand Prairie, TX

Group Member	Michael Pfeiffer Airbus Donauwörth, Germany
Group Member	Don Lambert Metro Aviation Shreveport, LA
Group Member	Carl Carner Broward County Sheriff's Office Fort Lauderdale, FL

D. ACCIDENT SUMMARY

On August 28, 2023, about 0844 eastern daylight time, a Eurocopter Deutschland GMBH EC135T1, N109BC, was destroyed when it was involved in an accident near Pompano Beach, Florida. The commercial pilot sustained minor injuries. One paramedic onboard and a resident of an apartment building were fatally injured, while a second paramedic onboard was seriously injured. The helicopter was operated as a Title 14 Code of Federal Regulations Part 135 air medical flight.

E. DETAILS OF EXAMINATION

1.0 #2 Engine Compartment

All firewall sections were present, and no material was missing¹. The fire wall components are shown in Figure 1. All sections sustained impact damage. Heavy soot and a powdery greyish-white material coated the interior surfaces of the firewall sections. An area of oily residue was found on the lower firewall along the inboard edge as shown in Figure 2. Blue thermal discoloration was present along the inboard and aft edges of the lower firewall as shown in Figure 3. Several areas of bright blue and brass colored, splatter-shaped patterns of thermal discoloration found on both interior and exterior surfaces of the lower and aft firewalls as shown in Figure 4.

2.0 Tail Driveshaft Compartment

Heavy soot covered most lower surface. Hydraulic lines located in the compartment were intact. The hydraulic lines were heavily sooted with the exception of the aft section. This aft portion was covered with a white, powdery material as shown in Figure 5. Blue thermal discoloration was present along the edge that bordered the

¹ For detailed aircraft layout information, see the Airworthiness Group Chairman's report.

#2 engine compartment and the aft edge of the driveshaft compartment. The thermal damage extended through the lower firewall to the exterior surface in a few areas. A bright yellow substance/discoloration was located on the aft, right-side exterior of the compartment as shown in Figure 6.

3.0 Battery

The battery case was intact as shown in Figure 7. Soot covered the exterior of the case. The polymeric connector was melted with areas of missing material. The battery interior was intact and exhibited a small amount of thermal damage to aft, inboard corner (as installed in aircraft) to the polymeric cell separators located on the top of the battery. The interior of the case lid exhibited some thermal-related building of the polymeric liner. There was light thermal degradation to the lid seal on the edge (facing aft as installed in aircraft). There were no visible signs of thermal runaway of the battery cells.

4.0 #1 Engine Compartment

All firewall sections were present, and no material was missing. Heavy soot covered all interior surfaces of the firewall panels as shown in Figure 8. A large area of blue-colored thermal damage was present on the upper outboard corner of the aft firewall as shown in Figure 9. There were several smaller areas of bright blue and brass colored, splatter-shaped patterns of thermal discoloration over the aft and lower firewalls. Thermal discoloration was also present along the seam adjacent to the driveshaft compartment as shown in Figure 10. A bright yellow, slightly oily substance was found just aft of the #1 aft firewall and below the hydraulic lines located adjacent to the driveshaft compartment.

5.0 Tail Boom and Rotor

The tail boom and rotor housing sustained heavy thermal damage as shown in Figure 11. The paint was missing along the entire length of the boom and composite material sustained significant thermal damage-the resin had burned out with only carbon fiber material and associated honeycomb material remaining. The paint was mostly missing on the lower surfaces of the winglets and the paint on the upper surfaces was blistered and sooted. The tail rotor housing was missing several areas of paint on the lower surface. The paint on the upper portion was intact but sooted and blistered in areas.

6.0 Collected Samples

Two swabs and a small amount of unknown material scrapings were collected. One swab and the scrapings were collected from the AC compressor drive pad. The other swab, an unknown bright yellow substance, was collected on the airframe just aft of

the #2 engine aft fire wall. In addition, scrapings were taken from the surface of the #2 inlet submitted to the NTSB Materials Laboratory.

