

# NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering  
Materials Laboratory Division  
Washington, D.C. 20594



September 21, 2018

MATERIALS LABORATORY FACTUAL REPORT

Report No. 18-010

## A. ACCIDENT INFORMATION

Place : Hertford, North Carolina  
Date : September 8, 2017  
Vehicle : Eurocopter MBB-BK 117C2 (N146DU)  
NTSB No. : ERA17MA316  
Investigator : Douglas Brazy

## B. COMPONENTS EXAMINED

1. #1 engine deck drain fitting (also known as a three-way union fitting).
2. #2 engine deck drain fitting (also known as a three-way union fitting).
3. #2 drain fitting line.

## C. DETAILS OF THE EXAMINATION

The as-received evidence is shown in Figure 1. In this report, the #1 engine deck drain fitting will be called #1 deck fitting and the #2 engine deck drain fitting will be called #2 deck fitting. Figure 2 shows a typical deck fitting. In Figure 2, each port's function is identified and the ports are numbered 1-4 for identification purposes. This number scheme will be used throughout the report. The two deck fittings and the drain fitting line were inspected for indications of oil sludge or coking deposits in all internal surfaces.

### #1 Engine deck drain fitting

The #1 engine deck drain fitting exhibited surface oxidation, rust, soot, and deposits of partially pyrolyzed polymer or organic matter as shown in Figure 4 with each port numbered consistent with Figure 2. Using a 5X to 50X stereo-zoom microscope and a 0.033 inch diameter stainless steel wire, each port was inspected for the presence of sludge, coking deposits, or other occlusions. The observations for each port are summarized in Figure 4 and closer details for occlusions are documented in Figures 5-8. As indicated in Figure 9, samples were removed locations labelled D through I and were evaluated by Fourier transform infrared spectroscopy (FTIR)<sup>1</sup>. The spectra were compared with reference spectra from exemplar hoses (see Figure 2, hoses 2 and 3) and shrink jacket tubing used over the hose connectors.

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<sup>1</sup> The sample was examined using a Fourier Transform Infrared (FTIR) spectrometer with a diamond attenuated total reflectance (ATR) accessory in accordance to ASTM E1252-98 (American Society for Testing Materials E1252-98: *Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis*).

## **#2 Engine deck drain fitting**

The #2 engine deck drain fitting exhibited surface oxidation, rust, and salt deposits consistent with exposure to temperature and time conditions enough to fully pyrolyze organic matter such as polytetrafluoroethylene (PTFE) hoses and shrink tubing (see Figure 10). Using a 5X to 50X stereo-zoom microscope and a 0.033-inch diameter stainless steel wire, each port was inspected for the presence of sludge, coking deposits, or other occlusions—no occlusions were observed.

## **#2 Engine drain fitting line**

The #2 engine drain fitting line exhibited surface oxidation, rust, and salt deposits consistent with exposure to temperature and time conditions enough to fully pyrolyze organic matter such as the elastomeric hose inside the braiding (see Figure 11). Using a 5X to 50X stereo-zoom microscope and a 0.033 inch diameter stainless steel wire, each port was inspected for the presence of sludge, coking deposits, or other occlusions—no occlusions were observed.

Michael Budinski  
Chief, Materials Laboratory Division

Table 1

## Material Identification by FTIR for the Locations in Figure 9

Location	Sample	FTIR spectra interpretation	Identified material (or closest spectral match)
A	Exemplar hose, corrugated, 117-600381.105 (oil supply line deflector, port 2, Figure 3)	Direct library match	PTFE
B	Exemplar hose, corrugated, 117-600381.104 (rear bearing vent line, port 3, Figure 3)	Direct library match	PTFE
C	Exemplar shrink jacket tubing, Raychem ¼ DR-25 (Figure 4)	No strong library match; Doublet at ~2920 and 2852; Strong peak at 1716; Peaks at 2360, 1434, 1268, 1102, 874 and 728	May be based on polyethylene and olefin copolymers, fluoropolymers, polyamides and polyesters
D	Shrink jacket submitted with #1 deck fitting (Figure 4)	Doublet at ~2922 and 2851; Strong peak at 1713; Peaks at 2593, 1371 and 1242	Shrink jacket tubing
E	#1 deck fitting, loose plug from port 2 (Figures 4 and 8)	Doublet at ~2922 and 2851; Strong peak at 1713; Peaks at 2389, 1371 and 1242	Shrink jacket tubing
F	#1 deck fitting, hose fitting exterior deposit, port 3 (Figure 4)	Peaks at 1688, 1265, 1099 and 728	Shrink jacket tubing
G	#1 deck fitting, A side corner, port 2 (Figure 4)	Peaks at 1688, 1265, 1099 and 728	Shrink jacket tubing
H	#1 deck fitting, hose fitting exterior deposit, port 2 (Figure 4)	Doublet at ~2924 and 2853; Strong peak at 1696; Peaks at 1418, 1268, 1160, 873 and 728	Shrink jacket tubing
I	#1 deck fitting, plug deposit, port 3 (Figures 4 and 7)	Doublet at ~2923 and 2854; Strong peak at 1719; Peaks at 2359, 1416, 1096, 873, 721	Shrink jacket tubing
J	#1 deck fitting, B side corner, port 3 (Figure 4)	Doublet at ~2922 and 2852; Strong peak at 1715; Peaks at 2081, 1580, 1420, 1240, 1095, 873, and 728	Shrink jacket tubing



