SEI-182

GE Aircraft Engines

CT58-140
TURBOSHAFT ENGINE

MAINTENANCE MANUAL

FAA APPROVED

JUNE 1, 1966
REVISION 16 – JULY 31, 2006

4. Daily and Minor Inspection/Checks.

NOTE: Minor inspection/checks should be performed at intervals of 100 engine operation hours or 90 days calendar time, whichever occurs first.

ENGINE COMPONENT AND NATURE OF INSPECTION

	Daily	Minor
A. Exhaust Casing. (Refer to 72-70-1 for limits.)		
(1) Cracks in casing, inner casing near forward flange, outer casing, power turbine blade guard, and exhaust clamp (vee-band coupling).....	x	x
NOTE: Vee-band used on CT58-140-1 Series A and Series L only.		
(2) Security.....	x	x
(3) Hot spots.....	x	x
(4) Buckling.....	x	x
(5) Dents.....	x	x
(6) Oil leaks.....	x	x
B. Power Turbine Rotor		
(1) Turbine blades for damage.....	x	x
(2) For evidence of overheating.....		x
C. Gas Generator Turbine Section. (Refer to 72-50 for limits.)		
(1) Visible areas for cracks, security, deformation, and hot spots.....		x

ENGINE COMPONENT AND NATURE OF INSPECTION (Cont)

	Daily	Minor
(4) Magnetic plugs (or chip detectors) that service: (Cont)		
Auxiliary sump scavenge fitting (No. 2 bearing) (see Note that follows).....		x

NOTE: Also at first runup on new or overhauled or repaired engines.

CAUTION: MAKE SURE THAT WHEN YOU ASSEMBLE THE MAGNETIC PLUGS, THE THICKER CROSS SECTION PREFORMED PACKINGS (0.103 INCH DIAMETER WHEN NEW) ARE INSTALLED AT THE ACCESSORY DRIVE GEARBOX AND THE POWER TURBINE ACCESSORY DRIVE HOUSING DRAIN PORTS. THE THINNER CROSS SECTION PREFORMED PACKINGS (0.072 INCH DIAMETER WHEN NEW) ARE INSTALLED AT THE NO. 2 AND NO. 3 SUMP DRAIN PORTS.

(5) Fuel control filter (see Note that follows).....		x

NOTE: Also at first runup on new or overhauled or repaired engines at time intervals established in SECTION 73-20-1.

(6) Static fuel filter (see Note after step (4)).....		x

NOTE: The inspection interval may be extended to every third minor inspection, provided the static fuel filter is inspected when the fuel control filter is 60 percent or more clogged.

(7) Centrifugal fuel filter (see Note after step (4)).		x
(8) Lube filter (see Note after step (4)).....		x
(9) Thermocouples and harnesses for:		
Probes for security.....		x
Harness for chafing broken wires, loose connections.....		x

(c) Open speed selector and flush using boost pump or while motoring engine (do not exceed starter limitations as specified in paragraph 4 (72-00) (Maintenance Practices - Adjustment/Test) until clean fuel is observed. Recheck fuel filters and fuel system for contamination if unable to get clean fuel. Reinstall line.

(d) Perform a fuel manifold pressure check (refer to paragraph 4.M. (72-00) Maintenance Practices - Adjustment/Test). This will ensure that there is no restriction in fuel manifolds or nozzles.

C. Inspection/Check.

(1) Position a small light inside the filter element and then visually inspect the element with a 10 power glass. It is necessary that an estimate of the degree of cleanliness be established. Count a representative sample of openings for a given area in the filter screen. Any element which has 70 percent or more of the available open area plugged is operating in partial or full by-pass and therefore, indicates the need to reduce the filter inspection/cleaning time interval. The optimum filter inspection/cleaning time interval can be established by consistently finding 50 percent or less of the available filter area plugged when inspected.

(2) The following guidelines are to be used in establishing optimum filter inspection/cleaning intervals:

(a) Consistent plugging of 40-60 percent of available open area. No change in procedure required.

(b) Consistent plugging of 61-70 percent of available open area. Recommend 20 percent reduction in inspection/cleaning interval. (e.g., current cleaning interval = 100 hours, reduce to 80 hours or less.)

(c) Consistent plugging of more than 70 percent of available open area. Reduce inspection/cleaning interval by 40 percent.

(d) Consistent plugging of less than 40 percent of the available open area. The operators may program an increase in the inspection/cleaning interval. Do not exceed 20 percent of inspection/cleaning interval on any increase.

(3) Facilities that have the Delta P Tester (21C4060 or 21C4120G07) must check the serviceability of the fuel control filter (figure 206) as follows:

CAUTION: DELTA P TESTER (21C4060) OPERATES ON A 120/208 VAC, 3 PHASE, 400 CYCLE POWER SOURCE. A DELTA P TESTER FREQUENCY CONVERTER (21C4129) IS PROVIDED TO OPERATE THE TESTER (21C4060) ON A 220 VAC, 60 CYCLE POWER SOURCE.

23. ABNORMAL T5 (Cont)

Trouble	Probable Cause	Troubleshooting	Corrective Action
		(b) Do a one-point tuning check, see paragraph K (Maintenance Practices - Adjustment/ Test).	Re-tune as required.
	(4) Stator vanes not fully open caused by binding in SVA system or improper vane schedule.	(a) Check actuating system for binding (75-30).	Repair or replace defective items.
		(b) Check stator vane schedule (75-30-1). If not within limits, extend the actuator piston to the fully open position and check the clearance between the machined surface of the pilot valve housing and the cam lever arm. Clearance must be 0.025 to 0.150 inch.	Adjust schedule. (75-30-1).
		(c) If trouble still exists, control is faulty.	Replace the fuel control (73-20-1).
	(5) Incorrect stage 1 nozzle installed in engine.	Disassemble the engine. Use the IPC SEI-181 and verify the part number of the stage 1 nozzle.	Install the correct stage 1 nozzle part number (refer to SEI-181).
D. Fluctuating T5 indication (all other indications stable).	(1) T5 indicating system error.	Calibrate instrumentation for accuracy.	Replace the indicator (77-20-0).

23. ABNORMAL T5 (Cont)

Trouble	Probable Cause	Troubleshooting	Corrective Action
	(2) Engine T5 thermocouple harness.	(a) Check harness for frayed or damaged insulation.	Replace faulty harness.
		(b) Test harness (77-20-0).	Replace faulty harness.
	(3) Aircraft temperature indicating system fault.	Check aircraft wiring harness for proper resistance as indicated in applicable aircraft maintenance manual.	Calibrate aircraft temperature indicator.
E. T5 exceeds max idle.	(1) Idle speed abnormally low.	Check idle speed.	Adjust as necessary.
	(2) Actuator ring "N" matchmarks and/or vg actuating piston stroke improperly set.	Check vg actuator system for correct adjustments.	Adjust as necessary.

24. ABNORMAL GAS GENERATOR SPEEDS.

Trouble	Probable Cause	Troubleshooting	Corrective Action
A. Ng exceeds maximum operating speed.	(1) Improper maximum gas generator speed adjustment.	Make a maximum gas generator speed (topping) check.	Adjust topping as necessary.
	(2) Fuel control malfunction.	(a) Topping cannot be adjusted.	Replace fuel control.
		(b) Be sure remote topping adjustment mechanism is not faulty.	Replace fuel control.

24. ABNORMAL GAS GENERATOR SPEEDS. (Cont)

Trouble	Probable Cause	Troubleshooting	Corrective Action
B. Ng stays at maximum whenever speed selector is in governing position, regardless of load.	No power turbine speed signal.	(1) Check flex shaft for core or spline failure.	Replace flex shaft.
		(2) Rotate power turbine wheel and check for accessory drive shaft rotation.	Disassemble power turbine and replace defective components. Check lube system for contamination. See 72-80-7.
		(3) Rotate power turbine wheel and check for rotation of flex shaft at the fuel control end.	Replace fuel control if shaft rotates.
C. Ng stays at maximum with Nf abnormally low when under load (indicates low power output).	Stator vanes remain closed.	(1) Check for disconnected stator vane linkage.	Reconnect after replacing defective or damaged linkage. Replace compressor rotor.
		(2) Check for disconnected feedback cable at pilot-valve arm or actuator.	Connect cable and check for proper rigging. See 75-30-1.
		(3) See if pilot valve cam-lever (12, figure 201) (75-30-1) is loose on cam shaft.	If arm is loose, replace pilot valve.
		(4) Check fuel system filters for contamination (73-50-1).	Replace fuel control and pilot valve. Correct source and clean fuel system as necessary.

24. ABNORMAL GAS GENERATOR SPEEDS. (Cont)

Trouble	Probable Cause	Troubleshooting	Corrective Action
		(5) If vanes fail to open during first runup after installation of pilot valve, remove valve and check to see if the fuel control stator vane button is properly positioned with respect to the pilot valve rocker arm slot.	Install valve properly.
		(6) Pilot valve or fuel control malfunction.	1. Replace pilot valve. 2. If trouble still exists, replace fuel control.
D. Low gas generator speed and high T5 at maximum power settings.	(1) Compressor damage.	(a) Check inlet for evidence of foreign object damage.	Replace engine.
		(b) Rotate compressor by hand and listen for audible evidence of blade or vane interference.	Replace engine.
	(2) Stator vane actuator Tuning "F" matchmarks not aligned.	Check alignment of "F" match-marks or last turning adjustment.	If misalignment is evident, adjust linkage per 75-30-0.

24. ABNORMAL GAS GENERATOR SPEEDS. (Cont)

Trouble	Probable Cause	Troubleshooting	Corrective Action
E. Gas generator speeds are abnormally high in the transition region and engine accelerates to maximum when the engine speed selector is advanced into the governing region. (Zero power turbine indicated speed).	Malfunction in the power turbine signal speed system.	(1) Disconnect flexible drive shaft at power turbine accessory assembly. Rotate power turbine wheel and check for rotation of accessory drive assembly gearing.	Repair as required.
		(2) Disconnect flexible drive shaft at fuel control. Inspect both ends of shaft, fuel control, and power turbine accessory drive splines for wear.	Repair as required.
		(3) Remove flexible drive shaft. Disassemble outer sheath and examine flexible drive for failure.	Replace drive if found to be defective.

25. ABNORMAL POWER TURBINE SPEEDS.

Trouble	Probable Cause	Troubleshooting	Corrective Action
A. Power turbine speeds abnormally low.	(1) Faulty rigging.	(a) Check for improper rigging of the linkage to the fuel control. Speed selector input shaft travel should be limited by power turbine speed adjustment screw (refer to 73-20-1).	Adjust linkage.
		(b) Make a max governing check (see paragraph L. (Maintenance Practices - Adjustment/Test).	Adjust per paragraph L. (Maintenance Practices - Adjustment/Test).
	(2) Faulty fuel control.	If external adjustments cannot correct problem, fuel control is faulty.	Replace fuel control.
	(3) Aircraft instrumentation error.	-	Calibrate the aircraft power turbine speed indicator.
	(4) Tachometer-generator error.	-	Calibrate tachometer-generator.
	(5) Fuel control droop schedule shaft.	-	If the maximum power turbine speed adjustment does not correct the low power turbine speeds, replace the fuel control.

Sikorsky
A United Technologies Company

Sikorsky Aircraft Corporation
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(203) 386-4000

ALERT SERVICE BULLETIN

No. 61B28-1

Subject: FUEL - Fuel Control Systems - Fuel System Installations - 40 Micron Fuel Filter Element and Packing, One-Time Replacement of

1. PLANNING INFORMATION

A. Effectivity

All S-61A/D/E/L/N/NM/R/V model helicopters.

Component:

Fuel filter, part number 52-2145 series manufactured by Janitrol Aero equipped with 40 micron filter.

B. Purpose

The purpose of this Alert Service Bulletin (ASB) is to provide instructions to replace the forward and aft fuel system 40 micron fuel filter elements with 10 micron fuel filter elements.

Background

Due to instances of contaminants being found in the fuel control pressure regulating valves, the potential existed for possible seizures of the fuel control pressure regulating valves. The fuel system currently operates with a 40 micron fuel filter installed. Installation of the 10 micron fuel filter elements would reduce the potential of larger contaminants reaching the engine, ultimately reducing the risk of sticking or seizure of the fuel control pressure regulating valves.

C. Description

Prepare helicopter for maintenance. Remove electrical and hydraulic power. Remove access cover to gain access to work area. Position applicable manual shut-off valve to CLOSE. Drain fuel from applicable fuel filter and line. Open fuel filter access panel in bottom of helicopter. Disconnect and cap drain line. Remove bowl, 40 Micron filter element,

FUEL - Fuel Control Systems - Fuel System Installations - 40 Micron Fuel Filter Element and Packing, One-Time Replacement of

1. PLANNING INFORMATION (Continued)

and packing from filter head. Install new 10 Micron fuel filter element in bowl. Install bowl onto filter head with new packing and safety wire. Remove cap from drain line and reconnect to fuel system. Position applicable manual shut-off valve to OPEN. Reidentify fuel filter and fuel control assembly. Prime fuel system. Close fuel filter access panel. Reinstall access cover. Return helicopter to service.

D. Compliance

Compliance is essential. Sikorsky Aircraft Corporation recommends fuel filter element replacement outlined herein to be performed at the next scheduled preventative maintenance inspection or within 150 flight hours from release of this ASB, whichever occurs first.

E. Approval

The technical change effected by this document is FAA approved in accordance with the applicable requirements of Federal Aviation Regulations. For civil registered aircraft, this constitutes EASA approval under the terms of the current interim procedures for working with the European Community on airworthiness certification and continued airworthiness. Reference to the ED Decisions mentioned above shall be made in the release documents issued by the EASA 145 approved organization, releasing the relevant EU-registered helicopter or component to service (No EU concurrence can be made for restricted category aircraft).

F. Manpower (Estimated)

	No. of Men	No. of Hours	*Man-Hours
Removal of Fuel Filter Elements and Packings	1	2.0	2.0
Installation of Fuel Filter Elements and Packings	1	2.0	2.0
Total		4.0	4.0

* Does not include time required to prepare helicopter for maintenance, or return it to flight status.

G. Material

None.

H. Tooling

None.

ALERT SERVICE BULLETIN

No. 61B28-1

FUEL - Fuel Control Systems - Fuel System Installations - 40 Micron Fuel Filter Element and Packing, One-Time Replacement of

1. PLANNING INFORMATION (Continued)

I. Weight and Balance

None.

J. Electrical Load Data

Not affected.

K. References

Applicable Maintenance Manual.

L. Publications Affected

Applicable Illustrated Parts Catalog.

M. Attachment

None.

2 MATERIAL INFORMATION

A. Basis for Material Data

Per helicopter.

B. Bill of Material

New Part No.	Qty	Key Word	Old Part No.	Instructions/ Disposition
AM52-01064-1	2	Fuel Filter Element	52-0505-2	(1)
MS29513-140	2	Packing	MS29513-140	(1)

(1) For price, availability, and lead time requirements of the parts listed above, contact your Customer Service Representative at Helicopter Support Inc. (HSI). Submit a purchase order referencing this ASB number and the helicopter serial number(s) upon which these parts will be used. This will allow HSI and the operator to track shipment and receipt of the parts. Orders will be accepted by letter, telephone, or facsimile (FAX). For prompt shipment, reference address of each shipping destination. Direct your order to:

FUEL - Fuel Control Systems - Fuel System Installations - 40 Micron Fuel Filter Element and Packing, One-Time Replacement of

2. MATERIAL INFORMATION (Continued)

HELICOPTER SUPPORT INC.,
124 Quarry Road
P.O. Box 11068
Trumbull, Connecticut U.S.A. 06611

Attn: Customer Service
FAX: (203) 416-4291 Telephone: (203) 416-4000
HSI website: www.HSIUS.com

C. Consumable Material

WARNING

OBSERVE ALL CAUTIONS AND WARNINGS ON CONTAINERS WHEN USING CONSUMABLES. WHEN APPLICABLE, WEAR NECESSARY PROTECTIVE GEAR DURING HANDLING AND USE. IF A CONSUMABLE IS FLAMMABLE OR EXPLOSIVE, MAKE CERTAIN CONSUMABLE AND ITS VAPORS ARE KEPT AWAY FROM HEAT, SPARK, AND FLAME. MAKE CERTAIN FIREFIGHTING EQUIPMENT IS READILY AVAILABLE PRIOR TO USE. FOR ADDITIONAL INFORMATION ON TOXICITY, FLASHPOINT, AND FLAMMABILITY OF CHEMICALS, CONSULT YOUR MEDICAL PEOPLE, OR THE MANUFACTURER OF THE CONSUMABLE.

QTY	KEY WORD	PART NO.	INSTRUCTIONS/ DISPOSITION
AS REQ'D	ANTI-SEIZE COMPOUND	TT-A-580 OR EQUIVALENT	(1)
AS REQ'D	LUBRICANT	VV-P-236 OR EQUIVALENT	(1)
AS REQ'D	CONTAINER (5-GALLON)	COMMERCIAL GRADE OR EQUIVALENT	(1)

(1) Procure from local supply

FUEL - Fuel Control Systems - Fuel System Installations - 40 Micron Fuel Filter Element and Packing, One-Time Replacement of

3. ACCOMPLISHMENT INSTRUCTIONS (Continued)

A. Replace Fuel System Forward and Aft Fuel Filter Elements:

NOTE: Fuel control assemblies S6130-63209-041, -042, -043 and -044 contain 10 micron fuel filter elements and do not require fuel filter element replacement unless they are scheduled to be replaced.

(1) Prepare helicopter for maintenance.

(2) Turn off all electrical and hydraulic power.

(3) Locate fuel control assembly.

(4) Replace 40 micron fuel filter element (52-0505-2) and old packing (MS29513-140) with 10 micron fuel filter element (AM52-01064-1) and new packing (MS29513-140). Refer to Applicable Maintenance Manual.

(5) On fuel filter identification plate, cross out existing fuel filter part number 52-2145-009 (S6130-63072-001) and reidentify fuel filter as 52-2145-014 (S6130-63072-002) using vibro-peen method or best shop practice.

(6) Using rubber stamp or best shop practice, remove existing part marking on fuel control assembly bracket and reidentify fuel control assembly as follows:

(a) Re-identify fuel control assembly (S6130-63209-001) to S6130-63209-041.

(b) Re-identify fuel control assembly (S6130-63209-002) to S6130-63209-042.

(c) Re-identify fuel control assembly (S6130-63209-003) to S6130-63209-043.

(d) Re-identify fuel control assembly (S6130-63209-004) to S6130-63209-044.

(7) Prime fuel system. Refer to Applicable Maintenance Manual.

(8) Examine components for security. Make sure area is clean and free of foreign objects before closing access panels/covers.

(9) Return helicopter to service.

B. Record of Compliance

(1) Make an appropriate logbook entry to show compliance with this ASB.

FUEL - Fuel Control Systems - Fuel System Installations - 40 Micron Fuel Filter Element and Packing, One-Time Replacement of

3. ACCOMPLISHMENT INSTRUCTIONS (Continued)

(2) Upon compliance with this Alert Service Bulletin, complete attached ALERT SERVICE BULLETIN COMPLIANCE RECORD CARD and return it to Sikorsky Aircraft.