F. LABORATORY EXAMINATION AND FINDINGS

7.0 Chemical Analysis

The residue swabs and scraping samples taken during the wreckage examination were examined using a Fourier Transform Infrared (FTIR) spectrometer with a diamond attenuated total reflectance (ATR) accessory in accordance with ASTM E1252-98 (American Society for Testing Materials E1252-98: *Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis and American Society for Testing Materials*). The spectrometer was used to collect and process infrared wavelength absorbance spectra of the unknown material. A small amount of the black material on the surface of the #2 inlet was examined using the same method. After the spectra was collected, a spectral library search was performed on the individual spectra.

The yellow residue spectrum was consistent with a straight-chained aliphatic hydrocarbon containing silicon. No strong matches were found in the spectral library search for a single material however the unknown material shared significant spectral peaks with several lubricants and lubricant additives. The sample was analyzed using an x-ray fluorescence (XRF) handheld alloy analyzer. The alloy analyzer found the presence of sulfur (S) and silicon (Si). These findings were consistent with the presence of a lubricating oil. Sulfur and silicon are present in oil additives. Exemplar samples of fluids from the aircraft were not evaluated.

The spectra for residue on the #2 inlet and the residue from AC compressor drive pad were similar to each other and were consistent with a carboxy-amine. No strong matches were found in the spectral library search for a single material. The unknown spectra shared significant spectral peaks with several types of polyurethane.

8.0 Firewall Examination

Discolored areas were observed on the firewall pieces during a wreckage exam completed by the investigative team. The firewall pieces for both engines were subsequently submitted to the NTSB Materials Laboratory for further examination². The remaining pieces reconstructed into their onboard configuration are shown in Figures 12 and 13.

Along with overall dark-colored fire damage to the pieces, three types of discoloration were observed. Shown in Figure 14, the first type of discoloration was

² The team identified puncture marks in the #1 engine exhaust pipe and #1 engine outlet diffuser that were evaluated separately and are documented in the 24-027 Materials Laboratory Factual Report

dark blue, purple, and brass, and appeared to be spatter from burning metal, polymer, or other solids near or in contact with the pieces. The second type of discoloration was light green, yellow, and pink, and appeared to be staining from liquid that experienced high heat and possibly burned after spilling onto the pieces as shown in Figure 15. The third type of discoloration, as shown in Figure 16, was blue, purple, green, and red, and appeared to be the result of heat discoloration from contact with another component that experienced elevated temperatures.

In addition, small tears were observed on several pieces of hot section firewall. The small tears appeared to be due to buckling, either during the accident or due to heat weakening the material of the pieces during the post-crash fire. One piece, the #2 engine exhaust ejector, had a large tear consistent with a puncture as shown in Figure 17.

No further work was performed on the firewall pieces.

G. MATERIAL INFORMATION

9.0 Air Conditioning Unit Refrigerant and Oil

R134a (1,1,1,2-Tetrafluoroethane) was the refrigerant used in the cabin air conditioning unit on the aircraft. Under normal conditions, R134a is nonflammable and will decompose when exposed to elevated temperatures³. A glycol-based refrigeration lubricant oil was also present within the AC system⁴.

10.0 Tail Boom Structural Material

The tail boom assembly consisted of carbon and glass fiber material with Nomex®(polyaramid) core. For more detailed information, see the Airworthiness Group Chairman's report⁵.

³ According to the Safety Data Sheet (SDS), the gas has no lower or upper flammability limits and its autoignition temperature is greater than 750°C. The gas can become combustible when mixed with sufficient oxygen under high pressure and exposed to high temperature ignition sources. In addition, contact with certain reactive metals may result in formation of explosive or exothermic reactions under very specific conditions (e.g., very high temperatures).

⁴ Polyalkylene Glycol, also known as PAG oil, was the lubricant used the air conditioning unit on the aircraft.