Figure 1 Overall image of the submitted evidence.

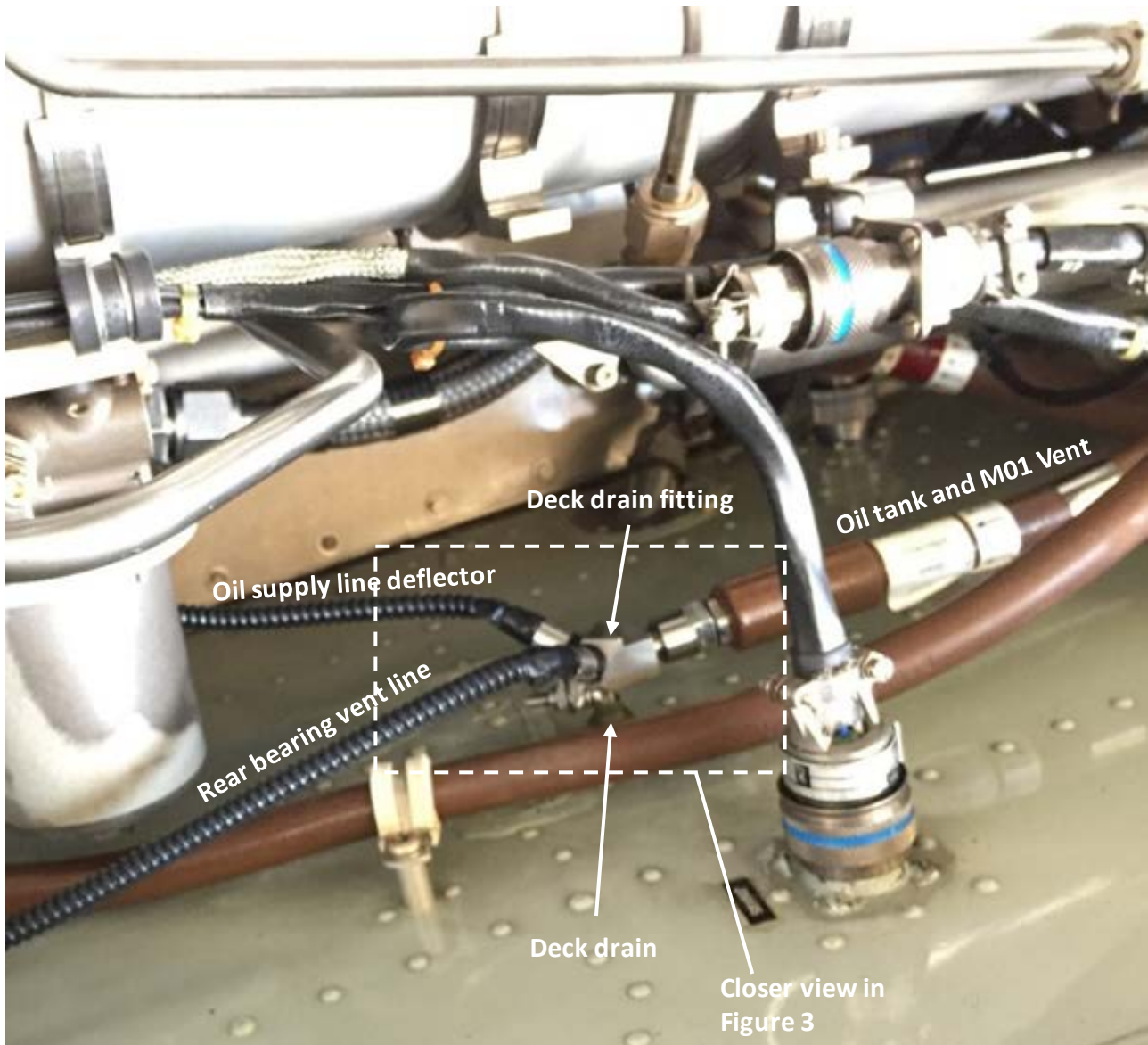


Figure 2 Image of an exemplar installed deck drain fitting.