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A United Technologies Company

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Please complete the form on the reverse side and FAX to
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SIKORSKY AIRCRAFT CORPORATION

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ATTENTION: DIRECTOR
COMMERCIAL CUSTOMER SERVICE

IMPORTANT NOTICE

Upon COMPLIANCE with the attached SB. Sikorsky requests your cooperation in completing and returning by mail or **FAX** this **ENTIRE PAGE.**

Please fill in the requested information at the bottom of the page, so we may maintain proper records documenting the configuration of your aircraft. This information is useful when determining configuration and effectivity of issues affecting fielded aircraft.

This request is in keeping with our policy to assure that our customers receive the latest information applicable for the maintenance of your aircraft. Thank you.

SERVICE BULLETIN: No. 61B28-1 **Compliance Record Card**

TITLE: FUEL - Fuel Control Systems - Fuel System installations - 40 Micron Fuel Filter Element and Packing, One - Time Replacement of

OWNER/OPERATOR: _____

SUBMITTED BY: _____ **DATE** _____

☐ **FOLLOWING SERIAL NUMBERS ARE NOT AFFECTED BY THIS SB**

☐ **SB *HAS BEEN COMPLIED* WITH ON THE FOLLOWING SERIAL NUMBERS**

_____ _____ _____ _____ _____ _____

_____ _____ _____ _____ _____ _____

_____ _____ _____ _____ _____ _____

(Fold Up to Arrows)

From: Garman, Ron (GEAE)
Sent: Wednesday, February 26, 2003 2:29 PM
To: Roach, Roger (GEAE) [redacted]
Subject: RE: Columbia Helicopters: Fuel control filter pressure relief valve

Thanks, please let me know by when, when you have a chance.

Ron

-----Original Message-----
From: Roach, Roger (GEAE)
Sent: Wednesday, February 26, 2003 5:16 PM
To: Garman, Ron (GEAE)
Subject: RE: Columbia Helicopters: Fuel control filter pressure relief valve
Importance: High

I will

-----Original Message-----
From: Garman, Ron (GEAE)
Sent: Wednesday, February 26, 2003 1:39 PM
To: Roach, Roger (GEAE)
Subject: Columbia Helicopters: Fuel control filter pressure relief valve
Importance: High

Roger,

Can we move this one up on the priority list? Case 1-23800774, created 17 Jan 2003.

Regards,

Ron Garman

---Original Message---
From: Bob Neihart [mailto [redacted]
Sent: Wednesday, February 26, 2003 12:58 PM
To: Ron Garman (E-mail)
Subject: FW: Fuel control filter pressure relief valve

Ron,

Never got a response from you on this subject. Was there any plan to create a case? Ontic will be here next week. I can bring this subject up to them. This may be a very big problem. We have had several engines fail to accelerate when collective is applied. The problem has been traced to contamination that sticks the PRV valve in the fuel control. I consider

this a flight critical problem. This problem normally occurs at the worst possible time.

Bob Neihart Ph. # [redacted]
Engine Shop Supervisor Fax 503 678 5841
Columbia Helicopters, Inc. [redacted]
[redacted]

---Original Message---
From: Bob Neihart
Sent: Friday, January 03, 2003 1:23 PM
To: Ron Garman (E-mail)
Subject: Fuel control filter pressure relief valve

Ref: SEI 181 73-10-0 page 44 Figure 1. Items 32, 33, 34, 35

Ron,

Over the years we have had many unscheduled fuel control/engine removals due to failure to accelerate or fluctuation. We have found small amounts of contamination in the fuel control pressure regulating valve causing it to stick. We do not know where the contamination is coming from. Most of the time the filter is clean and in good condition.

We have thought of one possibility of how the contamination is getting into the control. The fuel filter bypass valve is the same design, other than a radius change, (SB 73-40) since the control was initially designed. The engine has increased substantially in fuel flow and fuel pressure. We think that these increases may be causing the bypass valve to open even with a clean or partially dirty filter. Maybe they should look at increasing the amount of ?P allowed across the bypass valve.

Bob Neihart Ph. # [redacted]
Engine Shop Supervisor Fax 503 678 5841
Columbia Helicopters, Inc. [redacted]
[redacted]

From:	Gridley, David (GEAE) <[redacted]
Sent:	Thursday, September 11, 2003 11:13 AM
To:	Roach, Roger (GE Infra, Aviation, US) <[redacted]
Cc:	Garman, Ron (GE Infra, Aviation, US) [redacted]; Beaston, Chuck (GE Infra, Aviation, US) <[redacted]
Subject:	
Attach:	Hayes S61 fuel contam.xls

Roger,
Further to our discussion yesterday at the CT58 Operators Conference, I have attached my summary of the contaminants found in an S-61 fuel system from a recent incident. This incident occurred on a Hayes S-61N (CT58-140 engines) that was performing an engine performance check flight in Dec 2002. The helicopter experienced a loss of power to the main rotor and had to make an emergency 'run-on' landing on an empty highway. The flight crew experienced some trauma during the rough landing.
The No 1 engine is suspected of initially shutting down for mechanical problems unrelated to the fuel system. The TSB of Canada suspects that, when a higher sinlge-engine power was demanded of it, the No 2 engine may have experienced some power flucutation problems due to a 'sticking' PRV in its FCU. This fuel control unit (part no 725725-5, serial no 82827BR) appeared externally to be in good condition. The TSBC later assembled this FCU (along with the #2 engine's fuel flow divider, CFP and SVA) to a slave CT58 engine and ran it in the ACRO test cell, with no operational anomalies observed. However, subsequent bench testing and teardown of this FCU by an approved USA facility revealed a 'sticking' PRV. It was reported by TSBC that the PRV was found to be contaminated with debris as described in the attachment, which also summarizes the debris found in the airframe and FCU fuel filters. This debris may have resulted in an excessive delta pressure across the FCU filter, causing it to go into bypass thus allowing these contaminants to flow further downstream to the PRV. The aft fuel tank had been removed, repaired and replaced about 3 weeks before the incident. No similar contaminants were found anywhere in the No 1 engine fuel system.
<<Hayes S61 fuel contam.xls>>
As you heard yesterday, the No 2 engine's PRV may still be available from Hayes for further GE analysis. I will follow-up on this next week when everyone has returned from the Ops Conference. I will also contact TSBC to see if they would allow GE to analyze the contaminants that they recovered from the filters, if they still have them.
David Gridley,
GE Flight Safety Investigator.
Phone:[redacted]
Fax: 781-594-0542.

HAYES S-61N (C-FHHD); AIRCRAFT TO No 2 ENGINE FUEL SYSTEM

	A	B	C	D	E
1		AFT FUEL TANK	AIRFRAME	FCU	PRESSURE
2	CONTAMINANTS	BOOST PUMP	FUEL FILTER	FILTER	REG VALVE
3					
4	Particle Chip Board	Yes	Yes		Yes
5					
6	Cellulose	Yes	Yes	Yes	Yes (bleached)
7					
8	Paint	Yes	Yes	Yes	Yes
9					
10	Silk	Yes	Yes		
11					
12	Human hair	Yes	Yes	Yes	
13					
14	Polyethylene	Yes	Yes		
15					
16	Fibres			Yes	
17					
18	Metal				Yes
19					
20					
21	COMMON:	Cellulose; paint; human hair (FCU filter); particle board (PRV).			
22					
23	NOT IN ENGINE:	Silk; polyethylene.			
24					
25	ENGINE ONLY:	Metal found only in PRV. Fibres found only in FCU filter.			

Don Berg

From: Dave Wolf [redacted]
Sent: Tuesday, November 25, 2003 9:39 AM
To: Don Berg
Subject: FW: FCU filter

> -----Original Message-----
> From: Dave Wolf
> Sent: Thursday, November 06, 2003 12:20 PM
> To: [redacted]
> Cc:
> Subject: FCU filter
>
> Ron,
>
> I would like to add Carsons experience regarding the FCU filter
> element problem that was discussed by Bob Neihart of Columbia
> Helicopters at the GE CT58 conference. Thru Sept of 2003 we have had 2
> FCU's that after removal for erratic operation were found to have been
> in full bypass with the PRV contaminated when torn down by Columbia.
> One has a TSO of 695.2 and the other 3415.5. For previous years I know
> that we have had a minimum of seven FCU's with clogged PRV's but I
> cannot supply any data other then our collective memory.
> In August 2002, after we had replaced a few FCU's for surging and
> contamination, we elected to change the FCU filter elements every 50
> hrs of operation instead of the 150 hr period as stated in the
> Sikorsky inspection program. We decided on this time period after
> talking with Bob Neihart who told us that they change theirs every 5 days.
> We have never been able to determine exactly what the contamination is
> and in conversations with Don Burk at Columbia it seems that it is
> mostly a gritty substance. We have ruled out contaminated fuel because
> of the filters that we use on our tankers and that we never had an
> instance of both FCU's on the same helicopter being affected within
> any applicable time frame.
> Also, the 40 micron airframe fuel filter has been inspected after each
> FCU replacement along with a visual internal inspection of the fuel
> cell and we have never found any contaminates in either. We have also
> inspected the centrifugal fuel filter with the same results.
> Other than the loss of income to our company when we lose the
> helicopter services for a day or so there is the possibility of an
> in-flight problem which could have an adverse effect. We understand
> that the Hayes incident has been attributed to the inability of an
> engine to perform properly when the other engine experienced a mechanical problem.
> We strongly suggest that GE investigates these FCU/PRV contamination
> incidents.
>
> David Wolf
> Chief Inspector
> Carson Helicopters Inc

COL 2886

From: Roach, Roger (GEAE)
Sent: Friday, October 8, 2004 11:39 AM
To: Garman, Ron (GEAE) [redacted]
Cc: Beaston, Chuck (GEAE, FieldRep) [redacted] Otis, Doug (GEAE) [redacted]
Subject: RE: CT58 Main Fuel Control Removals and Contamination

Ron , Chuck , here are some common questions that may want to be asked during Chucks visit and some comments. I am sure you have already asked many of them. I will also be available next week to telecon if necessary.

- If the removals are excessive in only the past few months , then what in the environment has suddenly changed ?
- New fuel source/supplier ?
- New service shop ?
- Change in fuel type?
- New AC filter batch?
- New Filter bypass valves or seals or indicators?
- Change in technicians?
- New supplier for hardware?
- Wrong settings on filter relief valves? Have they been tested?
- Is somebody suddenly trying to follow the instructions after years of doing it differently ... the right way?
- What is TSO on units experiencing problem?
- What is the official lab analysis input on the contamination type found?
- Where in the fuel control is the contamination found ?
- Has there been confirmation of the FCU malfunction as a result of the contamination? DID the FCU undergo testing on the test bench prior to taking it apart to find the contamination? And did it pass the ATP testing?
- Is there similar contamination found in other fuel components upstream of the FCU? Down stream ?
- What type and what level of contamination is found in the AIRCRAFT filter?
- Did the AC Filters undergoes testing to determine ACTUAL operating delta P's and status of bypass prior to taking them apart?
- Have the fuel suppliers equipment been tested for levels of contamination?
- What are some of the common denominators in each of the units failed ? Same fuel source? Same maintenance crew? Same overhaul shop? Same contamination type?
- What is the operating environment of the mission of the AC? Hot / Cold days, icing of the fuel?

-----Original Message-----
From: Garman, Ron (GEAE)
Sent: Wednesday, October 06, 2004 12:17 PM
To: Roach, Roger (GEAE)
Cc: Beaston, Chuck (GEAE, FieldRep); Otis, Doug (GEAE)
Subject: CT58 Main Fuel Control Removals and Contamination

Roger,

Ref this morning's SRD meeting, please see attached report received today from GE FSR Chuck Beaston. Era Aviation is an S-61 operator out of Louisiana. Let's get a list of any questions

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together in time for Chuck's visit to Columbia.

Regards,

Ron Garman

CT58
ERA Aviation
Met with VP of Maintenance, Mark Jones, and discussed engine program as well as S-92 expectations. CT58 Main fuel control removals have been excessive in the last few months. Various contamination issues have been discussed to resolve removal rate. Will be visiting vendor (Columbia) to discuss probable causes.

From: Garman, Ron (GEAE)
Sent: Friday, October 15, 2004 10:09 AM
To: Gridley, David (GEAE) [redacted]
Subject: FW: SRD A-PROJ-04-01 PRV Closeout.doc;SRD A-PROJ-04-02 PRV Closeout.doc
Attach: SRD A-PROJ-04-01 PRV Closeout.doc;SRD A-PROJ-04-02 PRV Closeout.doc

David,

Please find SRD closeouts attached, ref our discussion yesterday.

Regards,

Ron Garman

-----Original Message-----
From: Maloney, Daniel (GEAE)
Sent: Wednesday, October 13, 2004 4:16 PM
To: Garman, Ron (GEAE)
Cc: Hayes, William (GEAE)
Subject: FW: SRD A-PROJ-04-01 PRV Closeout.doc;SRD A-PROJ-04-02 PRV Closeout.doc

Ron-
ESDI has reviewed the attached SRD Close-out Reports, and they are acceptable.
The referenced Hamilton Internal Correspondence and Lab Analysis FI-04-56 is available at LN 001 STNFOR/Roach.
Please review reports and provide feedback by Monday, October 18.
SRD will be remain on our spreadsheet until you provide a copy of your letter to the customer. Please do so by October 20.

Dan Maloney
T700/CT7/T58/T64 SRD Administrator
240B5, Ext 4-3511

-----Original Message-----
From: Roach, Roger (GEAE)
Sent: Wednesday, October 13, 2004 2:00 PM
To: Maloney, Daniel (GEAE)
Cc: Abraham, Joe (GEAE); Dunn, Francis (GEAE); Babbitt, Daniel (GEAE)
Subject: SRD A-PROJ-04-01 PRV Closeout.doc;SRD A-PROJ-04-02 PRV Closeout.doc

Dan , Case Closed . The attached files are the closeouts for the A-PROJ-04-01 and -02 SRD's. These files are not in the shared folder. I will be adding these closeout notices to my eDRB A1.24 Volume 25 Study 3.

SRD A-PROJ-04-01 PRV Closeout.doc;SRD A-PROJ-04-02 PRV Closeout.doc
<<...>> <<...>>

SRD CLOSEOUT NOTICE

TO (SRD ORIGINATOR):	DISTRIBUTION (BEYOND STANDARD SRD DISTRIBUTION LIST):	
R. Garman	Joe Abraham MD24062 Dan Babbitt MD24062 Frank Dunn, MD24062	
SRD NUMBER: A-PROJ-04-001		
TITLE/SUBJECT: FCU Pressure Regulating Valve (Hayes)		PROBLEM CONFIRMED: NO: ☐ YES: ☒
ENGINE MODEL NUMBER: CT58-140-1	ENGINE SERIAL NUMBER: 280324KL	CUSTOMER: Hayes
COMPONENT NAME: Pressure Regulating Valve (part of fuel control unit)	COMPONENT DWG NO: GE (HSD) Fuel Control 6003T91P13 PRV (725725-5)	COMPONENT SERIAL NO: 82827BR

CONCLUSIONS/RESULTS (Root Cause, Testing Performed, Suspect Population, Related Events, Etc):

Results:

The Hayes Valve as received was free to move, appearing to be operating normally, however exhibiting signs of wear. The fuel control filter was not available for examination at the time of this investigation.

Hamilton Internal Correspondence and Lab Analysis FI-04-56 cite silica fibers (fiberglass), and hard angular oxides trapped in the clearance area between I.D. and O.D. of the valve assembly as the cause of the temporary seizure of the Pressure Regulating Valve (PRV). The contamination particle sizes found range in size from 2.5 micron to 25 micron, which have made their way through the fuel control 40-micron filter and into the valve tight clearances. The Valve geometry all meets current drawing dimensional requirements and exhibit slightly higher than normal wear patterns.

Conclusions

The silica fibers were the dominant contaminates found in the valve assembly during inspection and is determined to be root cause of the temporary seizure. The silica fibers and other contaminates passed through the control filter and into the bypass valve. It is not known if the control filter had gone into bypass during operation, but the particle sizes found are small enough to pass through the filter when working normally. Changing of the fuel control filter relief pressure will not keep particles smaller than the filter opening from going through the filter.

The contaminate type found is not normal to the fuel system environment and is believed to have been brought into the fuel system externally, either during servicing of the fuel system hardware or during bypass of an aircraft fuel filter. Validation of the engine fuel control design was not required utilizing this type of contaminate, again as it is not normally part of engine fuel system components, and its performance under these conditions is undetermined. Although the valve design is ~ 40 years old it still meets current valve design standards for this application.

RECOMMENDATIONS (Product Improvements, Field Actions, Part Reuse/Repair, Etc):

The source of the relative abundance of silica (glass) fibers that were found should be investigated; the possible use of a glass fiber filter within the aircraft fuel system would appear to be a logical starting point. It was suggested by Columbia Helicopters that the only possible source of the silica fibers might have come from aircraft fuel piping fireproof coatings. GE recommends that this suggestion be completed. It is also suggested that the aircraft fuel system filtration be reviewed to ensure that adequate measures are in place to minimize risk of bypassing the aircraft barrier filters (10 micron) thus minimizing the size of contaminants that can be carried to the tight clearances within the control and other fuel system components. Operational history on this aircraft has also indicated that the engine centrifugal filter may at times not perform as well as desired. Consideration to a program to improve the Centrifugal Fuel Purifier (CFP) or replace it with a barrier type of element should be re-considered. There are no changes to the fuel control filtration and / or bypass valve being recommended at this time.

Additional Comments: This SRD has been documented in electronic Engineering Design Record Book A1.24 Volume 25 Study 3. Also, see SRD closeout A-PROJ-04-002 for similar finding on same valve design from different operator. It is understood that these two valves and operators had these events in separate operating regions. The only common factors determined during this

investigation is the use of common aerospace fuel system components, fuel type, and the service provided for overhaul by the same source. The findings of the silica fibers in both valve components from two different operating regions remains a concern until its source can be located.

Referenced Hamilton Internal Correspondence FI-04-56 will be retained on file.

Responsible Engineer:	Date:
Roger Roach	10/13/2004
Engineering Systems Mgr:	**Date:**
Frank Dunn	10/13/2004

SRD CLOSEOUT NOTICE

TO (SRD ORIGINATOR):	DISTRIBUTION (BEYOND STANDARD SRD DISTRIBUTION LIST):
R. Garman	Joe Abraham MD24062 Dan Babbitt MD24062 Frank Dunn, MD24062
SRD NUMBER: A-PROJ-04-002	

TITLE/SUBJECT:	PROBLEM CONFIRMED:
FCU Pressure Regulating Valve (Carson)	NO: ☐ YES: ☒

ENGINE MODEL NUMBER:	ENGINE SERIAL NUMBER:	CUSTOMER:
CT58-140-1	Unknown	Carson

COMPONENT NAME:	COMPONENT DWG NO:	COMPONENT SERIAL NO:
Pressure Regulating Valve (part of fuel control unit)	GE (HSD) Fuel Control 6003T91P15 PRV (725725-6)	90030

CONCLUSIONS/RESULTS (Root Cause, Testing Performed, Suspect Population, Related Events, Etc):

Results:

The Carson valve sent to GE was received in the stuck condition. The fuel control filter was not available for examination at the time of this investigation.

