

John Brannen

From: Nancy McAtee
Sent: Friday, October 13, 2023 1:27 PM
To: John Brannen
Cc: Michael Budinski
Subject: Email report (CEN23FA079)-Debris from oil screen and drain plug

John,

The debris removed from engine drain plug and oil screen of the accident aircraft was submitted to the Materials Laboratory for examination. The material consisted of small pieces of a dark brittle substance. The material was examined using a Fourier Transform Infrared (FTIR) spectrometer with a diamond attenuated total reflectance (ATR) accessory and a Fourier Transform Infrared (FTIR) micro-spectrometer with both a germanium ATR and a silicon ATR 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 and American Society for Testing Materials*). The spectrometers were used to collect and process infrared wavelength absorbance spectra of the unknown material.

The sample spectra contained the following combination of spectral peaks corresponding to particular functional groups found within molecular structure of the material. The presence of a strong doublet peak between $\sim 2920\text{ cm}^{-1}$ and $\sim 2850\text{ cm}^{-1}$ is indicative of a carbon-hydrogen (C-H) single stretching bond. The presence of a doublet peak ~ 2360 and 2340 cm^{-1} is indicative of a carbon-carbon (C-C) group (most likely in the form of elemental carbon or carbon black). These peaks can also indicate the presence of a triple bonded carbon-nitrogen ($\text{C}\equiv\text{N}$) group. The presence of a single broad peak $\sim 1600\text{ cm}^{-1}$ and at $\sim 1450\text{ cm}^{-1}$ are indicative of a carbon-carbon double stretching bond(s) within an aromatic ring structure. A trio of weak peaks at ~ 1560 , 1540 and 1500 cm^{-1} are indicative of phenol (aromatic ring)-carbon vibration bonds. The presence of peaks $\sim 1375\text{ cm}^{-1}$ and $\sim 1360\text{ cm}^{-1}$ are indicative of carbon-hydrogen₂ (C-H₂) deformation bonds. The presence of a single peak $\sim 1030\text{ cm}^{-1}$ is indicative of phenol (aromatic ring)-carbon deformation bonds. A peak at $\sim 950\text{ cm}^{-1}$ is indicative of a carbon-hydrogen deformation bond. This combination of functional groups is consistent with an aromatic hydrocarbon with straight-chained hydrocarbon attachment and an attached nitrile group. A spectral library search was performed on unknown spectrum. The search found similarities to acrylonitrile-butadiene copolymers and other similar polymers and copolymers.

A magneto drive cushion was provided as a potential source of the unknown debris. A section of the cushion was analyzed using the same method as the unknown debris. The known material spectrum was visually compared to the spectra of the unknown material by the laboratory examiner. The unknown spectra were a very strong match to the known material from the magneto drive cushion.

If you have any questions, please let me know.

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