NATIONAL TRANSPORTATION SAFETY BOARD

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

January 25, 2010

MATERIALS LABORATORY FACTUAL REPORT Report No. 10-002

A. ACCIDENT

Place	: Willow Creek, California
Date	: July 17, 2009
Vehicle	: Sikorsky SH-3H, N613CK
NTSB No.	: WPR09TA353
Investigator	: Mike Hauf (AS-40)

B. COMPONENTS EXAMINED

Seven envelopes (plastic bags) that contained cotton swab(s), a rubber O-ring, a plastic container, or combination of these materials that possibly may contain contamination particle(s). These samples were collected from the fuel control units (FCUs) from the left and right engines, model General Electric CT58 turbo shaft engines. The FCUs were reportedly part number 788226-1. The left FCU was serial number 72476M and right FCU was serial number 68032M.

C. DETAILS OF THE EXAMINATION

According to the Airworthiness Group Chairman, contamination particles were found in various portions of the FCUs during their examination at Columbia Helicopter, Inc. These particles were collected and placed in plastic envelopes (bags). A photograph of the as-received transparent plastic bags is shown in figure 1. The bags contained cotton swab(s), a rubber O-ring, a plastic container or a combination of these materials. The contents in each bag were examined with a bench binocular microscope to determine the presence of contamination particles. Contamination particles were found in every bag. Light was transmitted through each clear plastic bag and this procedure revealed the bottom of several bags contained contamination particles. When viewed under the bench binocular microscope, particles were removed with tweezers from the cotton swab, rubber O-ring, plastic container, and bottom of the bag and placed on a stub that contained double-sided carbon adhesive tape. The carbon adhesive tape assured that the particles did not fall off the stub. X-ray energy dispersive spectroscopy (EDS) analysis was performed on each particle. The size of the particles was measured. The description of the contamination particles, major elemental peaks that were found by EDS analysis of the particles, and the approximate size of the particles is shown in table 1. Table 1 also shows the results of the analysis for particles that were found at the bottom of several bags. The particles found in the FCUs were consistent with materials such as aluminum alloy, stainless steel,

chromium, lead, silicon, and chlorinated plastic or non-metallic material that is organic. The grade of aluminum alloy or stainless steel was not determined. The width of the particles varied between 18 micrometers (0.0007 inch) and 500 micrometers (0.20 inch). The FCU reportedly was equipped with 40 micron filters.[1] The size of many contamination particles was greater than the clearance between the wire meshes in the filter.

Frank P. Zakar
Senior Metallurgist

[1] The clearance between the wire meshes in the filter was designed to prevent the passage of contamination particles that exceed 40 microns (micrometers).

Table 1. Description of Particles and Size							
Bag Sample No. and Origin Of Collected Particles	**NTSB Sample No.**	**Description Of Contamination Particle Found**	**Major Elemental Peaks Found in the EDS Spectrum of the Particle**	**Consistent With Material Such as:**	**Size of Particle Measured in micrometers (converted to inches)**		
					Length, Approx	**Width, Approx**	**Thickness Max.**
Sample 1; FCU S/N 72476M (filter's main screen)	1A Cotton Swab	Flat; One side red; Other side gray.	Carbon, Oxygen, Chlorine	N-M Organic or Chlorinated Plastic such as PVC	675 (0.027)	330 (0.013)	20 (0.0008)
	1B Cotton Swab	Flat; Luster	Aluminum	Aluminum Alloy	820 (0.032)	300 (0.012)	20 (0.0008)
	1C Cotton Swab	Flat; Luster	Aluminum	Aluminum Alloy	1300 (0.051)	500 (0.20)	20 (0.0008)
	1D Rubber O-Ring	Flat; Tan	Carbon, Oxygen	N-M Organic	1100 (0.043)	300 (0.012)	20 (0.0008)
	1E Bottom of Bag	Flat; Luster	Aluminum	Aluminum, Alloy	1900 (0.075)	450 (0.018)	40 (0.002)
Sample 2: FCU S/N 72476M (filter bypass valve seat)	2A Cotton Swab	Flat; Luster	Aluminum	Aluminum, Alloy	30 (0.001)	30 (0.001)	--
	2B Bottom of Bag	None	NA	NA	NA	NA	NA
Sample 3: FCU S/N 72476M (post test inspection of filter	3A Cotton Swab	Flat; Red on all sides	Aluminum	Aluminum Alloy	100 (0.004)	90 (0.004)	--
	3B Bottom of Bag	Flat; Luster	Silicon, Oxygen	Silicon compound	440 (0.017)	170 (0.007)	--

screen)							
Sample 4; FCU S/N 72476M (fuel sample taken from TV end cap)	4A Cotton Swab	Irregular	Lead	Lead	24 (0.0009)	18 (0.0007)	--
	4B Plastic Container	Flat; Luster	Carbon	N-M Organic	380 (0.015)	160 (0.006)	--
	4C Bottom of Bag	None	NA	NA	NA	NA	NA
Sample 5; FCU S/N 68032M (main fuel filter)	5A Cotton Swab	Flat; Luster	Chromium	Chromium	100 (0.004)	70 (0.003)	--
	5B Cotton Swab	Flat; Luster	Iron, Chromium, Nickel	Stainless Steel	260 (0.01)	180 (0.007)	--
	5C Rubber O-Ring	Flat; Luster	Aluminum	Aluminum Alloy	430 (0.017)	90 (0.004)	--
	5D Bottom of Bag	None	NA	NA	NA	NA	NA
Sample 6; FCU S/N 68032M	6A Rubber O-Ring		D	D	D	D	D
	6B Bottom of Bag	None	NA	NA	NA	NA	NA
Sample 7; FCU S/N 68032M (PRV diaphragm)	7A Cotton Swab	Flat; Luster	Carbon, Oxygen, Chlorine	N-M, Organic	30 (0.001)	20 (0.0008)	--
	7B Bottom of Bag	None	NA	NA	NA	NA	NA