Hamilton Internal Correspondence and Lab Analysis FI-04-56 cite silica fibers (fiberglass), and hard angular oxides trapped in the clearance area between I.D. and O.D. of the valve assembly as the cause of the seizure of the Pressure Regulating Valve (PRV). The contamination particle sizes found range in size from 2.5 micron to 25 micron, which have made their way through the fuel control 40-micron filter and into the valve tight clearances. The Valve geometry all meets current drawing dimensional requirements and exhibit normal wear patterns.

Conclusions

The silica fibers were the dominant contaminates found in the valve assembly during inspection and is determined to be root cause of the valve seizure. The silica fibers and other contaminates passed through the control filter and into the bypass valve. It is not known if the control filter had gone into bypass during operation, but the particle sizes found are small enough to go through the filter when working normally. Changing of the fuel control filter relief pressure will not keep particles smaller than the filter opening from going through the filter.

The contaminate type found is not normal to the fuel system environment and are believed to have been brought into the fuel system externally, either during servicing of the fuel system hardware or during bypass of an aircraft fuel filter. Validation of the engine fuel control design was not required utilizing this type of contaminate, again as it is not normally part of engine fuel system components, and its performance under these conditions is undetermined. Although the valve design is ~ 40 years old it still meets current valve design standards for this application.

RECOMMENDATIONS (Product Improvements, Field Actions, Part Reuse/Repair, Etc):

The source of the relative abundance of silica (glass) fibers that were found should be investigated; the possible use of a glass fiber filter within the aircraft fuel system would appear to be a logical starting point. It was suggested by Columbia Helicopters that the only possible source of the silica fibers might have come from aircraft fuel piping fireproof coatings. GE recommends that this suggestion be completed. It is also suggested that the aircraft fuel system filtration be reviewed to ensure that adequate measures are in place to minimize risk of bypassing the aircraft barrier filters (10 micron) thus minimizing the size of contaminants that can be carried to the tight clearances within the control and other fuel system components. Operational history on this aircraft has also indicated that the engine centrifugal filter may at times not perform as well as desired. Consideration to a program to improve the Centrifugal Fuel Purifier (CFP) or replace it with a barrier type of element should be re-considered. There are no changes to the fuel control filtration and / or bypass valve being recommended at this time.

Additional Comments: This SRD has been documented in electronic Engineering Design Record Book A1.24 Volume 25 Study 3. Also, see SRD closeout A-PROJ-04-001 for similar finding on same valve design from different operator. It is understood that these two valves and operators had these events in separate operating regions. The only common factors determined during this investigation is the use of common aerospace fuel system components, fuel type, and the service provided for overhaul by the same source. The findings of the silica fibers in both valve components from two different operating regions remains a concern until its source can be located.

Referenced Hamilton Internal Correspondence FI-04-56 will be retained on file.

Responsible Engineer: Roger Roach	Date: 10/13/2004
Engineering Systems Mgr: Frank Dunn	Date: 10/13/2004

Don Berg

From: Bob Neihart
Sent: Friday, July 25, 2003 2:15 PM
To: Ron Garman (E-mail)
Cc: Don Berg
Subject: Questions for CT58 conference

- [redacted]
- We would like to discuss inadvertent bypass of the fuel control filter and the lack of any test procedure for the bypass poppet.
- [redacted]
- The fuel control filter is a 40 micron filter. This is equal to .00156". The clearance between the Pressure regulating valve and sleeve is .0004"-.0008". Fuel leaving the filter is routed directly to the PRV. It is very common to see fuel controls with stuck PRV's. This is a cause for engines to fail to accelerate during collective inputs.
- [redacted]

Bob Neihart
Engine Shop Supervisor
Columbia Helicopters, Inc.
Ph. # [redacted]
Fax 503 678 5841
[redacted]

General Electric visit on 3-14-05

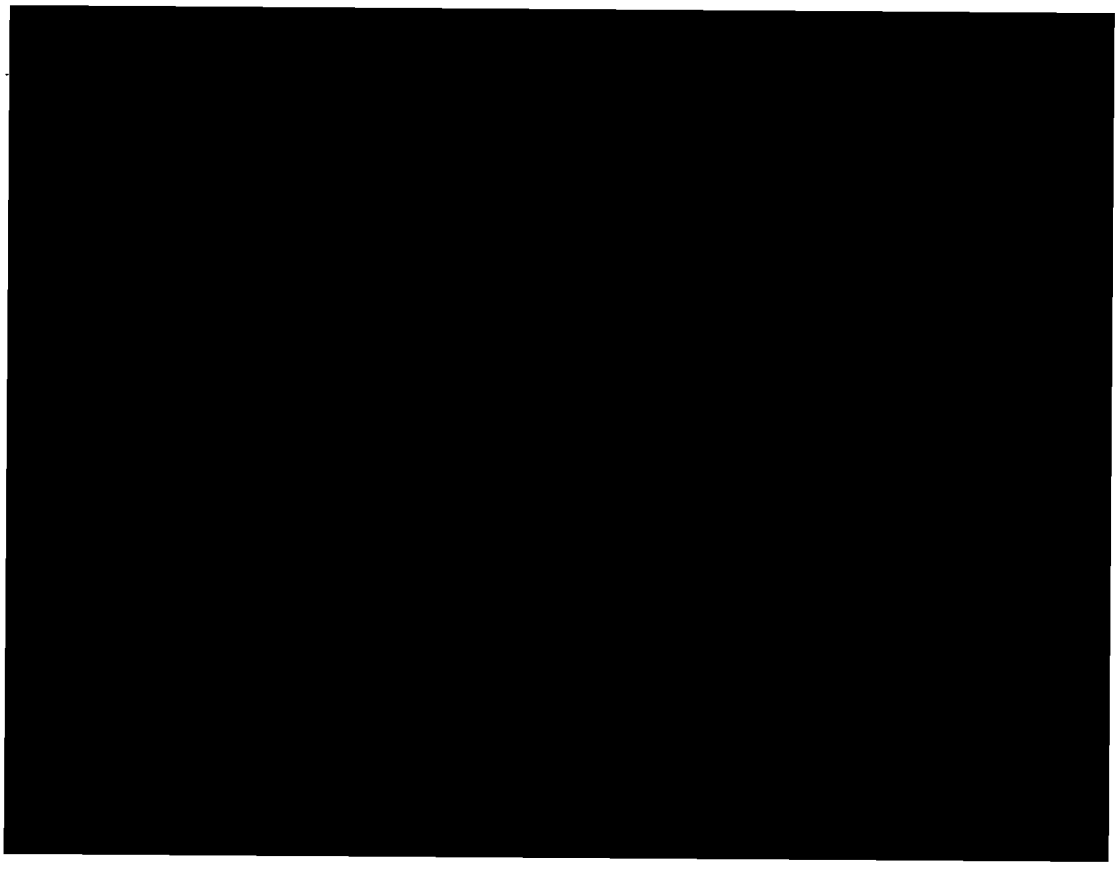
Attendees from General Electric
Ron Garmon International Program Manager
Harry Nahatis Program Director
Doug Otis Engine Systems Design & Integration Program Leader
Chuck Beaston Field Representative

Attendees from Columbia Helicopters
Greg Weinfurter, Don Berg, Chris Hansel, Chris Hankland, Bob Neihart.

GE personnel were given a tour of the shops.

Meeting started off with a discussion of open service requests that Columbia Helicopters has with General Electric.

Inadequate fuel control fuel filter and bypass valve. General Electric has not done any work on this. It appears that they are not very interested even though we feel that this has caused several fuel control contamination's' causing engines not to accelerate.



SERVICE REVEALED DIFFICULTY

(WORK REQUEST)

SRD Request Number	
A-7790-F06-GN-006	
Authorizing Document Number	
EFS WA111635-0	

Title	Engine Line - Model
CT58 Carson Stuck PRV SRD	CT58-140-1

Funding Source	Project Code / RI	Contract Code	DAN List Comment
T58 EAPS SRD Investigation	10 / JBAA	TFZ	**R3650**

I. BACKGROUND:

Customer	ESN	Part Name	
Carson	S/N 285-293	Valve assembly, pressure regulating	
Part Number	**Serial Number**	**Part TSN**	**Part CSN**
Piston P/N 543457	FCU S/N 72834	unknown	unknown

II. EVENT DESCRIPTION:

Engine operated by Carson Helicopters was removed for fluctuations of Ng, T5 and torque on April 11, 2005. Subsequent fuel control overhaul at Columbia Helicopters found the PRV stuck. . Pressure regulating valve of fuel control P/N 6003T91P13, S/N 72834. Piston P/N 543457 is stuck in sleeve P/N 734913-1. The time is not tracked on the piston and sleeve, but the time on the Fuel Control Assy is TSO:4710.7 and a LOH was accomplished at a TSO of 3415.5.

III. ADDITIONAL BACKGROUND INFORMATION:

PRV sticking has been seen before, most recently due to glass fibers between the sleeve and piston of undetermined origin.

IV. PROVIDE: A. PROBLEM CAUSE DEFINITION B. RECOMMENDED CORRECTIVE ACTION C. CLOSEOUT REPORT D. HARDWARE DISPOSITION
(Project to indicate which of the above are required, and any additional requirements below)

Please provide A, B and C above.

V. HARDWARE DISPOSITION (Hardware location, shipment details, repair instructions, etc.):

Hardware was delivered to M.A. Folkes Company, Hamilton, Ohio. Destructive evaluation is authorized. Customer does not want the hardware returned. At the end of the investigation, return the hardware to M.A. Folkes Company for scrap.

To:	Requested Closeout Date (consistent with 24 day turntime)
M. Nagy-Wentz/Roger Roach	2/28/06

Originator	Date	Phone
D. Otis	January 5, 2007	1921

Distribution

T58 SRD Distribution: R. Garman, D. Maloney

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> From: Garman, Ron (GE Infra, Aviation, US)
> Sent: Friday, April 07, 2006 8:45 AM
> To: Bennett, Dave (GE Infra, Aviation, US)
> Subject: Carson Helicopters: FCU / PRV contamination
>
>
> Dave,
>
> Info.
>
> Regards,
>
> Ron Garman
>
> -----Original Message-----
> From: Dave Wolf [mailto:[redacted]
> Sent: Friday, February 17, 2006 3:28 PM
> To: TRANS Customer Support Center (GE Infra, Aviation)
> Subject: FCU / PRV contamination
>
>
>
> Recently we had removed a FCU for Ng fluctuations and sent it to
> Columbia for O/H where they discovered the PRV was stuck due to
> contamination. The TSO on this FCU is 4495.2 and it had been light
> O/H'ed at TSO 4146.9. This is the fourth instance of FCU fluctuations
> and of finding the PRV contaminated, even though we remove the FCU
> filter every 30 hrs of operation. We have operated the S-61 for over
> 30 years and up to about 5 years ago we have never experienced any
> type of FCU contamination. Even though GEAE looked at this problem
> previously with a PRV from one of our FCU's we wish to strongly stress
> that we believe there is a problem with the fuel filtering regarding
> this system.
>
> David Wolf
> Chief Inspector
> Carson helicopters, Inc

SRD CLOSEOUT NOTICE

TO (SRD ORIGINATOR):	DISTRIBUTION (BEYOND STANDARD SRD DISTRIBUTION LIST):	
R. Garman	Scott Snyder, MD24062 Marty Nagy-Wentz MD24062	
SRD NUMBER: A-7790-F06-GN-006		
TITLE/SUBJECT: CT58 Carson Stuck PRV SRD		PROBLEM CONFIRMED: NO: ☐ YES: ☒
ENGINE MODEL NUMBER: CT58-140-1	ENGINE SERIAL NUMBER: S/N 285-293	CUSTOMER: Carson
COMPONENT NAME: Valve assembly, Pressure Regulating (part of fuel control)	COMPONENT DWG NO: GE (HSD) GE Fuel Control 6003T91P13 Hamilton PRV Piston P/N 543457 Sleeve P/N 734913-1	COMPONENT SERIAL NO: Fuel Control S/N 72834 Valve not serialized

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CONCLUSIONS/RESULTS (Root Cause, Testing Performed, Suspect Population, Related Events, Etc):

The time is not tracked on the piston and sleeve, but the time on the Fuel Control Assy is TSO:4710.7 and a LOH was accomplished at a TSO of 3415.5.

Results:
The Carson valve sent to GE was received in the stuck condition. The fuel control filter was not available for examination at the time of this investigation.

Hamilton Internal Correspondence and Lab Analysis FI-07-11 cite silica fibers (fiberglass), and hard angular oxides trapped in the clearance area between I.D. and O.D. of the valve assembly as the cause of the seizure of the Pressure Regulating Valve (PRV). Mineral oxides of silicon, aluminum, calcium and magnesium, as well as iron-based fines, were also detected. Potassium was found to co-exist with the oxides, but this unusual combination was not explainable.

The contamination particle sizes found range in size from 2.5 micron to 25 micron, which have made their way through the fuel control 40-micron filter and into the valve tight clearances. The Valve Piston O.D. was measured to be within original drawing requirements and the Valve Sleeve I.D. was just over drawing limit by .0007" and exhibit normal wear patterns. Valve material also meets current drawing requirements.

Additional Related Findings:

A sample PRV Diaphragm was sent to GE from Columbia Helicopters for analysis of the fiber's in the Nylon Backing for the Buna-N elastomer. The analysis came back negative for Silicon Fibers however Columbia included another contamination sample from a non-event related PRV from the same operator (Carson). The second contamination sample was analyzed in the Chemistry Lab at GE Aviation in Lynn and reported the same findings as the original sample analyzed by Hamilton. This finding stimulated further discussion with Columbia where it was reported by Columbia that the contamination in this configuration PRV was typical to find but not in this quantity. Columbia added that the Carson PRV's typically have higher levels of contamination than other operators. The quantity of contamination in the second sample was considered a risk to another potential stuck valve.

Additional discussion included input on the Carson Aircraft Fuel Filtration System. The Carson Filtration system was reported to provide filtering capability down to 40 micron. In other T58 / CT58 applications the Aircraft Fuel System includes filtering capability down to 10 micron. This may support the Columbia findings and input that Carson valves typically come in with higher levels of contamination. The engine fuel filtering system is rated to 40 micron. Additionally, the Silicon fibers found down to 2.5 micron are measured in the diameter of the fiber. The fiber lengths are significantly higher than 40 micron and it ability to pass through the aircraft filter or engine fuel filter are greatly dependent on how it inters the filter (axially or sideways).

These findings are identical to past SRD findings for the same operator as documented in SRD closeout A-PROJ-04-002 dated 10/13/2004.

Conclusions

The silica fibers were the dominant contaminates found in the valve assembly during inspection and is determined to be root cause of the valve seizure. The silica fibers and other contaminates passed through the control filter and into the bypass valve. It is not known if the control filter had gone into bypass during operation, but the particle sizes found are small enough to go through the filter when working normally. Changing of the fuel control filter relief pressure will not keep particles smaller than the filter opening from going through the filter.

The contaminate type found is not normal to the fuel system environment and are believed to have been brought into the fuel system externally, either during servicing of the fuel system hardware or during bypass of an aircraft fuel filter, or through the filter in normal operation for particles smaller than the reported rating of the AC filters. Validation of the engine fuel control design was not required utilizing this type of contaminate, again as it is not normally part of engine fuel system or system components, and its performance under these conditions is undetermined. Although the valve design is ~ 40+ years old it still meets current valve design standards for this application.

Recommendations

The source of the relative abundance of silica (glass) fibers that were found should be closely investigated; the possible use of a glass fiber filter within the aircraft fuel system would appear to be a logical starting point. It was suggested by Columbia Helicopters that the only possible source of the silica fibers might have come from aircraft fuel piping fireproof coatings. GE recommends that this suggestion be followed through.

It is also suggested that the aircraft fuel system filtration be reviewed to ensure that adequate measures are in place to minimize risk of bypassing the aircraft barrier filters and to confirm the filter rating reported to be 40 micron, and further review to incorporate a finer filtration system to bring it up to similar standards with remaining related fuel systems for the T58 applications, thus minimizing the size of contaminants that can be carried to the tight clearances within the control and other fuel system components.

Until the source of the Silicon Fibers has been identified and addressed this failure mode of the PRV remains a High Risk for continued service, particularly for this operator.

Operational history on this aircraft has also indicated that the engine centrifugal filter may at times not perform as well as desired. Consideration to a program to improve the Centrifugal Fuel Purifier (CFP) or replace it with a barrier type of element should be re-considered. There are no changes to the fuel control filtration and / or bypass valve being recommended at this time.

Attention should also be made to the high operating hours (TSO) for this operator and further studies performed to identify if in fact the operator , with this AC environment, is running the unit to end of life.

Additional Comments: This SRD has been documented in electronic Engineering Design Record Book A1.24 Volume 25 Study 11. Also, see SRD closeout A-PROJ-04-001 and SRD Closeout A-PROJ-04-002 for similar finding on same valve design. It is understood that these two valves and operators had these events in separate operating regions. The only common factors determined during this investigation is the use of common aerospace fuel system components, fuel type, and the service provided for overhaul by the same source. The findings of the silica fibers in both valve components from two different operating regions remains a concern until its source can be located.

Referenced Hamilton Internal Correspondence FI-07-11 will be retained on file.

Responsible Engineer: Roger Roach	**Date:** 06/20/07
Engineering Systems Mgr: Marty Nagy-Wentz	**Date:** 06/20/07

CONCLUSIONS/RESULTS (Root Cause, Testing Performed, Suspect Population, Related Events, Etc):

The time is not tracked on the piston and sleeve, but the time on the Fuel Control Assy is TSO:4710.7 and a LOH was accomplished at a TSO of 3415.5.

Results:
The Carson valve sent to GE was received in the stuck condition. The fuel control filter was not available for examination at the time of this investigation.

Hamilton Internal Correspondence and Lab Analysis FI-07-11 cite silica fibers (fiberglass), and hard angular oxides trapped in the clearance area between I.D. and O.D. of the valve assembly as the cause of the seizure of the Pressure Regulating Valve (PRV). Mineral oxides of silicon, aluminum, calcium and magnesium, as well as iron-based fines, were also detected. Potassium was found to co-exist with the oxides, but this unusual combination was not explainable.

The contamination particle sizes found range in size from 2.5 micron to 25 micron, which have made their way through the fuel control 40-micron filter and into the valve tight clearances. The Valve Piston O.D. was measured to be within original drawing requirements and the Valve Sleeve I.D. was just over drawing limit by .0007" and exhibit normal wear patterns. Valve material also meets current drawing requirements.

Additional Related Findings:

A sample PRV Diaphragm was sent to GE from Columbia Helicopters for analysis of the fiber's in the Nylon Backing for the Buna-N elastomer. The analysis came back negative for Silicon Fibers however Columbia included another contamination sample from a non-event related PRV from the same operator (Carson). The second contamination sample was analyzed in the Chemistry Lab at GE Aviation in Lynn and reported the same findings as the original sample analyzed by Hamilton. This finding stimulated further discussion with Columbia where it was reported by Columbia that the contamination in this configuration PRV was typical to find but not in this quantity. Columbia added that the Carson PRV's typically have higher levels of contamination than other operators. The quantity of contamination in the second sample was considered a risk to another potential stuck valve.