⁵ Section 2.3 Tail Rotor System

11.0 Air Conditioning Compartment

The condenser equipment was constructed of aluminum with various polymeric attachments and seals. Associated structure located within the compartment assembly was constructed of fiber glass. For more detailed information, see the Airworthiness Group Chairman's report⁶.

Submitted by:

Nancy B McAtee
Fire and Explosion Specialist/Chemist

⁶ Section 2.8-Metro Aviation Air Conditioning System



Figure 1. Photograph of inboard and lower firewall for #2 engine.



Figure 2. Photograph of area of oily residue was found on the lower firewall, inboard edge #2 engine.



Figure 3. Photograph of discoloration on aft inboard corner of #2 engine compartment.



Figure 4. Photograph of blue and brass colored, splatter-shaped thermal patterns on #2 engine firewall.



Figure 5. Photograph of white powdery residue on drive shaft.



Figure 6. Photograph of yellow residue (circled) on #2 engine firewall.



Figure 7. Photograph of aircraft battery case (left) and interior (right).



Figure 8. Photograph of engine #1 inboard firewall.



Figure 9. Photograph of thermal discoloration on #1 engine firewall.



Figure 10. Photograph of thermal discoloration on driveshaft compartment seam.



Figure 11. Photograph of tail boom and rotor housing.

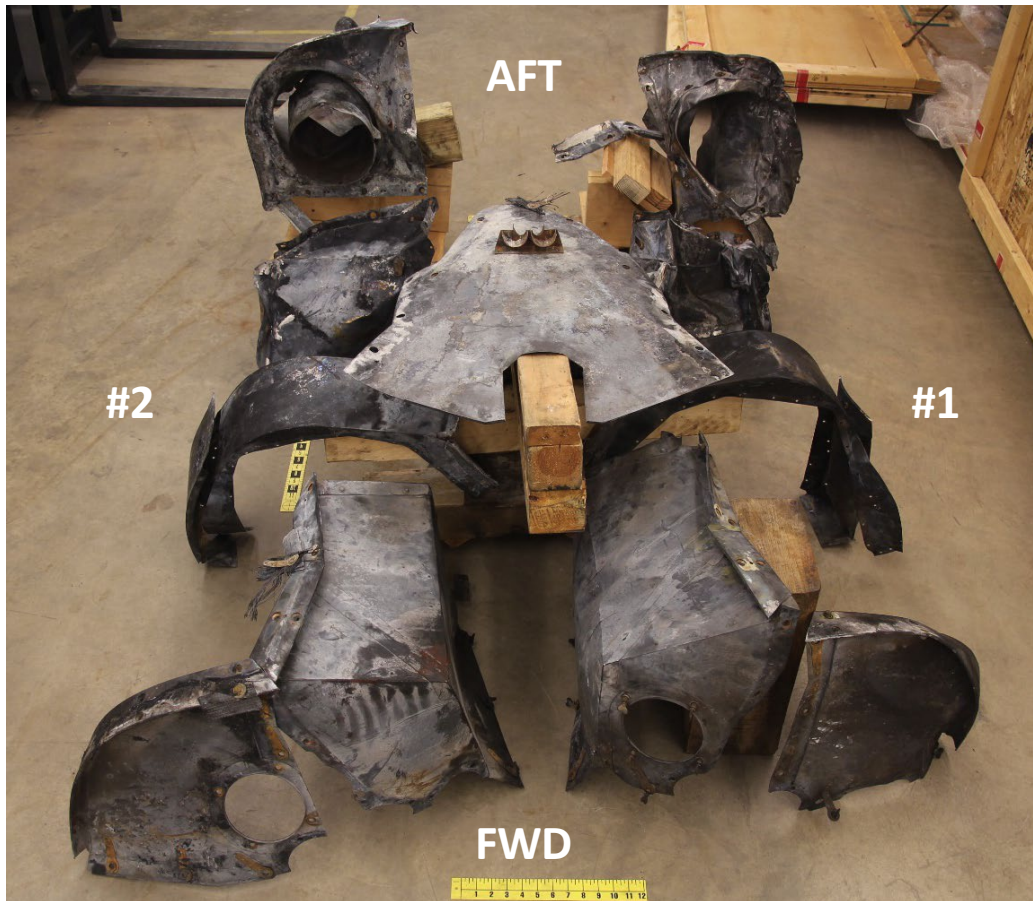


Figure 12. Photograph of laboratory firewalls reconstruction (forward).