Figure 3 Typical engine deck drain fitting (also known as a three-way union fitting) showing the function and numbering scheme for each port on the deck fitting.

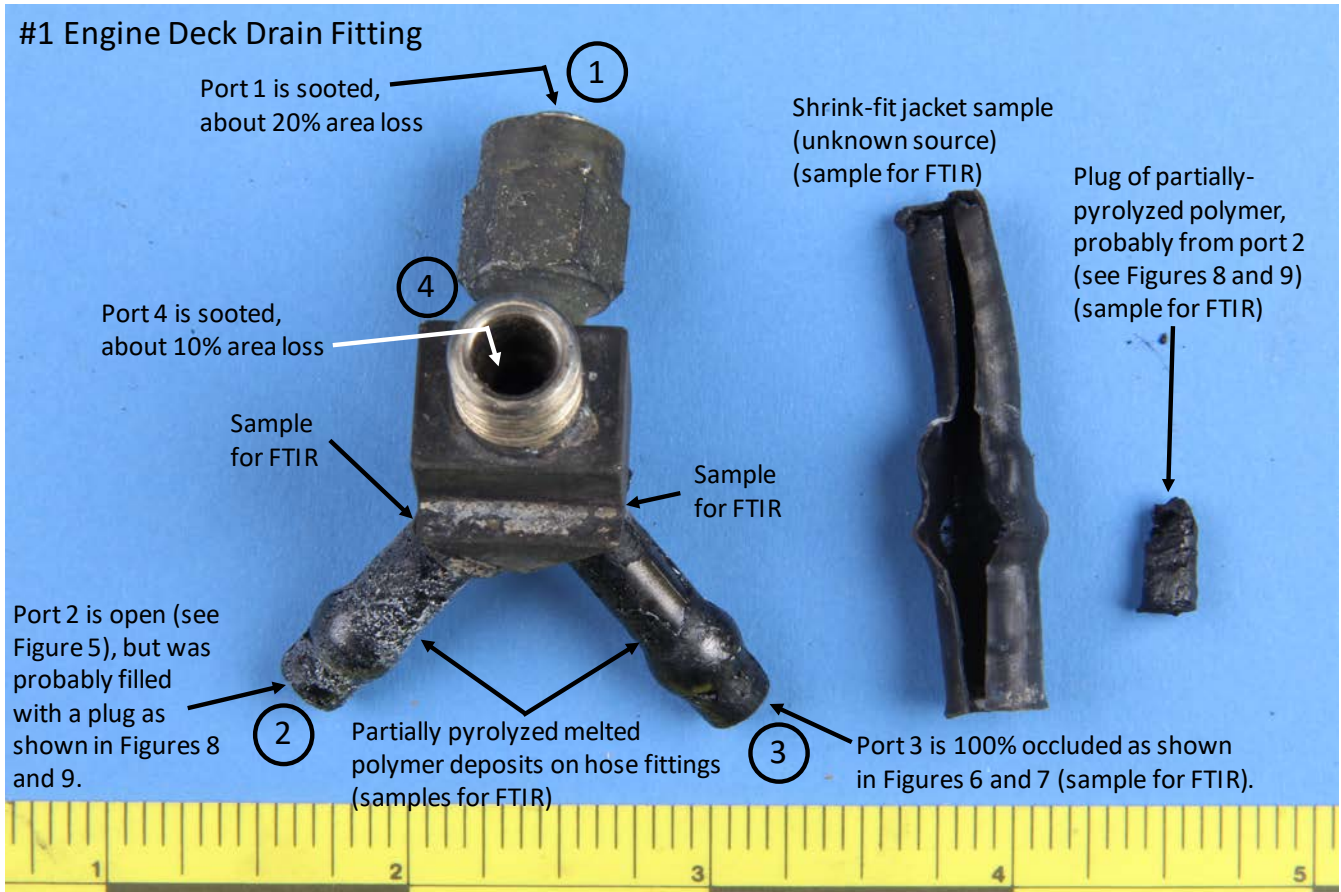


Figure 4 Image of the #1 engine deck drain fitting. Each port is identified relative to Figure 3. The