Additional discussion included input on the Carson Aircraft Fuel Filtration System. The Carson Filtration system was reported to provide filtering capability down to 40 micron. In other T58 / CT58 applications the Aircraft Fuel System includes filtering capability down to 10 micron. This may support the Columbia findings and input that Carson valves typically come in with higher levels of contamination. The engine fuel filtering system is rated to 40 micron. Additionally, the Silicon fibers found down to 2.5 micron are measured in the diameter of the fiber. The fiber lengths are significantly higher than 40 micron and it ability to pass through the aircraft filter or engine fuel filter are greatly dependent on how it inters the filter (axially or sideways).

These findings are identical to past SRD findings for the same operator as documented in SRD closeout A-PROJ-04-002 dated 10/13/2004.

Conclusions

The silica fibers were the dominant contaminates found in the valve assembly during inspection and is determined to be root cause of the valve seizure. The silica fibers and other contaminates passed through the control filter and into the bypass valve. It is not known if the control filter had gone into bypass during operation, but the particle sizes found are small enough to go through the filter when working normally. Changing of the fuel control filter relief pressure will not keep particles smaller than the filter opening from going through the filter.

The contaminate type found is not normal to the fuel system environment and are believed to have been brought into the fuel system externally, either during servicing of the fuel system hardware or during bypass of an aircraft fuel filter, or through the filter in normal operation for particles smaller than the reported rating of the AC filters. Validation of the engine fuel control design was not required utilizing this type of contaminate, again as it is not normally part of engine fuel system or system components, and its performance under these conditions is undetermined. Although the valve design is ~ 40+ years old it still meets current valve design standards for this application.

Recommendations

The source of the relative abundance of silica (glass) fibers that were found should be closely investigated; the possible use of a glass fiber filter within the aircraft fuel system would appear to be a logical starting point. It was suggested by Columbia Helicopters that the only possible source of the silica fibers might have come from aircraft fuel piping fireproof coatings. GE recommends that this suggestion be followed through.

It is also suggested that the aircraft fuel system filtration be reviewed to ensure that adequate measures are in place to minimize risk of bypassing the aircraft barrier filters and to confirm the filter rating reported to be 40 micron, and further review to incorporate a finer filtration system to bring it up to similar standards with remaining related fuel systems for the T58 applications, thus minimizing the size of contaminants that can be carried to the tight clearances within the control and other fuel system components.

Until the source of the Silicon Fibers has been identified and addressed this failure mode of the PRV remains a High Risk for continued service, particularly for this operator.

Operational history on this aircraft has also indicated that the engine centrifugal filter may at times not perform as well as desired. Consideration to a program to improve the Centrifugal Fuel Purifier (CFP) or replace it with a barrier type of element should be re-considered. There are no changes to the fuel control filtration and / or bypass valve being recommended at this time.

Attention should also be made to the high operating hours (TSO) for this operator and further studies performed to identify if in fact the operator , with this AC environment, is running the unit to end of life.

Additional Comments: This SRD has been documented in electronic Engineering Design Record Book A1.24 Volume 25 Study 11. Also, see SRD closeout A-PROJ-04-001 and SRD Closeout A-PROJ-04-002 for similar finding on same valve design. It is understood that these two valves and operators had these events in separate operating regions. The only common factors determined during this investigation is the use of common aerospace fuel system components, fuel type, and the service provided for overhaul by the same source. The findings of the silica fibers in both valve components from two different operating regions remains a concern until its source can be located.

Referenced Hamilton Internal Correspondence FI-07-11 will be retained on file.

Responsible Engineer: Roger Roach	**Date:** 06/20/07
Engineering Systems Mgr: Marty Nagy-Wentz	**Date:** 06/20/07

From: Gridley, David (GE Infra, Aviation, US) [redacted]
Sent: Wednesday, January 9, 2008 11:13 AM
To: Brunelle, Noelle SIK [redacted]
Cc: Pavia, Michael T SIK [redacted] Rindos, Michael C SIK [redacted]>; Joslow, Marc (GE Infra, Aviation, US) [redacted] Coffin, Brian (GE Infra, Aviation, US) [redacted] Lowenstein, Christopher O SIK [redacted]
Subject: RE: Fw: S-61 Aircraft Fuel Filter Size

Noelle,
The GE safety team has been monitoring this issue since early 2005. As described in the referenced GE letter of Nov 28 2005, GE has become aware of a condition that can cause power fluctuations, erratic operation or slow acceleration of CT58 engines. The condition has been linked to foreign solid contaminants entering and lodging in the engine fuel control pressure regulating valve (PRV), in turn causing the PRV to bind or seize. Since 2002, there have been several reports of abnormal CT58 engine operation related to this condition. One in particular was on a Hayes S-61N during an engine check flight (12/16/02; Lake Errock, BC. Ref. TSBC Report No A02P0320). A whining sound and loud bang were found to have been caused by failure of the helicopter main gearbox #1 input pinion forward bearing, causing the left engine to lose power due to loss of load, overspeed and shutdown.The right engine did not respond to the increased load demand on it from the main rotor, resulting in a hard autorotative landing on a road, with only minor injuries but substantial helicopter damage. This "non-responsiveness" of the right engine was found to have been caused by contaminants (particle chip board, cellulose, paint, metal) within the fuel system reaching the PRV in the engine's fuel control, causing it to bind.
Regards,
David Gridley,
GE Flight Safety Investigator.
Phone: [redacted]
Fax: 781-594-1697.

From: Brunelle, Noelle SIK [mailto:[redacted]]
Sent: Monday, January 07, 2008 9:25 AM
To: Gridley, David (GE Infra, Aviation, US)
Cc: Pavia, Michael T SIK; Rindos, Michael C SIK
Subject: Re: Fw: S-61 Aircraft Fuel Filter Size
Mr. Gridley,
I have received your request for status on the proposed S-61 fuel filter size change from 40 microns to 10 microns. We have reviewed this issue and are curious when GE's position moved from a "recommendation" (GE

letter dated 02/09/07, attached) to a "potential safety issue" (e-mail below), and what drove this change in classification. Any information you could provide would be greatly appreciated.

Noelle Brunelle
H-53 / S-61 / Legacy Models Team
Aviation and Product Safety
Phone: [redacted]
Fax: 203-386-7850
E-Mail: [redacted]

"In theory there is no difference between theory and practice. In practice there is."

-----Original Message-----
From: Lowenstein, Christopher O SIK
Sent: Friday, November 09, 2007 9:30 AM
To: Brunelle, Noelle SIK
Subject: Fw: S-61 Aircraft Fuel Filter Size

Noelle-
Can you please take this action?
Thanks!
Chris

----- Original Message -----
From: Gridley, David (GE Infra, Aviation, US) <[redacted]
To: Lowenstein, Christopher O SIK
Sent: Fri Nov 09 09:05:15 2007
Subject: S-61 Aircraft Fuel Filter Size

Hi Chris,
How are you? Sikorsky keeping you busy, I hope? Need your help please to clarify the status of a potential safety issue.
The GE Safety team has been tracking an issue for some time now relating to S-61 aircraft fuel filter size. This issue relates to possible contamination of the CT58's fuel control pressure regulating valve (PRV), which can cause it to stick, resulting in engine power fluctuations. Back in April 2006, Sikorsky notified GE that there were two S-61 aircraft filter configurations - 10-micron and 40-micron. At the 2006 CT58 Operators Conference the operators were advised to use the finest mesh aircraft fuel filter approved by Sikorsky. In April 2007, Sikorsky advised that they were working approval of a 10-micron filter as an alternative to the 40-micron filter (from a new supplier, no longer made by the old filter suppliers??). The last status update from Sikorsky was on 8/14/07 (Mike Rindos), when it was reported that there

was supplier difficulty in locating engineering data for the 10-micron filters. Could you please advise on the status of this Sikorsky program.
Best Regards,
David Gridley,
GE Flight Safety Investigator.
Phone: [redacted]
Fax: 781-594-1697.

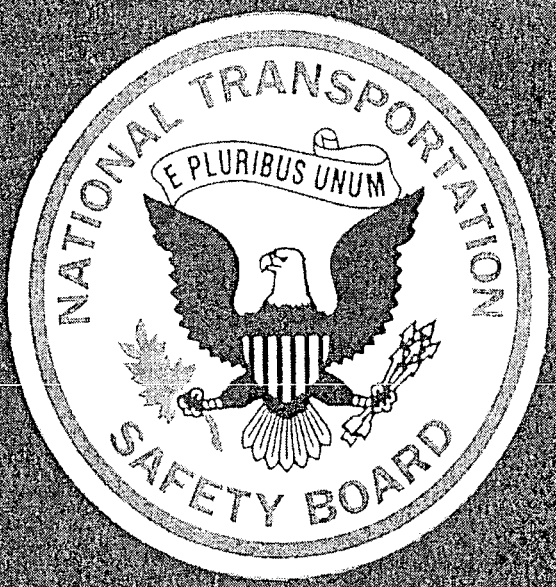
From: Seymour, Patrick (GE Infra, Aviation, US) <[redacted]>
Sent: Wednesday, August 6, 2008 1:31 PM
To: [redacted]
Subject: S-61 10 micron filters

Anthony,

One item we are still tracking on our Safety PMT is incorporation of 10 mic mesh fuel filters. This has been around for a couple of years now, with the last communication from SAC that they were working with new supplier, Honeywell, on this. The contact name given to me was Mike Rindos. Are you aware of the status on this filter? Could you forward this to Mike if not?

Regards,

Patrick Seymour
GE - Aviation
CT58/CT64 Program Manager
[redacted]
F 781 594 1739
[redacted]



ADMINISTRATIVE INVESTIGATION:
LAX08PA259 - WEAVERVILLE, CA

NTSB
National Transportation Safety Board
490 L'Enfant Plaza, SW
Washington, DC 20594-0001
www.ntsb.gov

MEMORANDUM

Date: March 6, 2009

To: Joseph Osterman, Managing Director

From: Michele Beckjord, Senior Project Manager, OHS [redacted]
Christopher Voeglie, Senior Accident Investigator, OHS

Subject: Administrative Investigation: Evidence Custody and Control Issues Regarding the LAX08PA259 Weaverville, California Helicopter Accident Investigation.

We have reviewed the facts and circumstances pertaining to evidence custody and control issues that were alleged to have occurred during the National Transportation Safety Board's Office of Aviation Safety investigation of the Weaverville, California helicopter accident (LAX08PA259) that occurred August 5, 2008. The goal of this administrative investigation was to impartially gather and compile relevant evidence.

In conducting the investigation, we have:

1. Investigated aspects of the evidence custody and control regarding the apparent loss, destruction or misplacement of physical evidence related to the subject accident investigation. We have traveled to the location of the helicopter engine teardown and observed the areas used by the NTSB during the examinations. We have interviewed the relevant NTSB personnel. In addition, we interviewed and obtained voluntary statements from the following:

    a. 3 Carson Helicopters, Inc. employees (Party to the Investigation)
    b. 1 Sikorsky Aircraft Corporation employee (Party to the Investigation);
    c. 1 GE Aviation employee (Party to the Investigation);
    d. 2 U.S. Forest Service employees (Party to the Investigation); and,
    e. 4 Columbia Helicopters, Inc. employees (Contracted Company)

2. This memorandum constitutes our report and discusses the pertinent facts and conclusions regarding the custody and control of evidence in this matter. The conclusions stated in this report are supported by the facts uncovered during the administrative investigation. The report also discusses the facts of the matter in light of the evidence handling procedures for the office involved.

This report is divided into three sections with seven separate attachments:

MEMORANDUM REPORT SECTIONS:

1. A chronological description of the relevant investigative activities of the NTSB team during the LAX08PA259 accident up through the last known location of the reported missing items from the accident helicopter involved in the Weaverville, California accident helicopter.

2. Our findings and conclusions regarding assertions about the NTSB investigations and missing pars in letters submitted by, or on behalf of, Carson Helicopters, Inc. One sent by Carson Helicopters, Inc on September 3, 2008 and the next sent on Carson's behalf by their outside counsel, Dickstein Shapiro, LLC on October 31, 2008.

3. Overall administrative investigation report findings.

MEMORANDUM REPORT ATTACHMENTS:

1. Source: NTSB – Witness Interview Declarations (NTSB personnel), Voluntary Statements (non-NTSB personnel), and Interview Summaries (non-NTSB);

2. Source: NTSB - Airworthiness Group field notes;

3. Source: NTSB - Carson Helicopters, Inc. field notes written by party representative;

4. Source: NTSB - Carson Helicopters, Inc. and Columbia Helicopters, Inc. documents and emails relevant to administrative investigation;

5. Source: NTSB: Carson Helicopters, Inc. handwritten inventory of fuel control unit shipment when boxes opened at Washington, DC headquarters on August 28, 2008;

6. Source: (b)(4)

7. [redacted]

   a. Source:

   b. (b)(4),(b)(6)

SECTION 1: CHRONOLOGY OF EVENTS

Tuesday, August 5 – Wednesday, August 6, 2008

- NTSB notified of accident involving Carson Helicopters, Inc. Sikorsky S-61 near Weaverville, California in remote mountain location. Team launched from: Los Angeles, California; Kailua-Kona, Hawaii, and Washington, DC duty stations to the remote accident site.

Thursday, August 7-10, 2008

- Team worked on-scene (hotel) and at remote accident site. Decision by IIC, NTSB investigators and party representatives to remove the engines from the accident helicopter, then transport them to Columbia Helicopters, Inc. facilities in Aurora, Oregon for examination/inspection.

- All parties agreed to utilize Columbia Helicopters, Inc. under contract to perform the engine and fuel control unit teardown. At the time of the accident, there were only two companies in North America (includes Canada) that serviced the GE Aviation engines (GE no longer supported the engine) on the accident helicopter; only one that serviced the FCU, which was Columbia Helicopters. Columbia Helicopters facility in Oregon is the only one in the Western U.S. that can test and work on the fuel controllers for the subject engine. According to Columbia, they are recognized by General Electric as a designated overhaul facility, and Columbia has adopted the full overhaul repair support responsibility for this engine (the CT/T-58 GE Engine) line following GE's decision to terminate their own factory support in July 1991. This includes the overhaul and repair of all accessories in addition to the basic engine: including the fuel controls.

- Carson Helicopters, Inc. (as a party to the investigation) agreed to Columbia Helicopters, Inc. performing the work. Previously, Columbia had performed work under contract for Carson on the accident helicopter; even though Columbia Helicopters is a direct competitor of Carson Helicopters, Inc.

Monday, August 11, 2008

- Helicopter engines removed from remote accident site, brought to rental truck, secured in locked truck on pallets and covered with tarps. Documentation of custody and control done by photographs of truck, license plate, pallets loaded in truck, and securing padlock.

Tuesday, August 12, 2008

- Engines were transported from the Weaverville, California accident location to the Columbia Helicopters, Inc. facility in Aurora, Oregon by U.S. Forest Service staff. The investigative team consisting of the NTSB Investigator-In-Charge and NTSB investigators along with party representatives from GE Transportation, Sikorsky Aircraft, Carson Helicopters, Inc., and U.S. Forest Service flew aboard a U.S. Forest Service airplane from the accident area in California to Portland, Oregon.

Wednesday, August 13 – Thursday, August 14, 2008

- The team (with all parties present) began the engine teardown and examination. The fuel control units were also examined alongside their respective engines. No discrepancies were noted by the end of the two day examination or during the last day (August 15th) during the debriefing. The missing parts were documented in photographs taken during the inspection process.

- At the end of the day on August 14, the Carson representatives informed the IIC they would be leaving to assist in preparing for a memorial service for their deceased pilot which was scheduled for Saturday morning, August 16th. At this point the team had completed its examinations and expected to dedicate the following day (Friday, August 15th) to finalizing their field notes and conduct an investigative debriefing at Columbia's training trailer. The IIC recalls Carson had promised to fly (in their company airplane) a representative to attend Friday's activities.

- Those present during the engine teardown and fuel control unit examinations are:
    1. NTSB
    2. Federal Aviation Administration
    3. Carson Helicopters, Inc.
    4. GE Aviation
    5. Sikorsky Aircraft Corp.
    6. U.S. Forest Service
    7. Columbia Helicopters, Inc.

Friday, August 15, 2008

- Activities this day began as planned with the finalizing of group notes, discussions and debriefing. All parties were present with the exception of Carson Helicopters. The IIC called the Carson representatives three times during the day to see when they would be arriving and was told each time that someone would be there shortly.

- (b)(6) from GE Aviation was performing calculations related to the fuel flow settings on the fuel control units, following up on calculations he had started near the end of the previous day of 8/14. As the team's discussion in the training trailer progressed, observations began to focus on (b)(6) calculations and results, as well as the fuel control units. The team went back into the workshop and spent some time looking at an exemplar fuel control unit. In the presence of the NTSB IIC, Sikorsky and GE, Mike Hauf removed the left and right engine FCU housings from their respective zip lock clear bags and placed them next to each other on a bench for photo documentation. This did not include the smaller, clear zip lock bags of component parts that had been removed from the main FCU housings. Both the FCU housings remained in the secure workshop area on the designated workbench, each was tagged with the FCU number and corresponding engine number.

- The team then returned to the training trailer and continued their discussions, which now focused on a cam measurement the GE representative (b)(6) had identified. (b)(6) felt that the measurement might be an indication of the engine's power output at the time

of the accident. The group asked the Columbia staff to bring the FCU units and some parts into the training trailer. They pushed some tables together, covered them with butcher paper and spread out the main units. Again, this did not include the smaller, clear zip lock bags containing the corresponding FCU component parts.

- The team concluded their discussion and gathered up their notes and belongings. The IIC asked the Columbia employee (who had been assisting the group) to box the fuel control units in order to ship them to the NTSB in Washington, DC. He also requested the employee to box the engines separately for shipment to the wreckage facility (Plain Parts) in California. The team departed the Columbia Helicopters, Inc. facility around 3pm and headed to their hotel in Portland, OR.

- As related by the Carson representatives during their interview, their employee [redacted] (b)(6) arrived in Portland around 3pm, went to Columbia's Aurora facility and found that the team had finished their work and had departed for Portland. (b)(6) then traveled back into Portland and met with the team for dinner, during which (b)(6) was debriefed on the activities, discussions and findings from the days activities for which (b)(6) did not attend.

Saturday, August 16, 2008

- Team departs Portland, returns to duty stations.

Monday, August 18, 2008

- Carson's (b)(6) [redacted] called the IIC to discuss the activities of August 15th and to discuss the status of the items left at the Columbia Helicopters facility. (b)(6) voiced concerns about the items having remained at Columbia without the NTSB's presence, and they discussed the process of the boxing and shipping of the items.

Wednesday, August 20, 2008 – Friday, August 22, 2008

- NTSB IIC provides shipping addresses to Columbia Helicopters on August 20th. From August 20th – 22nd, Columbia packages engines and fuel control units with videotape and still photographic documentation.