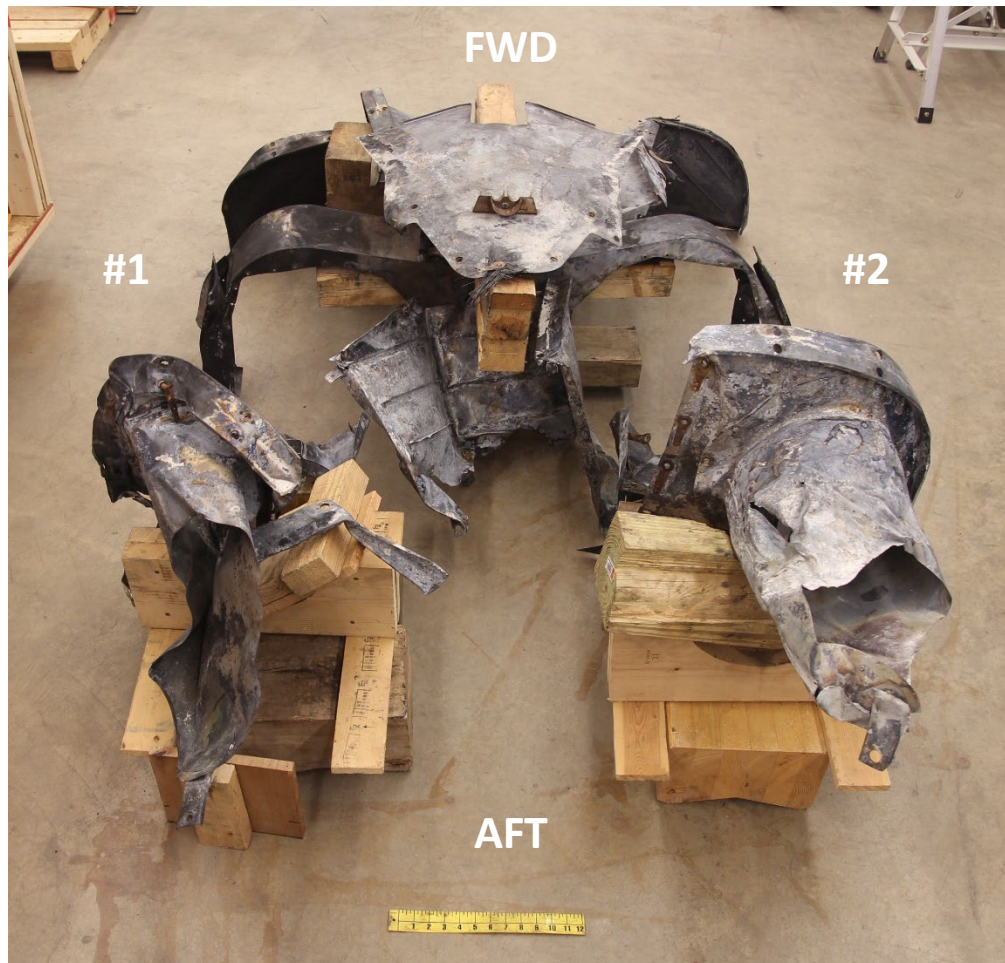


Figure 13. Photograph of laboratory firewalls reconstruction (aft).