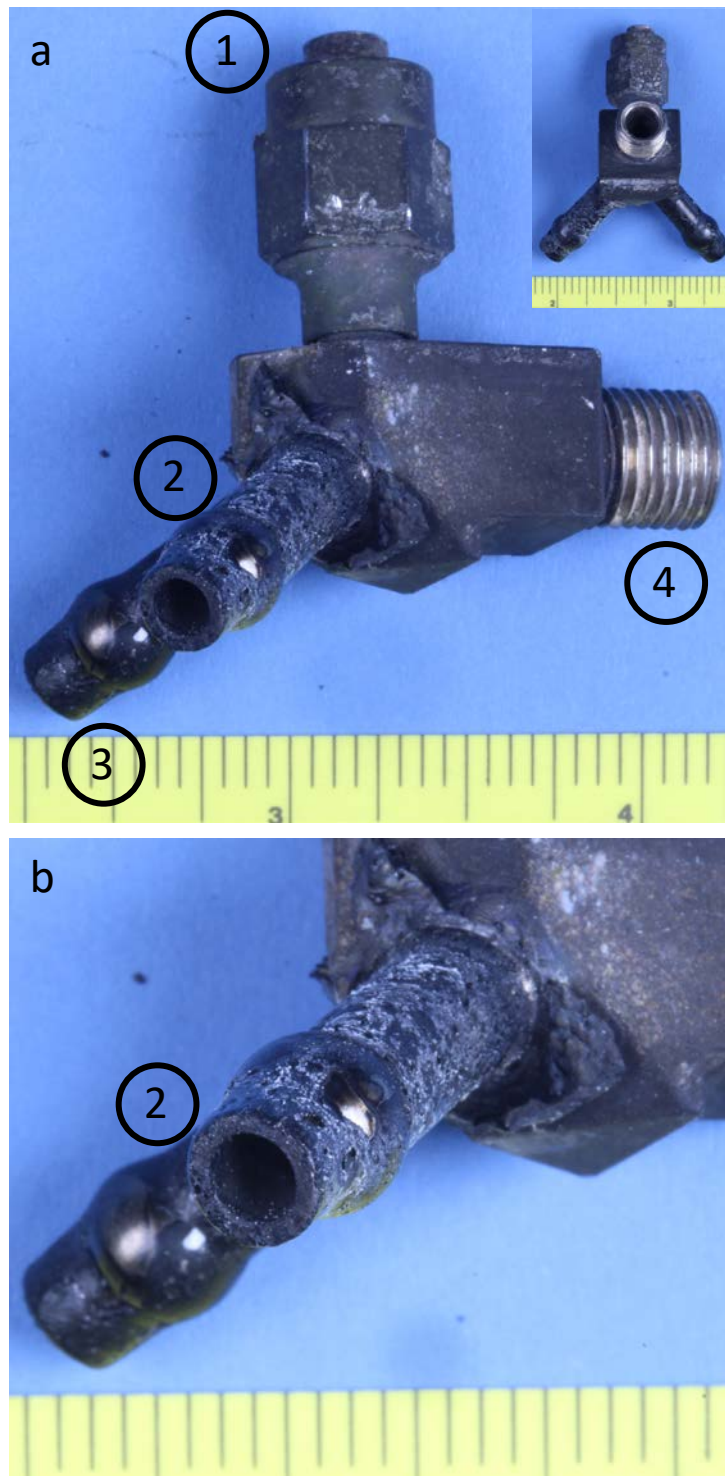


Figure 5 Images of port 2 of the #1 engine deck drain fitting.