Friday, August 22, 2008

- At 4:13 pm (HST) / 5:13 pm PST / 8:13 pm EST a Columbia representative emailed the NTSB Airworthiness group chairman the tracking numbers and reference numbers for the fuel control units that were shipped that day via FedEx to NTSB in Washington, DC.

- By 7:49 pm HST / 8:49 pm PST / 11:49 pm EST– Carson (b)(6) [redacted] sent an email to M. Hauf requesting it be recorded that "*engines not being packed up at Columbia when we left. We would also request to have a Carson representative on site when the fuel controls arrive to do a visual inspection of the items to ensure they arrived in the same condition as we last saw them in Oregon.*" This email message was sent within 3 ½ hours of the notice sent that Columbia shipped the boxes (and Carson was not included in the email sent directly to NTSB from Columbia).

- This email requesting that the record should reflect that Carson was not present when the parts remained at Columbia occurs one week after Carson's representative, [redacted] was fully advised of the days activities as well as the shipping plans during the debriefing on the evening of August 15th which was conducted in person with the NTSB IIC and team, and included a discussion that the parts were still located at Columbia's facility and not yet shipped.

- Mike Hauf received a cell phone call on August 22nd or August 23rd late in the evening (EST) (between 0730 hours and 0900 hours approximately) from (b)(6) who wanted to discuss Carson's concerns over the events of the 15th including the fact that the FCUs and other parts had been left unsecured and that Columbia was being permitted to gather and ship these items unsupervised.

Tuesday, August 26, 2008

- Boxes containing accident helicopter fuel control units arrive at NTSB headquarters in Washington, DC. Mike Hauf has them secured in the Materials Laboratory and the boxes remain sealed.

Wednesday, August 27, 2008

- Mike Hauf forwards to IIC a confidential letter from Carson Helicopters, Inc (which was undated and without a designated author) requesting the NTSB undertake actions to preserve, secure and obtain important documentary and other evidence "*that is relevant to the investigation in this matter*" and is specifically related to Columbia Helicopters and requesting multiple items related to the engines and fuel control units. The letter also specifically requests to be present at any further disassembly and/or testing of the engines and the fuel controls on the accident aircraft.

Thursday, August 28, 2008

- In the presence of Carson Helicopters, along with other party members in NTSB Washington, DC headquarters, the boxes shipped from Columbia Helicopters containing the accident helicopter fuel control units are opened[1]. Immediately, (b)(6) of Carson vocalizes that "parts are missing". (b)(6) then inventories the parts considered missing, the persons present in the room, and Mike Hauf re-packs the boxes and re-secures them in the Materials lab. The team convened in the conference room and called IIC, Jim Struhsaker to discuss the issue and next steps.

[1] The boxes arrived with indentations and "holes" as described by Mike Hauf in his documentation of the boxes after it was discovered parts were missing. Based on the size of the zip lock plastic bags as well as the component parts missing, NTSB staff and Carson have concluded that the missing parts did not fall out of the box during transport. Carson has acknowledged this (they paid for the shipping and therefore would be responsible for initiating a claim with Federal Express). See Attachment #1 with Carson's voluntary statements regarding their concurrence with this conclusion.

Wednesday, September 3, 2008

- Carson Helicopters, Inc. sends a letter to the NTSB IIC requesting the NTSB conduct an investigation of the events and circumstances related to the handling of the engine fuel control units of the helicopter from the initial disassembly at Columbia Helicopters in Oregon on 13-14 August 2008 to the inspection of those units following their transfer to the NTSB Headquarters in Washington, DC on 28 August 2008.

Thursday, September 25, 2008

- Carson Helicopters, Inc. sends a letter to the NTSB IIC indicating their position that the "mishandling" of evidence needs to be documented and addressed in a full and fair fashion with Columbia by the NTSB.

Friday, October 31, 2008

- Dickstein Shapiro LLP sends letter to NTSB General Counsel requesting an investigation into the events and circumstances surrounding the handling of the fuel control units related to the helicopter involved in the Weaverville, California LAX08PA259 accident.

SUMMARY

The following items were present during the fuel control unit teardown and examinations on August 13th-14th, 2008; however, none of the persons interviewed during this administrative investigation can recall definitively seeing these parts after 1348 hours on August 14th, 2008. The parts were not visible in the videos or still photographs taken by Columbia Helicopters, Inc. documenting their employees boxing up the items to be shipped to the NTSB from August 20th through August 22nd, 2008. While this administrative investigation was able to determine the last known location and time the parts were last photographed, we were not able to pinpoint the exact date or time these parts went missing (or in whose presence they went missing.)

FCU #1:

1. T2 bellows metal cap (Fig.1-8, #540911) *Position Adjusting Cover*
2. T2 bellows snap ring (Fig.11-3, #RRN-75-S) *Internal Retaining Ring*
3. T2 bellows assembly (Fig. 11-6, #543444) *Temperature Sensing Bellows Assembly*
4. Cap Screw near T2 bellows (Fig. 11-4, #574414) *Spring Retainer*

FCU #2:

5. *Internal bellows lever temp sensing* (#571886)

The above list constitutes five of the six missing parts that are the subject of the letters received from, and on behalf of, Carson Helicopters, Inc. The sixth part listed as missing by Carson Helicopters (a Spring Retainer for FCU#2) was determined by the NTSB and party members (including Carson) during the teardown activities to not to have been attached to the FCU#2, it was documented in photo's taken of the accident scene and had not been transported to Columbia Helicopters, Inc.

(End of section)

SECTION 2: ADMINISTRATIVE INVESTIGATION CONCLUSIONS IN RESPONSE TO STATEMENTS CONTAINED WITHIN CARSON HELICOPTER, INC., LETTERS TO THE NTSB

OCTOBER 31, 2008: Letter from Dickstein Shapiro, LLC to NTSB General Counsel

Carson Helicopters, Inc. states:

2. *"Two fuel control units recovered after the accident were disassembled and inspected at Columbia's overhaul facility in Aurora, Oregon and were left bagged and shelved at Columbia on August 15th, 2008."*

Conclusion: Based upon our interviews of the NTSB Investigator-In-Charge, NTSB investigators, party representatives (GE, Sikorsky, U.S. Forest Service), and staff from Columbia Helicopters, Inc., the accident helicopter's two main fuel control units (also referred to as FCUs) were accounted for, both by photographic evidence (see photographic evidence attachment) and through interview statements. However, it cannot be definitively established whether the smaller parts reported as *missing* were actually *present* on August 15th at Columbia Helicopter's facility. The following persons were present on August 15th, 2008 at the Columbia Helicopters, Inc. training trailer facility and were interviewed:

1. NTSB Investigator-In-Charge Mr. James Struhsaker
2. NTSB Airworthiness Group Chairman Mr. Mike Hauf
3. NTSB Operations Group Chairman Ms. Zoe Keliher
4. NTSB Air Safety Investigator Mr. Eliott Simpson
5. GE Aviation Party Representative [redacted]
6. Sikorsky Aircraft Corp. Party Representative [redacted]
7. U.S. Forest Service Party Representative [redacted] (A.M. only)
8. U.S. Forest Service Party Representative [redacted] (A.M. only)
9. Columbia Helicopters, Inc. employee [redacted]
10. Columbia Helicopters, Inc. employee [redacted]
11. Carson Helicopters, Inc. did not provide a representative on 8/15/08.

(b)(6)

The reported missing parts were not specifically handled by the persons interviewed (see above listing). Although none of these interviewees can establish specifically if the parts were present on August 15th, it was established that some of these parts were present and photographed on August 14th, 2008 at 1348 hours. Those persons present on August 14th at 1348 hours were the above listed 10 individuals; in addition, the FAA and at least four Carson Helicopters, Inc. representatives were also present: [redacted]

(b)(6)

3. *"An inspection of these units at NTSB headquarters on August 28, 2008 revealed several irregularities with both of these fuel control units."*

Conclusion: No irregularities were documented regarding the FCUs shipped to NTSB headquarters. When the boxes were opened in the presence of NTSB investigators as well as party representatives, (b)(6) of Carson Helicopters, Inc., reported six component parts were missing, parts that were removed from the main fuel control units during the disassembly and inspection on August 13-14, 2008; however no physical irregularities were noted with the received FCUs or accompanying component parts when the boxes were opened.

4. *Many parts critical to any analysis of the role these fuel control units played in the accident were missing from the units shipped by Columbia to NTSB Headquarters.*

Conclusion: While the letter sent October 31 from Dickstein Shapiro, LLC failed to provide any detail or specifics as to what the alleged missing parts are, the letter sent from Carson Helicopters, Inc. directly to the NTSB Investigator-in-Charge on September 3, 2008 did itemize parts Carson considers "missing". It cannot be assumed that the Dickstein Shapiro letter is referencing any or all of the same parts. However, for purposes of detailed discussion as to the critical nature of the parts to the accident causation analysis, below is the list of parts labeled by Carson's (b)(6) during the inspection of the boxes at NTSB headquarters on August 28, 2008 [Carson provided part numbers and part nomenclature as shown in italics in a February 19, 2009 email]:

FCU #1:

1. T2 bellows metal cap (Fig.1-8, #540911) *Position Adjusting Cover*
2. T2 bellows snap ring (Fig.11-3, #RRN-75-S) *Internal Retaining Ring*
3. T2 bellows assembly (Fig. 11-6, #543444) *Temperature Sensing Bellows Assembly*
4. Cap Screw near T2 bellows (Fig. 11-4, #574414) *Spring Retainer*

FCU #2:

5. *Internal bellows lever temp sensing* (#571886)
6. Cap screw near T2 bellows (Fig.11-4, #574414) *Spring Retainer* [2]

5. *The boxes shipped to NTSB Headquarters also contained additional parts that were not present when the units were initially disassembled in Columbia' overhaul facility, and other parts had been switched between the two containers.*

Conclusion: In reference to statement #5 and the "additional part," there was only one additional exemplar phenolic dust cap (Parts Catalog nomenclature is Position Adjusting Cover, part #540911) sent in the boxes by Columbia. This part was present during the August 15th, 2008 debriefing discussions with NTSB investigators and other parties to the investigation. Columbia produced an exemplar for viewing as well as being included in items set aside for shipment to the NTSB. Asking for exemplar parts for inspection and future comparison purposes is routine

[2] FCU#2 *Spring Retainer* was documented by the group as not having been attached to the fuel control unit and was not available during the teardown at Columbia. See page 10 for more detail.

during NTSB accident investigations in which original parts are destroyed in the accident due to damage, submersion, fire or other causes. Carson did not have a representative available on this day and therefore did not have knowledge of this part being requested by the NTSB.

Conclusion: Carson referred to one specific "missing" part (see Item #6 on page 9), the FCU#2 *Spring Retainer* was documented by the group as not having been attached to the fuel control unit at Columbia. The team determined the part had been documented in a photograph taken at the accident site which shows the part located under engine #2 and still embedded in debris and the aircraft firewall. That specific FCU internal component was not removed from the scene when the engines (with the FCUs still attached) were flown by helicopter from the accident site. Documented in the field notes taken by Carson Helicopter's (b)(6) was that several FCU#2 parts were missing during the examination at Columbia. This information was included in the final NTSB group field notes which Carson Helicopters' Party Representative (b)(6) signed his concurrence.

6. *We are very concerned about the manner in which these fuel control units were handled. Columbia's conduct with regard to these fuel control units raises serious questions about the handling and chain of custody of the fuel control units which may have a material effect on the NTSB's investigation into the cause of the accident.*

Conclusion: This statement pertains to a fuel control unit that had been removed by Carson previous to the accident and sent to Columbia Helicopters, Inc. for overhaul (approximately May of 2008). This fuel control unit was not inspected or examined by the NTSB while at Columbia's facility and the NTSB did not take custody at any time of this specific unit and the condition of this fuel control unit and all parts were not under the NTSB control at any time in this investigation. Therefore, this issue is outside of this administrative investigation's purview. See response to the letter sent from Carson Helicopters to the NTSB Investigator-In-Charge on September 25, 2008 on page 12 that specifically refers to this fuel control unit.

SEPTEMBER 3, 2008: Letter from Carson Helicopters, Inc. to NTSB Investigator-In-Charge

Carson Helicopters, Inc. states:

1. *The units appear to have been altered from the condition they were in on 15 August 2008, as verified by NTSB witnesses and photographs taken when the units were disassembled at Columbia helicopters.*

Conclusion: We have no evidence that the units were altered from the condition they were in on August 15, 2008. We have interviewed all NTSB investigators and party representatives present on August 15th (excluding Carson as they did not provide a representative on that date) and no one has stated that the fuel control units and parts that did arrive in Washington, DC were in a different or altered state from their physical appearance on August 15th, 2008.

2. *As you know, the fuel control units are directly relevant to the NTSB's investigation of the cause of the accident and, in particular, whether one of the engines lost power and that inquiry has not been concluded.*

Conclusion: Carson Helicopters, Inc. has maintained in their letters to the NTSB and subsequent team meetings that the engines and fuel control units are relevant to the cause of the accident and that without the missing parts the actual cause of the accident will no longer be possible as any further analysis of the parts cannot be performed. However, the following interviewed personnel (NTSB, GE Aviation, Sikorsky Aircraft, and U.S. Forest Service) all attest that the preliminary discussions held in the workshop as well as the training trailer on August 14th as well as August 15th were focusing on a cam measurement that the GE representative had identified. He felt the measurement might be an indication of the engine's power output at the time of the accident.

According to the IIC, there was not a specific discussion on August 15th regarding the parts that are now missing as they were not thought to be central to the accident because the theory about their effect on the fuel control unit's normal operation had been discounted by the end of the day on August 14th. The clear, zip lock bag labeled with the parts for FCU#1 was not handled by the team on August 15th. Further work performed since August 15th, 2008 by the team has analyzed the additional factual evidence with the on-scene examination findings, and the lack of access to the missing fuel control units have not prevented the team from making analytical determinations related to the accident engines and fuel control units.

3. *Accordingly, we respectfully request that the NTSB conduct an investigation of the circumstances related to the handling of the fuel control units, including the chain of custody and control of the units from disassembly at Columbia Helicopters in Oregon to inspection of the units in Washington, DC, to determine why their condition upon receipt at the NTSB lab was significantly different from what existed upon conclusion of the initial tear down on 15 August 2008.*

Conclusion: The NTSB has determined that the condition upon receipt of the main fuel control units and condition of received parts were not in a significant different condition from that which existed at the conclusion of the teardown on August 15th, 2008.

SEPTEMBER 25, 2008: Letter from Carson Helicopters, Inc. to NTSB Investigator-In-Charge

Carson Helicopters, Inc. sent a letter to the NTSB IIC to update the NTSB on the status of a fuel control unit that had been removed from the accident aircraft in May of 2008, prior to the August 5, 2008 accident. According to Carson, the unit had been removed from the aircraft and sent to the Columbia Helicopters, Inc. repair facility for inspection and overhaul. After the August 5, 2008 accident and during the fuel control unit examination August 13-14, 2008 at Columbia Helicopters, Carson states the NTSB requested this fuel control unit be sent to Hamilton Sundstrand in Connecticut for examination when the NTSB and party representatives were going to be there examining the two fuel control units that had been on the aircraft at the time of the accident. However, at no time did the NTSB examine, inspect, teardown or take custody or control of this 3rd fuel control unit while at Columbia Helicopters in August 2008. In the September 25, 2008 letter to the NTSB, Carson asserts the following:

> *this type of handling of extremely expensive and sensitive part is, at the very least, highly irresponsible; combined with the known issues concerning Columbia's botched return of the earlier accident fuel control units (documented by NTSB reports and photos and our letter to you of 3 September 2008), we are very disturbed by the consistent pattern of damage and mishandling of parts by Columbia.*

Conclusion: Because this 3rd fuel control unit was not received as evidence by the NTSB, nor did the NTSB take custody or control of the unit, the assertions made by Carson in the September 25, 2008 letter were not under the purview of this administrative investigation.

(End of section)

SECTION 3: FINAL ADMINISTRATIVE INVESTIGATION REPORT FINDINGS

1. The administrative investigation has determined that to date, five component parts that were removed (see A-E below) from the accident helicopter engines on August 13th and 14th were not visible in the videotapes and still photographs taken during Columbia Helicopters, Inc. packaging of the fuel control units for shipment to the NTSB between the dates of August 20th to August 22nd, 2008. It is concluded that the referenced missing parts were not lost in during shipment from Columbia Helicopters to the Safety Board's headquarters in Washington, DC[3]. The parts missing are listed as Parts A-E from the fuel control units FCU#1 serial number 72835BR[4] and FCU#2 serial number 49882[5]:

   A. *Position Adjusting Cover*, part #540911 (metal)
   B. *Temperature Sensing Bellows Assembly*, part #543444
   C. *Internal Retaining Ring*, part #RRN-75-S
   D. *Spring Retainer*, (cap screw) part #574414
   E. *Internal bellows lever temp sensing*, part #571886

2. One additional part listed as missing by Carson Helicopters, Inc. in the September 3, 2008 letter was the FCU #2 *Spring Retainer* (cap screw) part #574414. The NTSB has reviewed the notes taken by the Carson party representative present on-scene and during the engine and fuel control tear downs at Columbia; these notes did not include the part listed above as being present during the examination. Further, it has been determined by the NTSB and party members by examining on-scene photographs that this part was not attached to the engines and fuel control unit post-crash and therefore was not removed from the scene with the engines.

3. This administrative investigation has determined the last known and documented location of the parts missing was on August 14th, 2008 at approximately 1348 hours; when the fuel control units were last seen, documented and photographed by all parties. These units were accessible to all parties including Carson Helicopters, Inc. None of the NTSB personnel, Columbia Helicopters staff or the party representatives can attest to seeing the missing parts on August 15th, 2008. While these individuals do recall seeing a clear, zip-lock type bag containing what they believed to be fuel control unit parts inside the training trailer, none can attest to specifically touching or observing the specific missing 5 components. It is important to note that there were several similar individually labeled, clear, zip lock bags that contained numerous, separated sets of parts from both engines and both fuel control units.

4. It is not possible to determine with certainty how the parts were either removed from or were lost during the engine and fuel control unit examination. We have also not been able to determine who may have last had physical contact with the missing parts, as all parties were present at the last time these items were handled, all parties had access to the parts under the party system, and all parties were known to be in the controlled access location.

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[3] See Carson Helicopters, Inc. email statement regarding shipping in attachment #4.
[4] GE Aircraft Engines Accessories Overhaul and Parts Catalog, SEI-185, dated Jul 30/99 and Jul 31/03.
[5] GE Aircraft Engines Accessories Overhaul and Parts Catalog, SEI-185, Item #1, Figure 9.

5. We find that the NTSB IIC and Airworthiness group chairman followed currently available, written OAS protocols[6] (including those publicly available on the NTSB website) while performing the engine teardown and fuel control unit examination, including allowing all parties access to the teardown examination itself as well as unfettered access[7] to the component parts during this examination.

6. The last documentation of the missing parts was on August 14th at 1348 hours, and the loss of the subject parts, in all probability occurred during the investigative activities and in the presence of all parties to the NTSB investigation on August 14th, 2008.