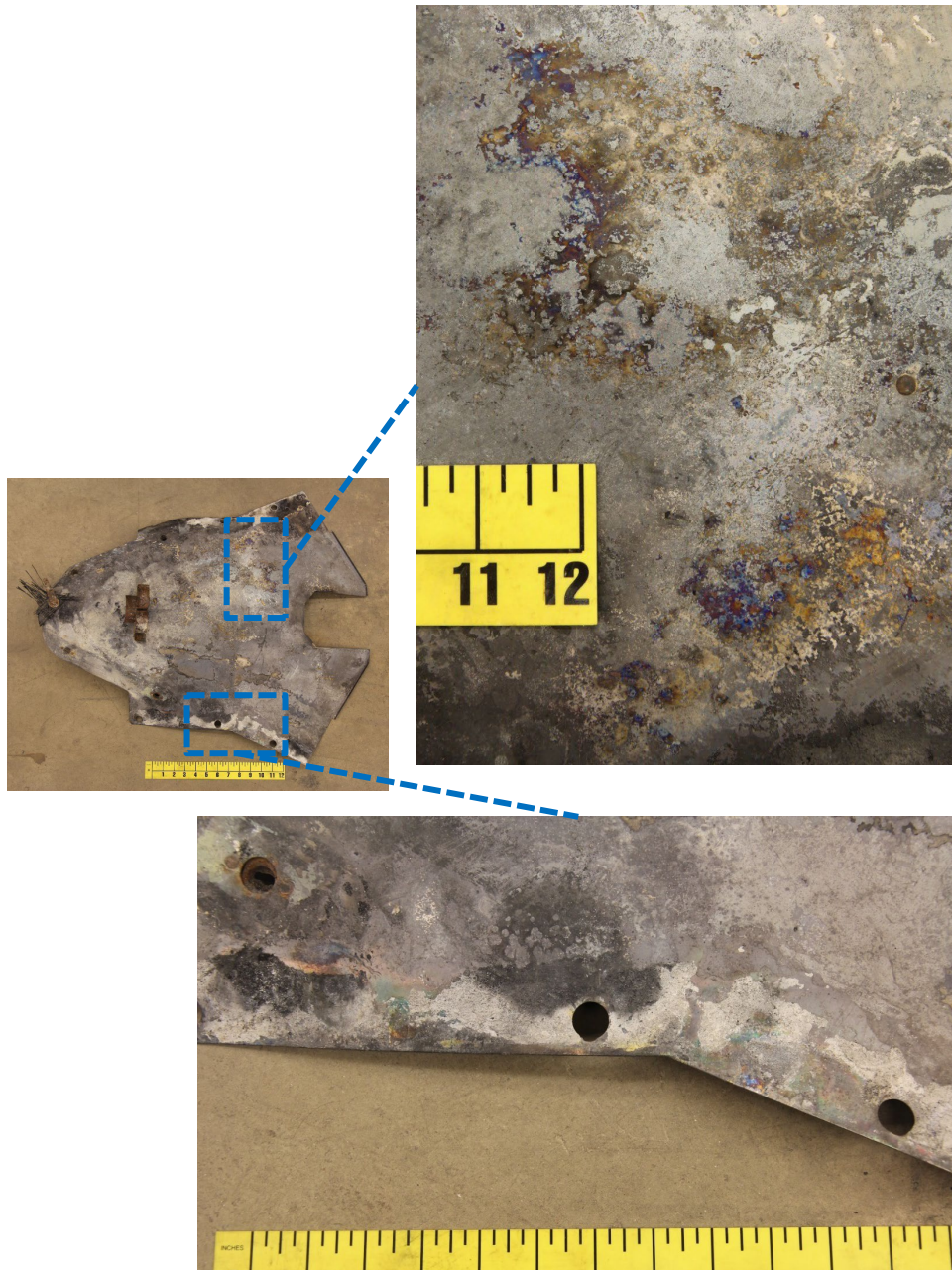


Figure 14. Photograph of discoloration on the outboard side of the intake cover.