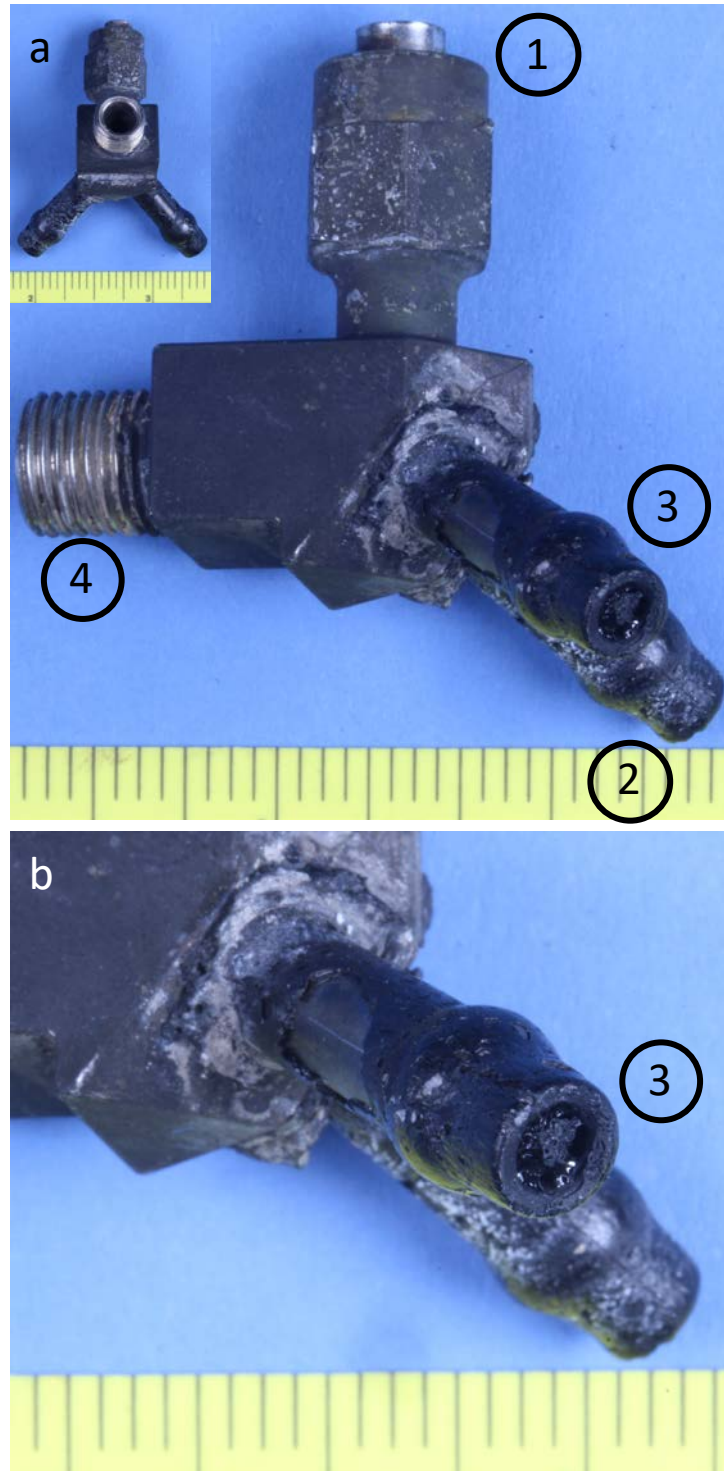


Figure 6 Images of the occlusion in port 3 of the #1 engine deck drain fitting.