7. It is not known, and would be supposition to suggest, that the presence of the IIC and NTSB Airworthiness group chair after August 15th (during the packing of the parts) would definitely have prevented the loss of or the possible intentional removal of the parts. While their presence would have maintained NTSB custody over the parts that were present to be packaged and shipped, it was not evident during this administrative investigation exactly when the parts became missing or how. It is likely that the missing parts would have gone undetected until inventoried packaging therefore this would still be an "after-the-event" discovery. It may have provided the NTSB with knowledge of the missing parts sooner that when the shipped boxes were opened in Washington, DC headquarters a week later.

8. We find the IIC and Airworthiness group chairman documented the activities of the component examination team, monitored the contracted company staff and party representative's actions as closely as possible while still performing their primary duties of factually documenting the component examinations. Based upon the resources available at the teardown facility, the parties (GE, Sikorsky, and U.S. Forest Service) along with Columbia Helicopters, Inc. stated they felt the IIC and NTSB maintained control over the workshop area, evidence and the parties and persons participating in the teardowns.

9. Of particular note, the Airworthiness group chair reported during this administrative investigation that when Mike opened the boxes in Washington, DC in the presence of the group on August 28, 2008, the Carson representatives were focused immediately upon the condition of and the packaging of, the fuel control units and component parts. In later group discussions the same day, Carson also was vocal in saying they thought Columbia Helicopters, Inc. was "not playing fair, overcharging for work, not honoring warranties on fuel control unit rebuilds due to alleged contaminated. Carson also stated that they feel Columbia is not maintaining their fuel control units properly."

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[6] Office of Aviation Safety's following protocols: *Major Investigations Manual*, pages 16-25; *Major Investigations Manual Appendices*, Appending H "Group Chairman Checklists: - Pages H-68, H-89-H91; *Regional Investigations Manual*, pages 75-76; and *Regional Operations Policy Memorandum No. AS2R-ROPM-0*[illegible]: Pages 1-5 and http://www.ntsb.gov/info/inv_guides.htm

[7] This unfettered access did not extend to the contracted company, Columbia Helicopters, Inc., as the workshop area was restricted to only those personnel directly working on a specific component as overseen by the Columbia management and while NTSB was present on-site.

10. Finally, the NTSB has taken Carson Helicopters, Inc. concerns seriously, addressing them as requested by Carson, in conducting this administrative investigation. We find that the NTSB investigators did not deviate from written policies provided by the Office of Aviation Safety regarding evidence handling; however, we do believe the NTSB could benefit from a review of our Board-wide practices and development of more robust and detailed guidelines regarding the handling, custody and control of investigative evidence.

END OF REPORT

ATTACHMENT #1

WITNESS DECLARATIONS: NTSB EMPLOYEES

1. James Struhsaker, Investigator-In-Charge
2. Mike Hauf, Airworthiness Group Chairman
3. Zoë Keliher, Operations Group Chairman
4. Eliott Simpson, Aviation Safety Investigator

WITNESS VOLUNTARY STATEMENTS: CARSON HELICOPTERS, INC.

1. (b)(6)
2. [redacted]
3. [redacted]

WITNESS INTERVIEW SUMMARIES*: PARTIES TO INVESTIGATION

1. Carson Helicopters, Inc.
2. Columbia Helicopters, Inc.
3. Sikorsky Aircraft Corporation
4. GE Aviation
5. U.S. Forest Service

* Summary of notes taken by Investigating Officer during both telephone and in-person interviews.

42 Pages
(Includes Cover Sheet)

NTSB ADMINISTRATIVE INVESTIGATION
OF MISSING COMPONENTS FROM LAX08PA259

EMPLOYEE INFORMATION AND ACKNOWLEDGEMENT FORM

Good morning/afternoon. My name is Michele Beckjord, and I am a Senior Project Manager with the National Transportation Safety Board. On the phone is Mr. Chris Voeglie, an investigator from the Office of Highway Safety. Mr. Voeglie and I have been tasked by the Managing Director to conduct an administrative investigation into the disappearance of several parts associated with the August 5, 2008, S-61 helicopter accident near Weaverville, California (NTSB investigation number LAX08PA259). At the conclusion of our administrative investigation, we will prepare a report documenting the relevant facts and circumstances for the Managing Director. It should be noted that all of the information collected by us could be made public in one form or another, and, therefore, witnesses should not assume any confidentiality regarding the substance or details of their testimony.

We are interviewing you because you participated in this accident investigation as part of your normal duties as an employee of the NTSB, and/or you were present at Columbia Helicopters' facilities during NTSB examination there of relevant accident aircraft components. During the pendency of this administrative investigation, you should not discuss this administrative investigation or your testimony with others.

During the interview, if at any time you do not understand a question, please stop and ask me/us to clarify it for you. After this interview, we will prepare a summary of your testimony, and present it to you for review for accuracy. After incorporating any necessary editorial corrections, your testimony will be formatted as a declaration for you to sign. You will be permitted to keep a copy of your declaration.

JM 1/28/2009 3:35 pm

In addition, please read carefully and acknowledge the following additional information by initialing each section:

[redacted] I have been informed and I understand this is an official investigation involving matters relating to my official duties as a federal employee.

[redacted] I have been informed and I understand, as a federal employee, I am required to cooperate with this official investigation and provide truthful answers.

[redacted] I have been informed and I understand that if I refuse to cooperate and answer questions in this official investigation, my refusal to cooperate can be a basis for disciplinary action, which may result in my removal from federal service.

[redacted] I have been informed and I understand this is not a criminal investigation and neither the information I provide in response to question s by the investigator or any evidence gained by reason of my answers will be used against me in a criminal proceeding unless I knowingly provide false information. *Garrity v. New Jersey*, 385 U.S. 493 (1967).

[redacted] I have been informed and I understand that if I provide information during this official investigation that I know to be false at the time I provide that information, my providing false information can be a basis for disciplinary action which may result in my removal from federal service.

[redacted] I have been informed and I understand if I provide information during this official investigation that I know to be false at the time I provide that information, my providing false information can be a basis for criminal prosecution.

[redacted] 01/27/2009

Witness signature date

[redacted] 01/28/2009

HAUF

10 05 AM 1/28/09

In addition, please read carefully and acknowledge the following additional information by initialing each section:

[redacted] I have been informed and I understand this is an official investigation involving matters relating to my official duties as a federal employee.

[redacted] I have been informed and I understand, as a federal employee, I am required to cooperate with this official investigation and provide truthful answers.

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[redacted] I have been informed and I understand if I provide information during this official investigation that I know to be false at the time I provide that information, my providing false information can be a basis for criminal prosecution.

[redacted] 1/27/09
Witness signature date

[redacted] 1-27-2009

ZOE KELIHER - 2:30 PM 01.28.2009

In addition, please read carefully and acknowledge the following additional information by initialing each section:

[redacted] I have been informed and I understand this is an official investigation involving matters relating to my official duties as a federal employee.

[redacted] I have been informed and I understand, as a federal employee, I am required to cooperate with this official investigation and provide truthful answers.

[redacted] I have been informed and I understand that if I refuse to cooperate and answer questions in this official investigation, my refusal to cooperate can be a basis for disciplinary action, which may result in my removal from federal service.

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[redacted] I have been informed and I understand if I provide information during this official investigation that I know to be false at the time I provide that information, my providing false information can be a basis for criminal prosecution.

[redacted] 1/28/2009

Witness signature date

[redacted] 01.28.09

ELIOTT Simpson

11:40 AM EST
01-28-2009

NB

In addition, please read carefully and acknowledge the following additional information by initialing each section:

[redacted] I have been informed and I understand this is an official investigation involving matters relating to my official duties as a federal employee.

[redacted] I have been informed and I understand, as a federal employee, I am required to cooperate with this official investigation and provide truthful answers.

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[redacted] I have been informed and I understand if I provide information during this official investigation that I know to be false at the time I provide that information, my providing false information can be a basis for criminal prosecution.

[redacted] 1/28/2009

Witness signature date

[redacted] 1/28/09

DECLARATION

Pursuant to 28 United States code § 1746, I *Jim Struhsaker*, declared as follows during a telephone interview conducted on January 28, 2009 pertaining to an administrative hearing on the Weaverville, CA accident investigation that:

I was launched to the accident when the NTSB received notification of the 9 fatal (it had originally come in as a serious injury crash instead). Once it was known to be a 9 fatal, it was decided that it would be a Field Major, I would be IIC, and Zoë Keliher, Eliott Simpson and Mike Hauf would also launch. The Board Member on-scene was going to be Member Higgins. I launched on the evening of 8/6, arrived on-scene in the afternoon of August 7th, 2008 (due to launching on 8/6 from Hawaii). I started that afternoon by holding an organizational meeting. The accident crash had occurred in remote forested wilderness and the aircraft burned for 2 days. On August 8th the retrieval of the fatally injured began and this lasted for 3 days.

On August 11th the engines were removed, flown by helicopter from the remote accident site then loaded into a rental box-type truck, locked up and driven by the U.S. Forest Service to Columbia Helicopters, located in Aurora, Oregon. Columbia Helicopters was chosen for the location of the engine and fuel control unit examination because the manufacturer (GE) no longer serviced these engines and there were only two companies in North America (one being in Canada) that serviced them. Columbia was located in the United States, on the West Coast and had experience with the engines. The engines arrived on August 12th and the team flew on the U.S. Forest Service's King Air and also arrived on 8/12. The team at Columbia included: one GE representative, one Sikorsky representative, 5-6 representatives from Carson, two representatives from U.S. Forest Service, one FAA inspector from Portland and the staff from Columbia. The FAA POI and PMI did show up on August 14, but were there only to be interviewed.

The examination of the engines began at Columbia on 8/13, starting with engine #1 (left). Engine #2 was examined on 8/14. The fuel control units were also examined along with each engine on those days. There were many photographs taken of the engines and fuel control units. The later identified missing parts were last photographed on August 14th around 2pm.

At the end of the day, on 8/14, the Carson party members announced that they were leaving to assist in preparing for a memorial service for their deceased pilot. It was scheduled for Saturday morning, August 16. The team had wrapped up with the examinations and expected to work the next day finalizing their notes and debriefing at Columbia's training trailer location. I recall that Carson had promised to fly (in their own airplane) a representative to attend Fridays activities. However, no one showed up in the morning. I called the Carson representatives three times during the day to see when they would be arriving and was told each time that someone would be there shortly. During the notes and debriefing session (August 15th in the morning) the team (parties included) began discussing the engines, the fuel control units, and their observations while sitting in the training trailer. Then Zoe Keliher left the facility and drove to Grants Pass to interview some of Carson's staff. (b)(6) was doing some calculations related to the fuel flow settings on the fuel control units that he had begun near the end of the day on 8/14. At this time, the engines had been separated, labeled and put on a shelving unit in the workshop. The fuel control units were on separated workbenches in the workshop.

As the team's discussion in the training trailer progressed, observations focused on the fuel control units, the team did go into the workshop and spend some time looking at an exemplar fuel control unit. Then we returned to the trailer again and continued our discussions. The discussion was focused on a cam measurement that (b)(6) had identified. (b)(6) felt that the measurement might be an indication of the engine's power output at the time of the accident. The group asked Columbia to bring the units and some parts into the training trailer. They pushed some tables together, covered them with butcher paper and spread out the units.

We did talk about some parts of the fuel control units that were still at the accident scene, visible in documentation photographs from the scene. The Columbia representative brought in a' plastic phenolic cap that was an exemplar to show what the one from the accident aircraft (that had not been found and was considered burned and/or melted during the post-crash fire) would look like. [Each fuel control unit had one cap, on our accident helicopter, one was metal and one was phenolic]. The recovered metal cap, with its associated parts, was last seen on Thursday. It was in a plastic bag with black writing, which identified it. I cannot recall specifically looking at or touching the now missing parts on Friday, although I believe I did see some clear bags with black marker writing on them in the training room. I think these were bags containing parts from the engines and fuel control units. However, I cannot recall which parts were in those bags, as I did not inspect them. There was no real discussion at that time about the parts that are now missing. They were not thought to be central to the accident , because the theory about their effect on the fuel control unit's normal operation had been discounted by the end of the day on 8/14.

At the end of the discussions, when the team had wrapped up with notes and were gathering their belongings, I asked the representative from Columbia who had been assisting the group to box specific items (the fuel control units) and send them to the NTSB in Washington, DC. I do recall that there were several clear plastic bags with parts on the table next to the wall in the training room, and (b)(6) from Columbia Helicopters had been sitting there while the team was discussing the FCUs. When the team left the training room that day, I recall that the fuel control units were on the table in the training trailer. I cannot specifically recall the presence of the now missing parts on 8/15 and cannot recall specifically seeing them after about 1-2pm on 8/14 when they were last photographed.

We departed Columbia's facility around 3pm and headed to our hotel near Portland International Airport. When we were leaving the hotel for dinner that evening, a representative from Carson (b)(6) finally showed up and went to dinner with us and we briefed him on our 8/15 discussions and activity. On August 18th or 19th, I did receive a call from Carson's (b)(6) (b)(6) (b)(6) and that is when he voiced his concerns about Columbia having the engines and associated parts in their possession, and that the NTSB left before they were boxed and ready for shipping. I supplied Columbia with the shipping info they needed within a day or two of that conversation, and the boxes were shipped from Columbia by Federal Express on August 22nd. The boxes arrived in Washington, DC around August 26th and Mike Hauf opened them a few days later in the presence of (b)(6) and other Carson employees. Immediately upon opening the boxes containing the FCUs, (b)(6) asked about the

missing metal dust cap. Mike determined that it was not present, and he immediately called me. I inturn immediately called Columbia and spoke with (b)(6) .

(b)(6) stated he did not know anything about missing parts and would search the Columbia facility for them.

I had never worked with Columbia before but felt that Columbia was well organized when the NTSB left. I did not have any concerns and didn't feel there were any reasons to worry. In addition, Carson never spoke to me about being concerned, mistrusting or having an adversarial relationship with Columbia when the decision was made to go there for the teardown work. Nor did they express concerns when they decided to not have a representative present on the final day (8/15). In retrospect, I feel that Columbia was not as experienced in this type of examination and activity as other companies. I feel that if I had it to do again, I would do it differently by staying and watching the company, who performed the examination or component teardown, box up the parts and seal them for shipment.

I declare under penalty of perjury that the forgoing is true and correct.

Executed on 02/13/2009
Date

[redacted]
Signature

[redacted]
Witness signature

DECLARATION

Pursuant to 28 United States code § 1746, I *Mike Hauf*, declared as follows during an in-person interview conducted on January 28, 2009 pertaining to an administrative investigation on the Weaverville, CA accident investigation that:

At the time of the accident, I had been with the agency for about 6 years. I attended the 2 week long Office of Aviation Safety, Aviation Accident Investigation course immediately after I was hired.

On August 6, 2008, I was launched to Redding, California and was designated the Airworthiness Group Chairman for the investigation into the loss of a Sikorsky, S-61N helicopter, N612AZ. While on-scene on August 7th, I recovered and secured the Cockpit Voice Recorder. When I returned to the hotel, I called the Investigator-In-Charge and let him know that I had recovered the CVR from the helicopter and could bring it to him. The IIC stated that I should keep the CVR with me and give it to him in the morning. I kept the recorder with me and then gave it to the IIC in the morning at a progress meeting. As the Airworthiness Group Chair, I worked on-scene for several days documenting the wreckage and accident site. During a progress meeting, the IIC stated that the engines could be examined at Columbia Helicopters Inc., or at a facility in Canada. Upon receiving comments from the party members, the IIC decided to do the engine examination at Columbia the following week. At this time, a Powerplants group chairman had not been created for this accident.

On Monday, August 11th, both engines were removed from the helicopter on-scene, transported by another helicopter from the remote accident site to a flatbed moving truck and the door to the moving truck was secured with a lock. The truck was then driven to Columbia Helicopters Inc. (I do not remember who drove the truck). On Tuesday, August 12th the team traveled to Aurora, Oregon to do the engine / component examination. On August 13th, representatives from Columbia Helicopters, Inc. disassembled the number 1 engine (left) under the supervision of the NTSB and witnessed by representatives from the Federal Aviation Administration, Columbia Helicopters, Inc, General Electric Aviation Engines, Sikorsky Aircraft, United States Forest Service and Carson Helicopter Services, Inc. Most of the parts that were removed from the engine were tagged (with ivory colored tags) labeling which engine they came from and then placed on a shelf. The fuel control units was removed from the engine, placed on separate workbench, disassembled and examined.

During the examination of the FCU, a visual examination of the bellows assembly revealed that a metal position adjusting cover remained intact and lock wired in place. A lead seal should have been present on the lock wire, but was not present (assumed melted due to the post crash fire). A representative from Columbia removed the lock wire and the metal position adjusting cover from the bellows housing exposing the aspirator and bellows group. The aspirator bellows assembly was observed to be loose within its housing. When the housing assembly was rotated down, the following components fell

out of the housing: snap retainer ring, spring retainer cap, spring and Bellows. Visual examination of the assembly revealed a circumferential fracture on the outboard end of the adjusting screw. The metal position adjusting cover and the components that fell out were placed into a plastic bag.

On August 14th, representatives from Columbia Helicopters, Inc. disassembled the number 2 engine (right) under the supervision of the NTSB and witnessed by representatives from the Federal Aviation Administration, Columbia Helicopters, Inc, General Electric Aviation Engines, Sikorsky Aircraft, United States Forest Service and Carson Helicopter Services, Inc. Most of the parts that were removed from the engine were tagged (with ivory colored tags) labeling which engine they came from and then placed on a different shelf than the parts from Engine 1. The fuel control unit was removed from the engine, placed on separate workbench, disassembled and examined.

During the examination of the FCU, a visual examination of the bellows assembly revealed that its position adjusting cover was not present, but the covers lock wire remained in place and intact. A representative from Columbia explained that some FCUs contain a position adjusting cover made out of plastic. The team discussed the possibility that it had burned during the post-crash fire. A lead seal should have been present on the lock wire but was not (assumed melted due to the post crash fire). The aspirator bellows assembly group (snap retainer ring, spring retainer cap, spring and Bellows) was not present; they were later identified (in a photo) by representatives from Carson as resting on the engine deck at the accident site.

Prior to the engine examinations, it was known that Carson was going to return to Grants Pass to attend the memorial service for the fallen Carson crew and therefore would not be present On Friday, August 15th.

August 15th was planned out by the IIC and team to be a debrief day for everyone to work on their notes from the inspections together at the Columbia facility in their training trailer. As the debriefing discussion took place, considerable discussions were held regarding the fuel control units. During this discussion it was requested that a representative from Columbia retrieve both FCUs and bring them into the training trailer. In addition, the group also requested Columbia to bring an exemplar plastic position adjusting cover into the trailer to show the group what the position adjusting cover looked like. After reviewing the FCUs, Both fuel control units were then taken back to the workshop and laid out next to each other and photographs were taken. I do not recall seeing the bag containing the parts (metal position adjusting cover, snap retainer ring, spring retainer cap, spring and Bellows) from FCU #1 in the lab during this time and do not specifically recall seeing the parts after the 13th.