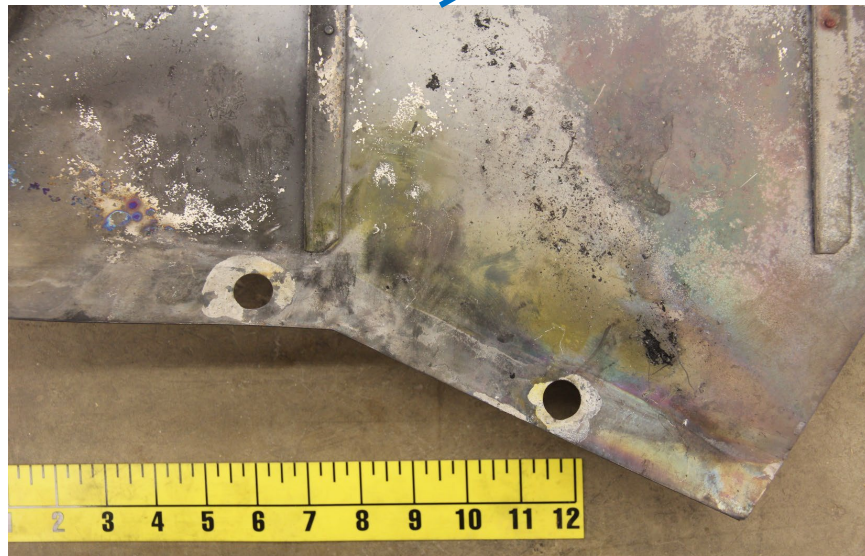


Figure 15. Photograph of discoloration on the inboard side of the intake cover.



Figure 16. Photograph of thermal discoloration on #1 engine hot section firewall (lower), forward.

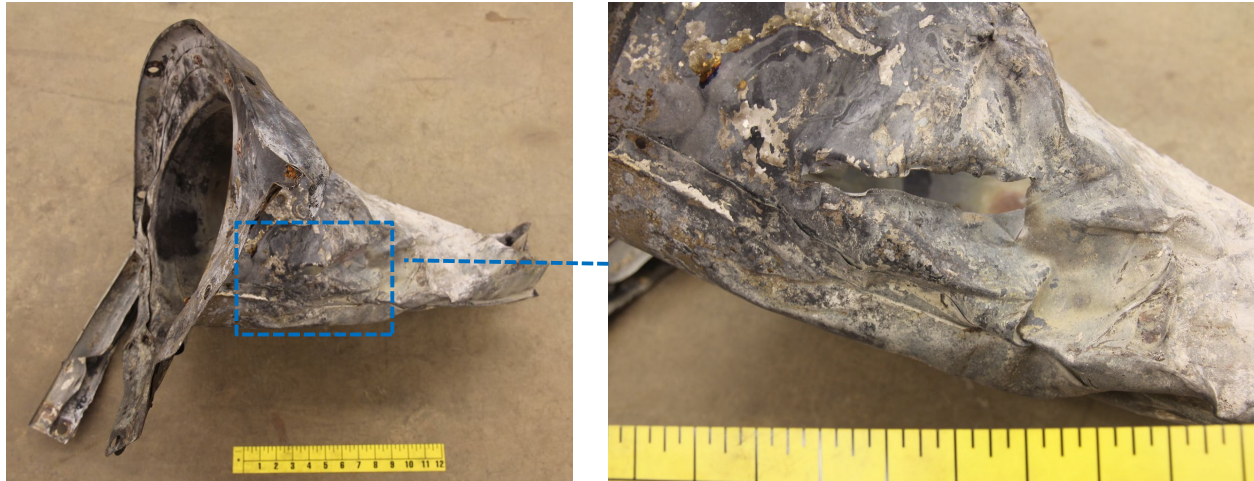


Figure 17. Photograph of puncture (tear) in wall of the #2 engine exhaust ejector.