Notes: -- indicates that the thickness of the particle was not measured. However, based on visual observation, the thickness for the particles was significantly less than (a small percentage of) the width.

N-M Organic indicates a non-metallic material that is organic

NA indicates not applicable

D Disqualified
During disassembly from FCU, the rubber O-ring fell on the floor and because of potential secondary contamination was disqualified from EDS analysis. EDS analysis was not performed on particles that were found on the O-ring

Conversion Units: 1 micrometer = 0.001 millimeter = 0.000039 inch

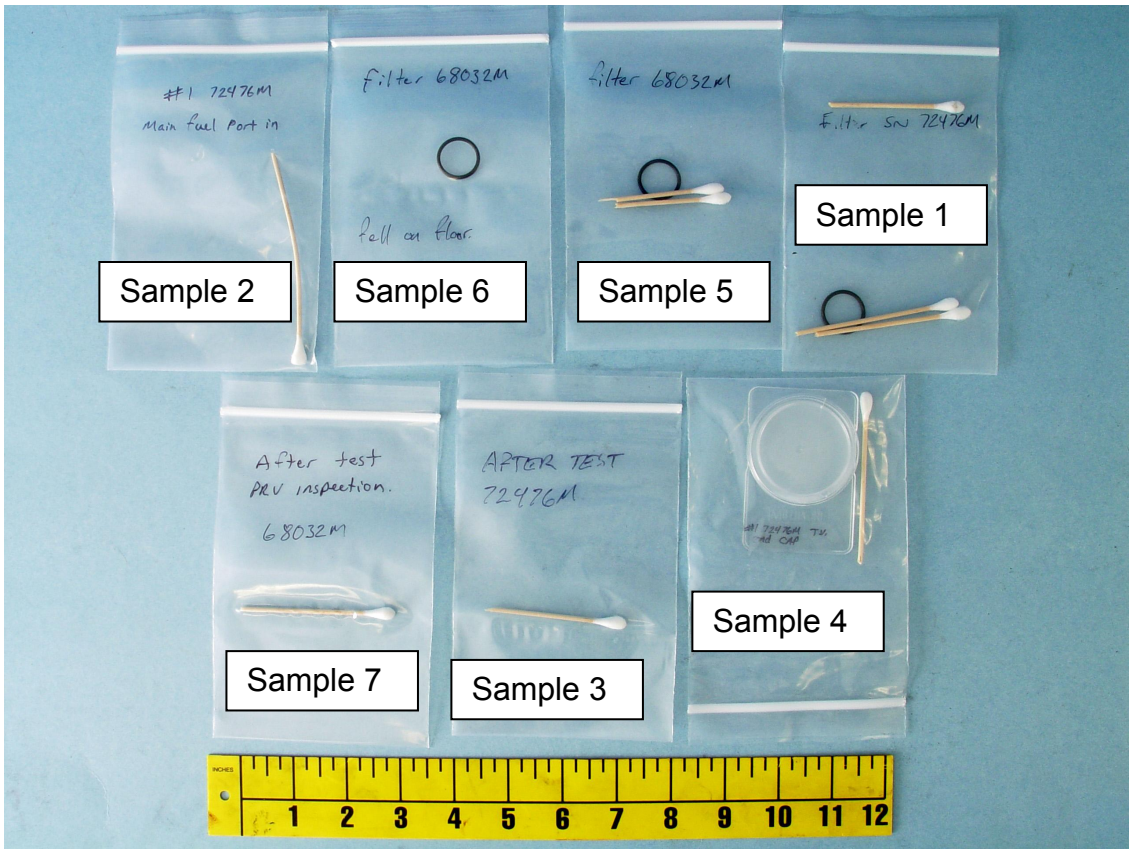

Figure 1. Photograph of the as-received plastic envelopes (bags). The bags were randomly labeled samples "1" through "7". The following sentences describe the contents that were found in each bag. For the purpose of this examination disregard the original marking (written in black marker) that was found in each bag. The bags were relabeled in coordination with Mike Hauf (Systems Group Chairman).
Sample "1" - FCU S/N 72476M (filter's main screen)
Sample "2" - FCU S/N 72476M (filter bypass valve seat)
Sample "3" - FCU S/N 72476M (post test inspection of filter screen)
Sample "4" - FCU S/N 72476M (fuel sample taken from TV end cap)
Sample "5" - FCU S/N 68032M (main fuel filter)
Sample "6" - FCU S/N 68032M rubber O-ring
Sample "7" - FCU S/N 68032M (PRV diaphragm)