Once the team was finished in the lab, the IIC asked a representative from Columbia Helicopters to package all of the engine components and ship them to a storage facility (Plain Parts, located in Pleasant Grove Ca.) The IIC also asked Columbia Helicopters to package and ship both FCUs to the NTSB office located in Washington, D.C. We returned to the training trailer and had further discussions on the operation of the FCUs.

The team packed up their belongings and I do not recall seeing the bag of parts in the trailer at that time. I do recall the IIC asked Columbia to box and ship the fuel control units, and I assumed they would also box and ship all the parts, there was not any concern on my part that this would not happen.

On the evening of 8/15, the team met in the lobby of the hotel, and was joined by a representative from Carson (b)(6) was briefed about the activity from the day (August 15th) and he was casual and I do not recall if he expressed any concerns or issues at that time about the engines and parts being left at Columbia.

I do recall that (b)(6) from Carson Helicopters called me on my work cell phone at home, late on Friday evening of August 22nd to discuss concerns about Carson and NTSB not being present on August 15th when the engines and fuel control units were boxed up for shipping. When the boxes containing the FCUs were received at the NTSB in Washington, DC headquarters from Columbia helicopters on August 26th, I secured the boxes (in sealed condition). Representatives from Carson were in Washington D.C. when the boxes were received, they were at DCHQ to work with the CVR group and to review and sign the Airworthiness group engine examination field notes. When I opened the boxes containing the FCUs in front of Carson (Aug. 28th) they were very focused from the moment the boxes were opened on the quality of the packaging. I recalled their discussions centered on how poorly they considered the parts to be boxed and that housing assemblies from FCU #1 and FCU #2 were mismatched.

Later in the day, Carson was vocal in saying they thought Columbia was not playing fair, overcharging for work, not honoring warranties on fuel control unit rebuilds due to alleged contamination. Carson also stated that they feel Columbia is not maintaining their fuel control units properly.

I declare under penalty of perjury that the forgoing is true and correct.
Executed on 2-24-09.
Date

[redacted]
Signature

[redacted] 2.24.09
Witness signature

DECLARATION

Pursuant to 28 United States code § 1746, I *Zoë Kelliher*, declared as follows during a telephone interview conducted on January 28, 2009 pertaining to an administrative investigation on the Weaverville, CA accident investigation that:

I began my employment as an intern with the NTSB in the Los Angeles office, and as part of my training, I launched on accidents with other investigators about 10 times over the approximate year duration. I was subsequently hired as a full-time Aviation Safety Investigator (ASI) and as part of my initial training, I attended the Office of Aviation Safety's 2 week Basic Accident Investigator Course in May 10, 2004.

I was taking the calls as part of my regional rotation schedule when I was originally notified by the FAA communication center about an accident that had occurred near Weaverville, CA. The notification first reported that a helicopter accident had occurred with serious injuries incurred (both the accident and original notification occurred on August 5, 2008 evening). The following morning it was reported that in fact the accident had resulted in nine fatalities; the decision was made by the Regional Chief, Jeff Rich, to launch a team. I was chosen to launch to the accident, a Field Major accident, because of my helicopter experience; the following day I was assigned to be the Operations group chair. Jim Struhsaker, a Senior ASI, was assigned as the IIC to the accident and group members were assigned to the accident due to the Field Major classification. The designation as a Field Major instead of regional accident is usually as preparation for an accident that may potentially result in a report that would go to the Board.

Eliott Simpson, a relatively new ASI out of the Los Angeles office, was directed to accompany me to the accident so that he could observe and provide IT support. When I arrived at the staging site (a hotel in Redding, CA), I came before the IIC (who was traveling from Hawaii) and greeted the Board Member (Member Higgins) who was staying at the same hotel. I then held the first opening briefing meeting with a group of about 10 people all of which were from the Safety Board. The IIC then arrived the next day and took over, beginning with a meeting of over 100 people. I worked on-scene (both at the hotel and the accident site) for about 3-4 days and then I proceeded to Aurora, Oregon where I interviewed a FAA inspector (Principal Operations Inspector for the operator).

I conducted my interview at Columbia Helicopters facility where the remaining team was present and conducting their examinations of the engines and accessories (specifically fuel control units). During this time, I was not intimately involved with the examination of the engines. I worked on my computer in the training trailer and at the tables adjacent to the examination, typing up field notes from the scene and the notes from my interviews. On August 14th, 2008, I recall following the GE representative around for short durations while he was working so I could hear what he was explaining about the GE engines.

On August 15, 2008 I was present at Columbia Helicopters in the morning and did work in the training trailer facility, and I recalled a meeting the IIC was holding. However, I needed to drive to Grants Pass, Oregon (which was about a 4 hour drive) to interview some representatives from the accident operator, Carson Helicopter Services. I arrived at my hotel around 1300 and

subsequently went to Carson for the interview. I departed Grants Pass, Oregon the next day, August 16th and returned to my permanent duty location in Los Angeles, California.

I have not had any contact with Columbia Helicopters since I was present at their facility on the morning of August 15th and I do not have any information or opinion regarding the fuel control units that are central to this administrative investigation.

I declare under penalty of perjury that the forgoing is true and correct.

Executed on 02.10.09
Date

[redacted] ZOE KELCHER
Signature

[redacted] 02-17-09
Witness signature

DECLARATION

Pursuant to 28 United States code § 1746, I *Eliott Simpson*, declared as follows during a telephone interview conducted on January 28, 2009 at 11:40 am EST pertaining to an administrative hearing on the Weaverville, CA accident investigation that:

I joined the NTSB around March 3, 2008 as a full-time Aviation Safety Investigator (ASI). Prior to that time I had been an intern in the Los Angeles, CA office from approximately April of 2007 until December of 2007. I was then hired in March 2008 as an ASI.

After I was hired in March of 2008, I did travel to the NTSB Training Center to attend the NTSB Office of Aviation Safety's 2 week Aviation Accident Investigation course. While I was an intern, I had launched several times (about 5-6) with other ASIs. I have not launched on a major accident.

I did launch on August 6th, 2008 to the Weaverville, CA accident which was considered to be a Field Major accident. I was launched to the accident as a "learning experience" and provided IT support. In addition, I was assigned to work on an issue related to the helicopter's bungee cord and left the main investigation group to go see exemplar aircraft of Carson's and work on this issue from August 12th, 2008 through August 13th, 2008.

I then rejoined the group around lunchtime at Columbia Helicopters location in Aurora, Oregon on August 14th, 2008 when the examination of the accident helicopter's engines was already underway. I proceeded to work on my laptop and don't recall anything in particular about the engine examination. I was working on typing up my field notes. I was working on this in the Columbia Helicopters workshop area where the other investigators and party members were engaged in the work on the engines and fuel control units of the accident helicopter; however, I did not participate in that particular activity.

I did take photographs on August 15th when the group had moved over to a training trailer location (still at Columbia helicopters) and the group was looking at an exemplar fuel control unit. I considered the work on August 15th to be a brainstorming session, including comparing the fuel control units to the exemplar fuel control unit from Columbia and remember the focus was on the cover or cap of the fuel control unit. On that day I additionally took photographs of an exemplar engine that was located at the Columbia facility, as well as various pictures of turbine blades and fuel pump parts from the accident engines.

I do not recall anything particular regarding the packing up of the engines or the fuel control units on August 14 in the workshop or anything specific that occurred out of the ordinary during the wrap up meeting on August 15th in the training trailer.

I declare under penalty of perjury that the forgoing is true and correct.

Executed on _____ [redacted] 2009.02.18 17:02:59 -08'00'
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Signature

[redacted] 02-18-2009
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NTSB STATEMENT TO CARSON HELICOPTERS, INC.

Good morning. My name is Michele Beckjord, I am currently employed as a Senior Project Manager with the National Transportation Safety Board. I am here today as part of an administrative investigation on behalf of the Safety Board's Managing Director. An administrative investigation is an agency investigation that is not conducted for the purpose of law enforcement or criminal prosecution. This particular administrative investigation entails impartial gathering and compiling of relevant evidence and testimony regarding the disappearance of several parts involved in the LAX08PA259 aviation accident investigation, being conducted by the NTSB. This accident involved a Carson Helicopters, Inc. aircraft, and occurred on August 5, 2008 near Weaverville, CA. As such, Carson Helicopters, Inc. was named as a party to the investigation.

As part of this administrative investigation I am requesting to interview you on issues relevant to this investigation as you participated in the NTSB investigative activities between the dates of August 12th, 2008 through present day as party representatives for Carson Helicopters, Inc.

The NTSB recognizes that as a Carson Helicopters, Inc. employee you are not employed by, and do not work for, the United States government, and you are not required to participate. However the Safety Board appreciates your participation on behalf of Carson Helicopters, Inc. and your willingness to provide information related to the matters at hand.

Declaration to Michele Beckjord, NTSB investigator, follows up to interview on 22 January, 2009.

RE: Missing fuel control parts associated with the N612AZ helicopter accident

By: (b)(6) [redacted], Carson Helicopters, Inc., 18 February 09

I was part of the Carson Helicopter team that responded to the accident scene on 5 August 08. I, along with several other Carson personnel, was made a party to the NTSB investigation team by Jim Struhsaker immediately following the accident. I was part of the airworthiness team that went to Columbia Helicopters for the engine teardown, I was present in Washington, DC when the fuel control parts shipment from Columbia were opened, and I was present at Hamilton Standard in Connecticut for the in-depth fuel control inspection The Carson team that went to Columbia consisted of myself, [redacted] (b)(6) We were part of the NTSB group that did the initial teardown and documentation of parts at Columbia's facility in Aurora, Oregon from 12 threw 14 August 2008. On 14 August 08 the group flew back to southern Oregon to be present at a national memorial ceremony for the victims. Immediately following the ceremony, Carson flew (b)(6) [redacted] back to Columbia's facility to rejoin the investigation team that afternoon, but by the time (b)(6) [redacted] arrived in Aurora, the NTSB Team had concluded their work and was already waiting to fly out at the airport in Portland OR.

While conducting the engine teardown inspection I noted that there was damaged fuel control parts around the # 2 fuel control unit's T2 bellows assembly, and that the two engines exhibited very different wear internally. We did a comparison inspection to the #1 engine fuel control to determine and visualize what parts were in fact missing. All of the T2 bellows sections for the #1 engine were intact and present at this initial tear-down. This finding instantly drew a large crowd of senior Management from Columbia Helicopters not previously present. After the tear-down was complete Mr. Struhsaker conducted a preliminary round table discussion of what we had all found, Initially all NTSB team members were in general agreement that it appeared there was a possible issue with one engine and/or fuel control unit and that one engine was not running at impact. When the Carson team left Columbia's offices, the engine and fuel control parts were packaged and labeled separately for the #1 and #2 units and put on separate shelves at Columbia.

When the Carson team learned that the fuel control units from the accident had been left in the sole care and custody of Columbia, the very facility that had preformed the overhaul of the suspect part in the first place, with no NTSB oversight, I became concerned. On Monday 18 August 08, I expressed my concerns about custody of the parts to Mr. Struhsaker. Mr. Struhsaker agreed to have the fuel control parts shipped to the NTSB's offices in Washington DC. At that time, Columbia was the only certified repair facility for these fuel control units in the world, and they had worked on many Carson parts in the past, and at that time still had several units from Carson in their shop for repair. In addition to its maintenance services operations, Columbia is also a large heavy lift helicopter operator, and is a competitor to Carson on firefighting and construction-lift contracts.

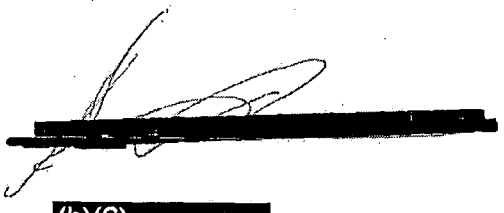
According to FedEx records, Columbia shipped the fuel control parts to the NTSB on 22 August 08, 8 days after those parts had been left in Columbia's custody. The shipped fuel control parts were received by the NTSB on 26 August 08. On 28 August 08, the shipping box was opened in the presence of the airworthiness team party members including myself. The box was taped and sealed shut, and the parts were enclosed in plastic bags inside the box. The main body of the fuel control unit had one section sticking through the box due to poor packaging, but that the resulting tear in the box was not large enough to allow parts to fall out. Upon opening the boxes it was immediately apparent to all present that all of the #1 engine T2 bellows parts that where present at Columbia's facility were now missing and there were parts included that had not been part of the fuel control units removed from the wreckage of N612AZ. In addition to the missing and additional parts, the #1 bellows section housing/assembly was in the box with the #2 fuel control and the #2 bellows section housing/assembly was in the box with the #1 fuel control. These two units and associated parts had originally been separated in plastic bags and left on separate shelves at Columbia.

All members of the airworthiness team were very concerned about the way these parts had been shipped and the negative impact that this would have on their ability to determine the ultimate cause of the accident. Mike Hauf (NTSB airworthiness group leader) was visibly upset and unhappy with the situation. I informed Mr. Hauf that we needed to speak with Mr. Struhsaker immediately. I then proceeded to call Mr. Struhsaker myself and inform him of the status of the missing and miss packed fuel control parts. Mr. Struhsakers response was one of disbelief. Mr. Struhsaker then commented that maybe the parts were inadvertently shipped with the remaining engine components to Plain Parts, a warehouse storage facility in Sacramento California. A follow on meeting at Plain Parts with the airworthiness group revealed that the parts were not to be found. Carson's management discussed the situation and I documented all the parts that were missing and the parts that had been swapped between fuel control units. I sent a letter detailing all of these facts to Mr. Struhsaker on 3 September 08. My letter included a detailed list of the parts at issue and expressed Carson's concern over the custody of the parts. I further requested that the NTSB formally investigate the handling of these parts.

In May 2008, almost two months before the accident, N612AZ had experienced power failures with another fuel control unit serviced by Columbia. The NTSB requested that this unit be sent from Columbia to the NTSB in order to inspect it for any possible correlation to the fuel controls from the accident aircraft. This shipment was opened on 19 September 08 by the NTSB airworthiness team members at Hamilton Standard's (the manufacturer of the fuel control unit) facility in Connecticut. Prior to being shipped by Columbia this fuel control unit had been completely disassembled down to the smallest parts, and was literally in hundreds of pieces with every individual piece stripped and cleaned. The hundreds of intricate, small parts from the interior of the fuel control unit had all been thrown together in two plastic bags in a haphazard way. These bags were then placed in a box along with a small amount of jet fuel. The Hamilton Standard engineers present said they had never seen a fuel control unit disassembled to that degree for repair or shipping, and that the unit would no longer be certifiable for use due to probable damage to the many small parts. . There was no accompanying documentation concerning why or when the unit was torn apart. The NTSB also requested documentation on the fuel control units and repairs from all the Carson units in Columbia's care.

On 25 September 08, we sent a second letter to Mr. Struhsaker detailing this second incident and relaying our serious concerns over this and the handling of the fuel control parts recovered at the accident site. We requested further NTSB investigation into all of these issues. Given our concerns about the handling of the fuel control units, we instructed our attorneys to send a letter to the general counsel of the NTSB on 31 October 08 about these issues.

The engine fuel controls are critical components and should be an important part of the investigation, along with other factors. I feel that the mishandling and loss of custody of these critical components has crippled this investigation and has forced a skewed focus on the actual cause of this tragic accident



(b)(6)

Carson Helicopters Inc.

Declaration to Michele Beckjord, NTSB investigator, follow up interview on Jan 22, 2009.

RE: Missing fuel control parts associated with N612AZ helicopter accident

By: (b)(6) Carson Helicopters, Inc., Feb 28, 2009

I was part of the Carson Helicopter team that responded to the accident scene on August 5 2008. Along with several other Carson employees, I was made a party to the NTSB investigative team by Jim Struhsaker. I am a member of the CVR and Survival Factors teams.

On or about August 11, 2008, N612AZ's engines were removed from the accident scene. After the engines were removed from the accident scene, they were loaded into a enclosed and locked rental truck at the Weaverville, California airport. The next morning the engines were driven to Columbia Helicopters Inc.'s facility in Aurora, Oregon. At Columbia Helicopters the engines were disassembled by members of the Airworthiness Team, including Jim Struhsaker, Zoe Kellher, Mike Hauf, (b)(6) 4 or 5 personnel from Columbia Helicopters Inc., and some representatives from the local FAA. Columbia is a vendor to Carson and repairs our engine fuel control units. Columbia's fuel control employees helped the NTSB investigative team disassemble the fuel control units.

Upon disassembly of the #2 engine, it was noted that the #2 engine fuel control unit's T2 bellows was not present and that the #2 engine T2 bellows cap had melted away leaving just the safety wire. It was also noted that the #1 engine fuel control unit did have the T2 bellows section present, and that the #1 engine T2 bellows cap was still intact. The #1 engine T2 bellows cap was metal whereas the #2 engine T2 bellows cap was fiberglass. The #2 engine fuel control unit T2 bellows was an area of concern to everyone present at the engines tear-down at Columbia's facility. In the course of examining N612AZ's fuel control units it became clear to me, and to the other members of the investigative team present, that each of the two engines presented very different internal wear patterns. Members of the investigative team agreed that there appeared to be a possible issue with one engine or one fuel control unit. The members of the investigative team planned to follow up on these issues and analyze these parts in greater detail at the NTSB lab in Washington, D.C.

When I left Columbia's facility on Thursday, August 14, 2008, all the engine components had been separately arranged, packaged, labeled and categorized on shelves in a sectioned-off area at Columbia's facility. When the Carson employees participating in the NTSB investigation realized that the engines components, including all of the fuel control unit components, were left at Columbia's facility by the NTSB without anyone from the NTSB present to maintain the chain of custody over these components, we became very concerned. The fuel control units remained at Columbia's facility for approximately 4 or 5 days without any NTSB custody or oversight and without adequate security control measures.

On or about August 18, 2008, (b)(6) from Carson called Mr. Struhsaker and expressed our concerns about leaving these fuel control units unattended at Columbia's facility. Mr. Struhsaker then had the two fuel control units shipped from Columbia's facility to the NTSB lab in Washington D.C. on approximately August 20, 2008. These fuel control units were boxed up by Columbia employees and shipped via Fed Ex using Carson's Fed Ex billing number. No one from the NTSB investigative team observed the packaging and shipping of the items by Columbia. Mike Hauf of the NTSB told us that upon arrival of the box containing the two fuel control units at the NTSB's Washington D.C. lab, the shipping boxes were secured and put into a locked room. Mr. Hauf said that the boxes containing the

fuel control units were not opened or touched until the members of the Carson, GE, Sikorsky, and NTSB teams arrived in Washington, D.C. to open them up and look at them (on August 26 or 27, 2008).