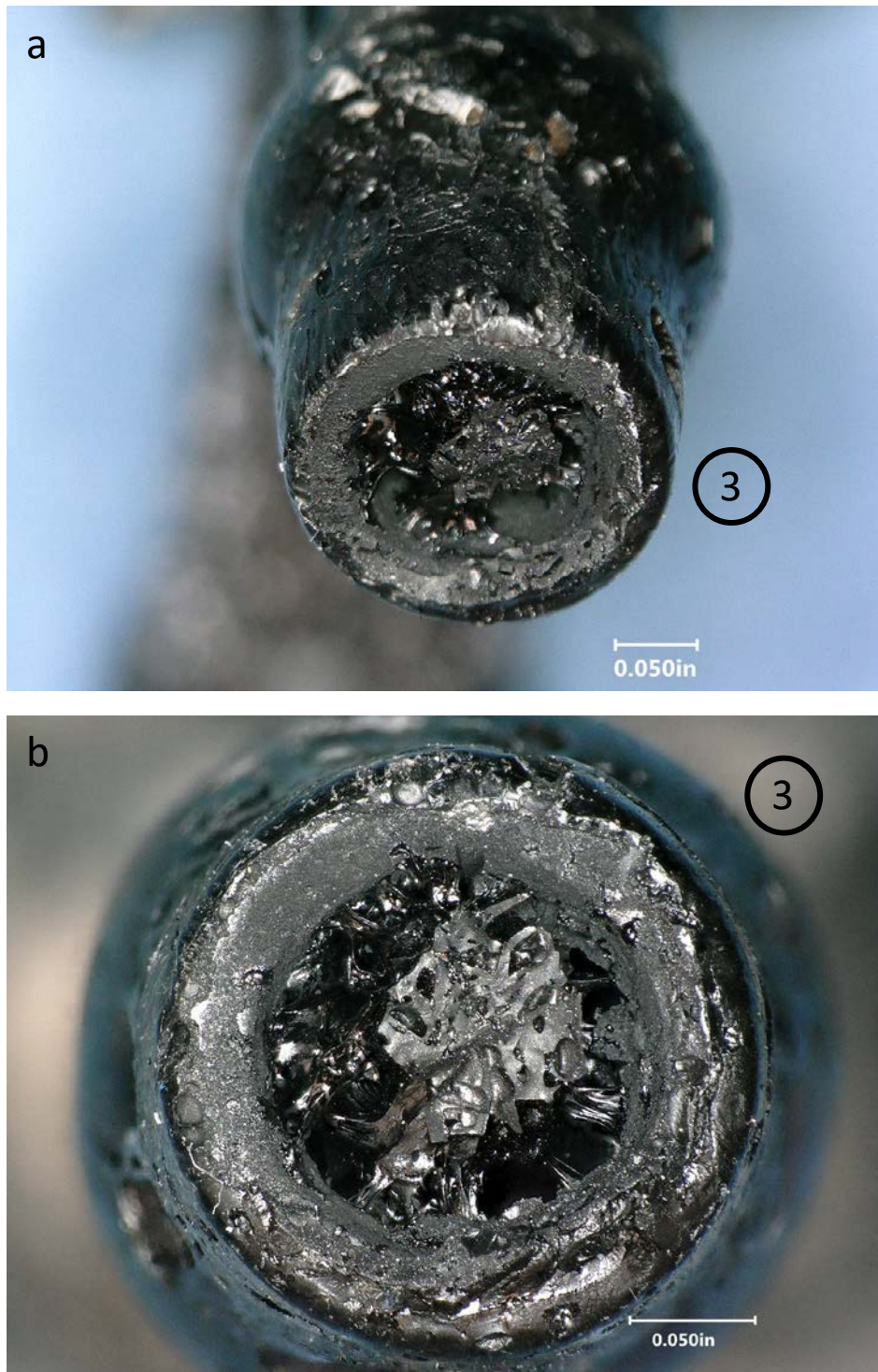


Figure 7 Closer images of the occlusion in port 3 of the #1 engine deck drain fitting shown in Figure 6. A sample was removed for FTIR analysis (see Figure 9 and Table 1).



Figure 8 Images of the plug submitted with the #1 deck drain fitting. Most likely this plug was removed from port 2 as indicated in Figure 4.

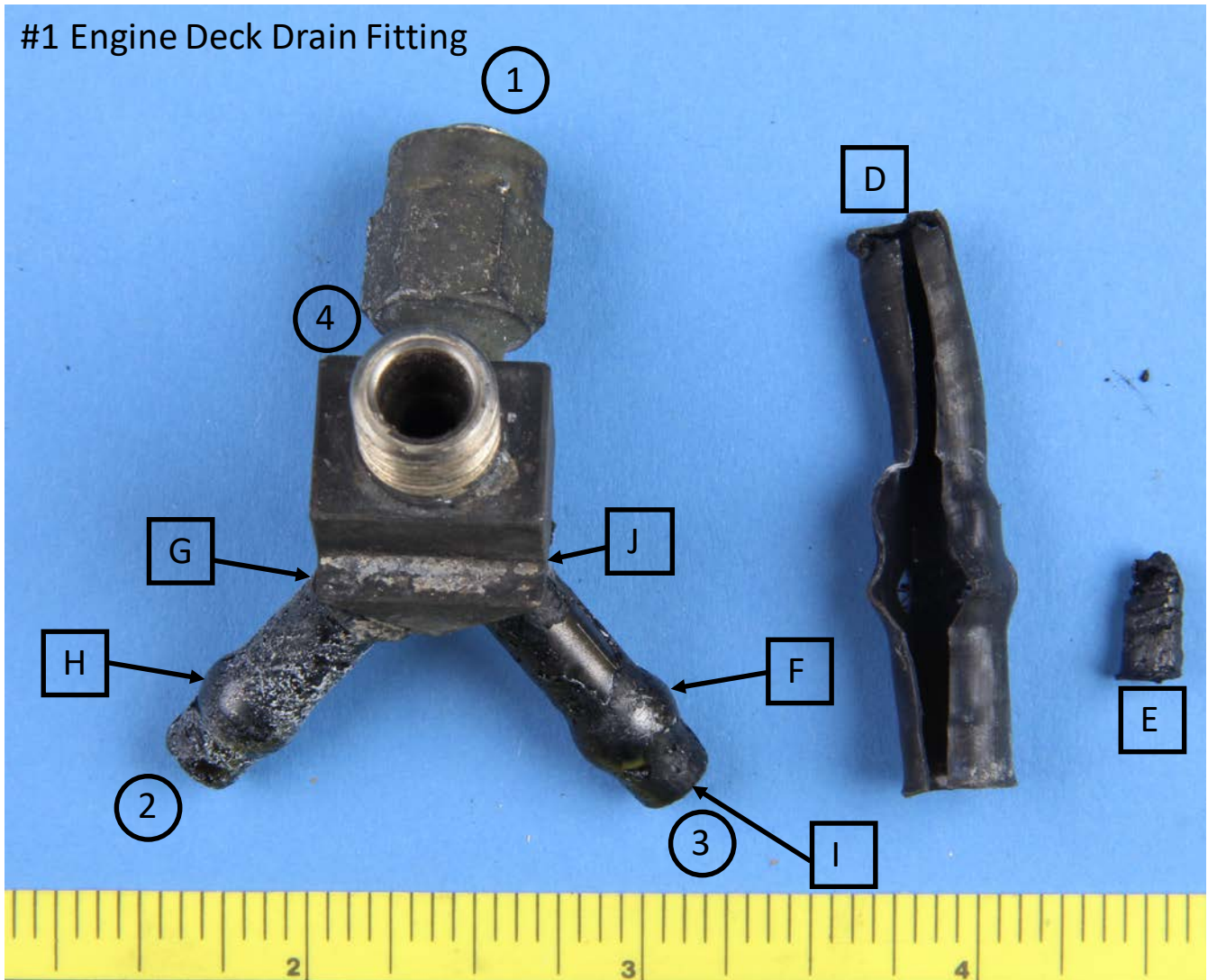


Figure 9 Image of the #1 deck drain fitting annotated to indicate all of the samples and sampling locations for Fourier transform infrared spectroscopic analysis (results are listed in Table 1).

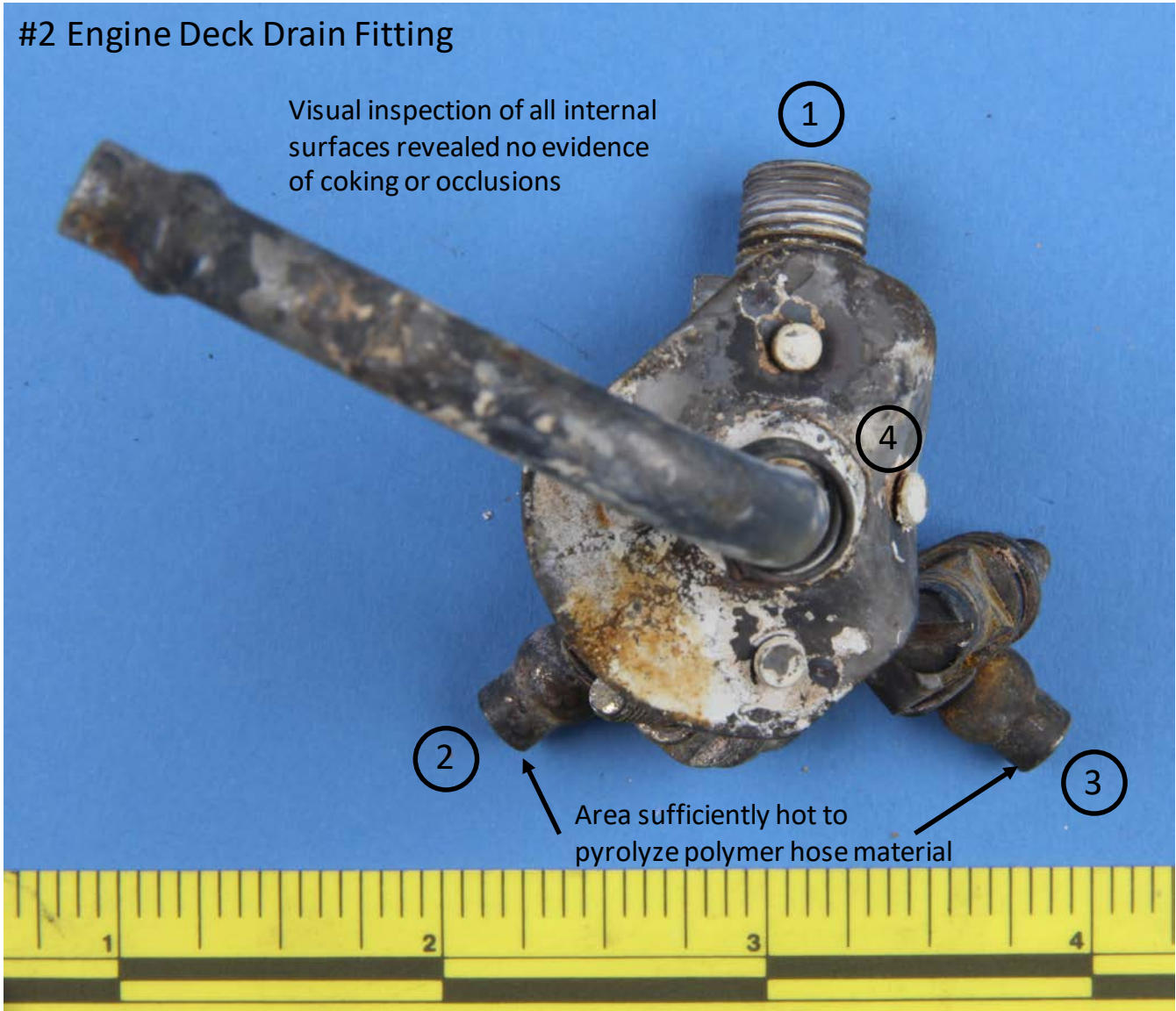


Figure 10 Image of the #2 engine deck drain fitting.

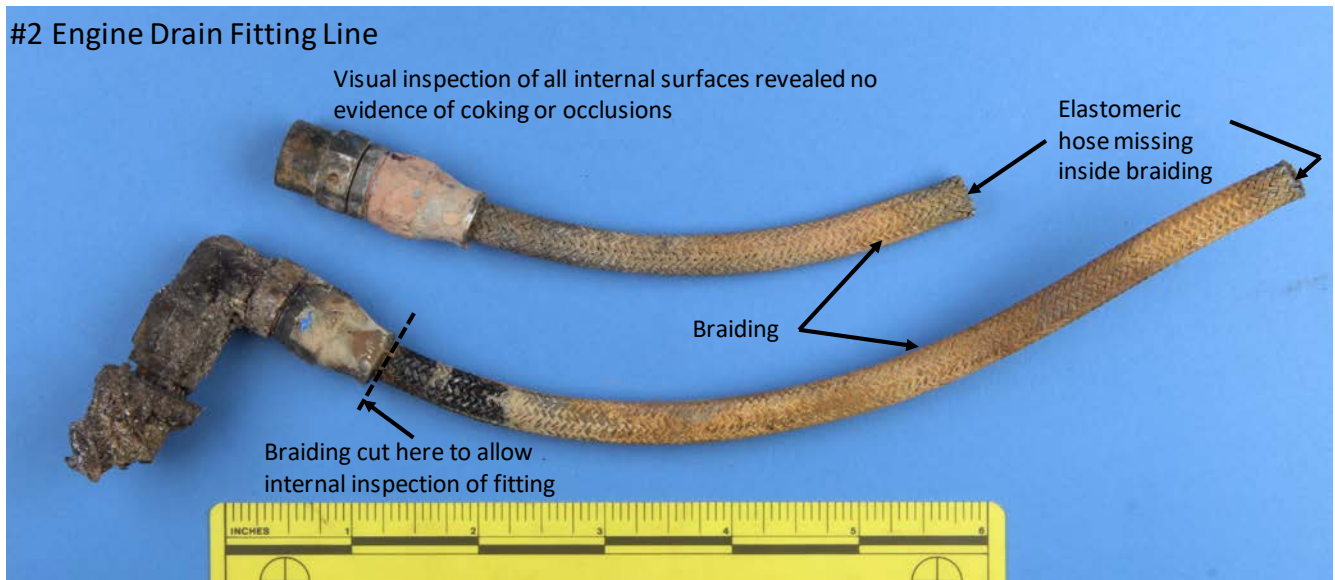


Figure 11 Image of pieces of the #2 engine drain fitting line.