Even before the boxes were opened it was clear that something was wrong. There were small pieces of the fuel control units sticking out of the shipping boxes. It appeared that these components had been exposed because the box in which they were shipped was too small for the fuel control units and related components. Mr. Hauf said that this is the way they had arrived at the NTSB lab. The shipping boxes were opened and then inventoried by Mr. Hauf, (b)(6) and me. While doing the inventory, it was discovered that the larger components had been placed in the box without any protective wrapping or packaging materials, while the smaller items had been placed loose into Ziploc bags. It was also discovered that the following items were missing;

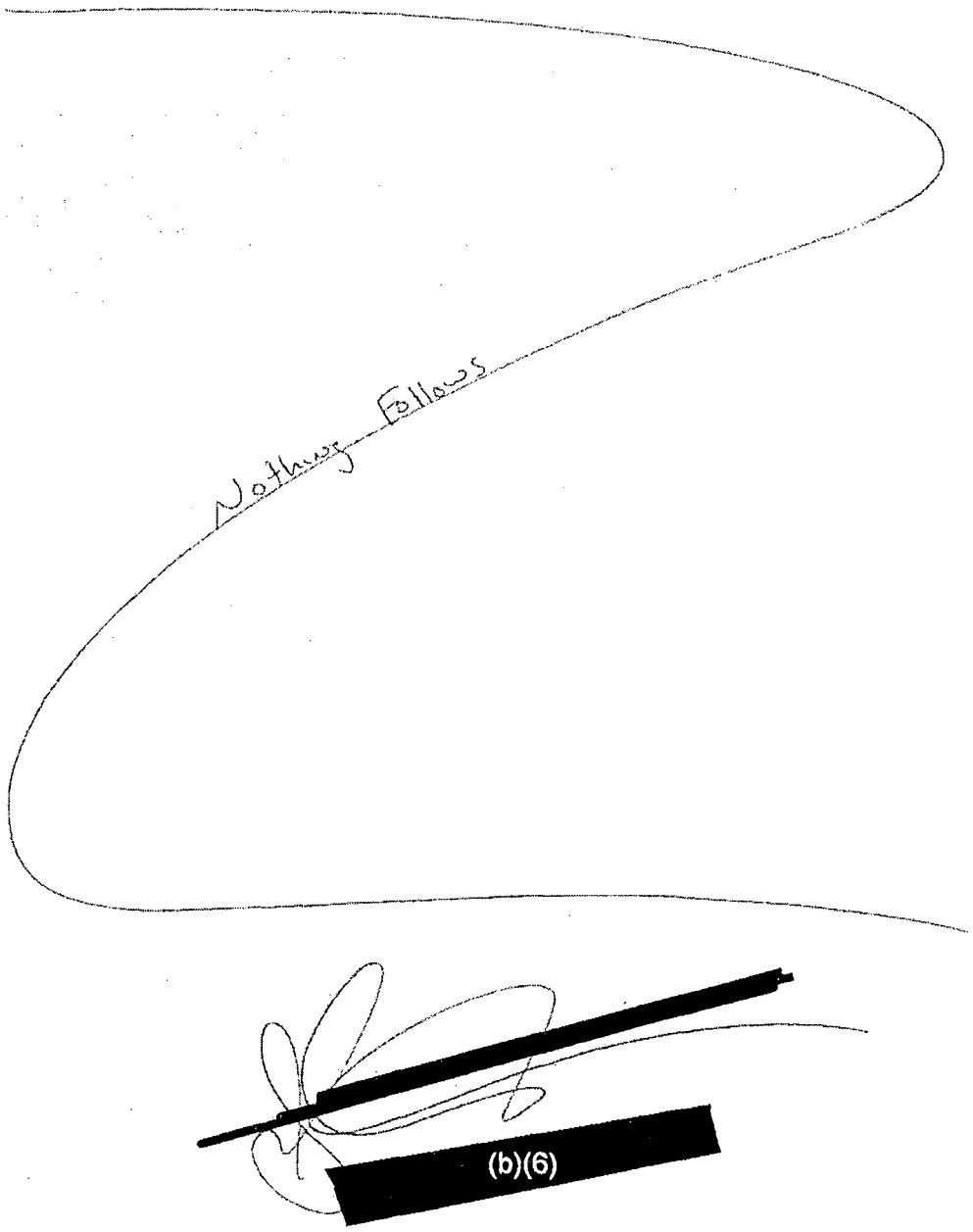
- T2 bellows assembly (#1 fuel control)
- Metallic dust cap (#1 fuel control)
- Internal snap ring (#1 fuel control)
- Plunger (#1fuel control)
- Spring (#1 fuel control)
- Bellows assembly (#1 fuel control)
- T2 control rod (#2 fuel control)

All of these components had been present and handled at Columbia's facility during the initial disassembly of the engines.

Additionally, while conducting this inventory, at the NTSB lab, it was discovered that someone had mixed multiple components from the #2 fuel control in with the #1 fuel control and some of the #1 components had been mixed in with the #2 fuel control component. This made it almost impossible to identify which components belonged to which fuel control unit. Also someone had placed a brand new fiberglass dust cap in the shipping box for the #2 fuel control unit. This brand new fiberglass dust cap did not belong to either of the accident aircraft's fuel control and was not among the parts recovered from the accident scene.

Secondly the NTSB had requested that an additional fuel control be sent from Columbia Helicopters to Hamilton Standard (Approximately Sept 5, 2008). The reason for this request is because this fuel control was involved in an aircraft occurrence on Sept 2, 2008. The thinking behind this request was to tear down the fuel control and find a possible link between the failure of this fuel control, and that of the accident aircraft. Columbia again shipped this unit by Fed Ex. The condition of the package upon arrivial at Hamilton Standard was problematic. The exterior of the box had a small tear or puncture. Upon opening the box the interior was found to be wet throughout and smelling of jet fuel. A sample of jet fuel contained in a small plastic jar within a plastic bag was found in the box. Jet fuel was dripping from this bag when it was lifted out of the box. Columbia had again completely disassembled the components of the fuel control unit and this time had placed all of those loose components together in a single Ziploc bag, placed in the shipping box with minimal packing material. Because of the way the parts were shipped, the very small and very intricate metal components of the fuel control unit were allowed to rub against one another during shipping. Upon seeing this, the Hamilton Standard representatives present stated that they considered this fuel control unit unserviceable and suggested that it be scrapped.

In closing, on Thursday, August 14, 2008 in a meeting with all the members of the NTSB investigative team at the Columbia facility, we all agreed that there was something wrong or unusual with the N612AZ's #2 engine, with the suspected area being in the T2 bellows or fuel control unit areas. In my opinion, the NTSB's failure to properly secure these parts has severely impacted the NTSB investigative team's ability to follow up on these key areas of inquiry.



Declaration to Michele Beckjord, NTSB investigator, follow up to interview on 22 January,2009.

RE: Missing fuel control parts associated with the N612AZ helicopter accident

By : [redacted] Carson Helicopters, Inc., 18 February 09

I was part of the Carson Helicopter team that responded to the accident scene on 5 August 08. I, along with several other Carson personnel, was made a party to the NTSB investigation team by Jim Struhsaker immediately following the accident. After remaining 3 days at the accident scene, I returned to Carson's offices in Grants Pass, Oregon to deal with other company issues. I was not part of the airworthiness team that went to Columbia Helicopters for the engine teardown, and I was not present in Washington, DC when the fuel control parts shipment from Columbia was opened. However, I collected detailed information regarding the missing parts and wrote the report and letters to the NTSB.

The Carson team that went to Columbia consisted of [redacted]. They were part of the NTSB group that did the initial teardown and documentation of parts at Columbia's facility in Aurora, Oregon. On 14 August 08 that group flew back to southern Oregon to be present at a national memorial ceremony for the victims. Immediately following the ceremony, Carson flew [redacted] back to Columbia's facility to rejoin the investigation team that afternoon, but by the time [redacted] arrived in Aurora, the NTSB Team had concluded their work and were already waiting to fly out at the airport.

When the Carson team returned from Columbia on 14 August 08, they advised me that there were damaged fuel control parts around the # 2 fuel control unit's T2 assembly, and that the two engines exhibited very different wear internally, and that NTSB team members were in general agreement that it appeared there was a possible issue with one engine and/or fuel control unit. When the Carson team left Columbia's offices, the fuel control parts were packaged and labeled separately for the #1 and #2 units and put on separate shelves at Columbia.

When the Carson team learned that the fuel control units from the accident had been left in the sole care and custody of Columbia, with no NTSB oversight, we became concerned. By Monday 18 August 08, [redacted] and I expressed our concerns about custody of the parts to Mr. Struhsaker. Mr. Struhsaker agreed to have the fuel control parts shipped to the NTSB's offices in Washington DC. At that time, Columbia was the only certified repair facility for these fuel control units in the world, and they had worked on many Carson parts in the past, and at that time still had 10 units from Carson in their shop for repair. In addition to its maintenance services operations, Columbia is also a large heavylift helicopter operator, and is a competitor to Carson on firefighting and construction-lift contracts.

According to FedEx records, Columbia shipped the fuel control parts to the NTSB on 22 August 08, 8 days after those parts had been left in Columbia's custody. The shipped fuel control parts were received by the NTSB on 26 August 08. On 28 August 08, the shipping box was opened in the presence of the

airworthiness team party members including [INSERT NAMES OF PERSONS PRESENT AT THE OPENING OF THE BOX]. It was immediately apparent to all present that parts were missing from one unit and there were parts included that had not been part of the fuel control units removed from the wreckage of N612AZ. In addition to the missing and additional parts, the #1 bellows section/assembly was in the box with the #2 fuel control and the #2 bellows section/assembly was in the box with the #1 fuel control. These two units and associated parts had originally been separated in plastic bags and left on separate shelves at Columbia.

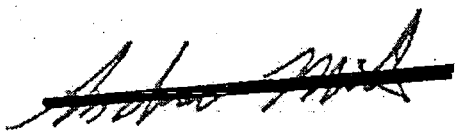
I spoke with (b)(6) by telephone immediately following the opening of the box, and (b)(6) relayed that all members of the airworthiness team were very concerned about the way these parts had been shipped and the negative impact that this would have on their ability to determine the ultimate cause of the accident. (b)(6) also informed me that Mike Hauf was visibly upset and unhappy with the situation. (b)(6) relayed to me that he and Mr. Hauf had just informed Mr. Struhsaker of the situation. I asked if there was any way that the parts could have fallen out of the box in transit, and (b)(6) said no. According to (b)(6) the boxe was taped and sealed shut, and the parts were enclosed in plastic bags inside the box. He also told me that the main body of the fuel control unit had one section sticking through the box due to poor packaging , but that the resulting tear in the box was not large enough to allow parts to fall out. T. I made a preliminary list over the phone of what had been swapped.

Carson's management discussed the situation and I documented all the parts that were missing and the parts that had been swapped between fuel control units. I sent a letter detailing all of these facts to Mr. Struhsaker on 3 September 08. My letter included a detailed list of the parts at issue and expressed Carson's concern over the custody of the parts. I further requested that the NTSB formally investigate the handling of these parts.

In May 2008, almost two months before the accident, N612AZ had experienced power failures with another fuel control unit serviced by Columbia. The NTSB requested that this unit be sent from Columbia to the NTSB in order to inspect it for any possible correlation to the fuel controls from the accident aircraft. This shipment was opened on 19 September 08 by the NTSB airworthiness team members at Hamilton Standard's (the manufacturer of the fuel control unit) facility in Connecticut. Prior to being shipped by Columbia this fuel control unit had been completely disassembled down to the smallest parts, and was literally in hundreds of pieces with every individual piece stripped and cleaned. The hundreds of intricate, small parts from the interior of the fuel control unit had all been thrown together in two plastic bags in a haphazard way. These bags were then placed in a box along with a small amount of jet fuel. I spoke with (b)(6) via phone right after they opened the box and (b)(6) reported that everyone present was stunned at the condition of the fuel control unit and parts. The Hamilton Standard engineers present said they had never seen a fuel control unit disassembled to that degree for repair or shipping, and that the unit would no longer be certifiable for use due to probable damage to the many small parts. . There was no accompanying documentation concerning why or when the unit was torn apart. The NTSB also requested documentation on the fuel control units and repairs from all the Carson units in Columbia's care.

On 25 September 08, we sent a second letter to Mr. Struhsaker detailing this second incident and relaying our serious concerns over this and the handling of the fuel control parts recovered at the accident site. We requested further NTSB investigation into all of these issues. Given our concerns about the handling of the fuel control units, we instructed our attorneys to send a letter to the general counsel of the NTSB on 31 October 08 about these issues.

The fuel controls are critical to engine and power management and should be an important part of the investigation, along with other factors. Carson Helicopters has removed all fuel control units from Columbia's overhaul facility and is not contracting Columbia for future overhaul work.



JANUARY 22, 2009 IN-PERSON INTERVIEW CARSON HELICOPTERS

- INTERVIEWER: MICHELE BECKJORD
- INTERVIEWEES:
  - (b)(6)
  -
  -

The following is a summary of my personal notes taken while I interviewed the above representatives of Carson Helicopters, Inc.:

(b)(6) :

The accident occurred on August 5th, 2008 and while on-scene, the NTSB and party members, Carson included, agreed to remove the accident aircraft engines and send them to Columbia Helicopters due to that company's proximity to the accident location and their ability to conduct the engine and component examination. The IIC boxed up the engines and had them trucked (in a rental truck, locked and driven by someone from the U.S. Forest Service) to Columbia Helicopters in Aurora, Oregon.

When the Carson rep's and NTSB and other party members arrived at Columbia, the engines were still under tarps but were laying in a cordoned off area and still on the pallets as they had been when they had been placed in the truck from removal from the scene.

On day 1: which was August 13th, the engine #1 (left) engine was disassembled and inspected and the fuel control unit was visually inspected. On day two: the right engine (engine 2) was also disassembled and inspected, with the fuel control unit visually inspected as well.

(b)(6) :

Both fuel control units on the helicopter had been overhauled at Columbia and Carson's concerns was that while the engines had been removed at the scene and were under NTSB's control, as soon as they left the scene they were outside of NTSB's control/custody.

(b)(6) :

During the fuel control unit "tear-down" or inspection at Columbia, (b)(6) was photographing the unit, including all the items. (At this point in the conversation there was confusion on Carson's part as to what parts were missing – such as whether the metal cap was from engine #1 or #2 – and it was the metal cap that is now missing. Also the phenolic cap was missing itself from the recovery of the engines because it is thought to have burned in the post-crash fire).

At the end of August 14th – the IIC asked the group on their thoughts on the FCUs and "tear-downs". There was also a discussion about the photo's to see where the engine #2 bellows or parts were at the scene. At this time, Mike Hauf and the IIC decided to secure the units and send them to the lab for review of the FCU.

On August 14th in the evening, all the Carson employees left for the memorial. On August 15th, the NTSB group and the other parties went back to Columbia but no one from Carson was present.

On August 18th (b)(6) called the IIC to review what the group did on August 15th. (b)(6) asked the IIC about the parts and the IIC said the parts were at Columbia on a shelf. (b)(6) expressed his concern about the custody of the parts being with Columbia. (b)(6) agreed with the IIC that day that the parts would be boxed and sent to NTSB, but (b)(6) disagreed with the IIC about who should box them up. In (b)(6) opinion, Columbia and not the NTSB had custody of the parts from Aug. 15th through Aug. 22nd.

Carson had concerns that the FAA POI was not allowed in the cordoned off area yet Columbia had multiple employees going into the area. The POI had arrived on 8/14 around 10 am and the PMI arrived late in the morning.

(b)(6) then discussed the conflict with Columbia over contracts, etc. They discussed that Columbia imposed contingencies in their insurance policies that negated their ability to continued with the contracts for overhauling parts, contracts that had been in place since 1990. The contingencies started around 8/18 through 8/28.

The following observations were made by all three interviewees

1. Mr. Hauf had discussions while at Columbia about fatigue analysis that would be done on the FCUs at NTSB's materials lab, but now that is not possible since the parts are missing.
2. When the boxes of parts arrived in Washington, DC and Carson was present when Mr. Hauf opened the boxes, the FCUs were mixed up between the boxes. Mr. Hauf was upset when the boxes were opened and it was pointed out that parts were missing.
3. The items were then re-boxed and placed into a safe at NTSB and everyone met in a room (U.S. Forest Service, Sikorsky, GE, NTSB) and Mr. Struhsaker called in. (b)(6) told the IIC about the missing parts and then there was a discussion as to where the parts could be.
4. The next time the group met again was at Plain Parts in California, where they searched for the parts where the engines were boxed. The parts were not found. The group was Hauf, (b)(6) (b)(6)

Carson did send (b)(6) up to Columbia on August 15th (after the memorial) around 3pm. (b)(6) went to Columbia, and when (b)(6) found no one from the NTSB was still there, (b)(6) tracked them down and met them for dinner to get an update on the activities or discussions from that day.

The accident aircraft had 2 FCU, one per engine. In May or June of 2008, Carson removed one of the FCUs and sent it to Columbia to be overhauled. Then Carson placed a different FCU into the accident aircraft. The one removed from the accident aircraft in May/June 2008 was sent to Hamilton Sundstrand for inspection by the NTSB and parties. Carson had concerns about the way this unit had been bagged and shipped to Hamilton by Columbia.

NTSB STATEMENT TO COLUMBIA HELICOPTERS, INC. EMPLOYEES

Good morning. My name is Michele Beckjord, I am currently employed as a Senior Project Manager with the National Transportation Safety Board. I am here today to conduct an administrative investigation on behalf of the Safety Board's Managing Director. An administrative investigation is an agency investigation that is not conducted for the purpose of law enforcement or criminal prosecution. This particular administrative investigation entails impartial evidence gathering and compiling of relevant evidence and testimony regarding the disappearance of several parts involved in the LAX08PA259 aviation accident investigation, being conducted by the NTSB. This accident occurred on August 5, 2008 near Weaverville, California.

As part of this administrative investigation I am requesting o conduct the following today: 1) interview several Columbia Helicopter employees relevant to this investigation; 2) view the area in which the NTSB, along with Columbia personnel and NTSB party members conducted the engine and fuel control unit teardown and examination, and 3) view the area where the parts were stored before and after the NTSB investigative examination and 4) the areas reviewed in the subsequent search for the missing parts. During the course of the day, should it become evidence additional Columbia Helicopters employees participated in the NTSB investigative activities between the dates of August 12th, 2008 through present day I would like to interview those identified individuals.

The NTSB recognizes that Columbia Helicopter employees are not employed by, and do not work for, the United States government, you are not required to participate; however, the Safety Board appreciates Columbia Helicopter's willingness to provide information related to the matters at hand.

(b)(6)
COLUMBIA HELICOPTERS

IN-PERSON INTERVIEW
JANUARY 21, 2009

(b)(6) is the Engine Shop Supervisor. (b)(6) set up the area at Columbia for the inspections/examinations by NTSB. (b)(6) then roped off the area to keep any uninvolved employees out of area. (b)(6) provided the tools and the necessary employees for the work but (b)(6) did not participate in the engine tear down or any photographing, or the packaging of the parts for shipment.

(b)(6) was present in the training trailer on August 15th for the discussions. (b)(6) recalls that the NTSB IIC, Mr. Hauf, Ms. Keliher, GE's (b)(6) the Sikorsky representative were all there. It was very hot outside, and the NTSB asked if Columbia could bring some of the parts into the trailer from the workshop. (b)(6) did step out a few times during the discussions to retrieve parts and replace them back onto the shelving unit in the workshop.

(b)(6) has spoken with Mr. Struhsaker a few times since August 15th about the fuel control units and contamination issues. (b)(6) has not spoken with any of the other team / party members. (b)(6) did assist in looking for the missing parts when Columbia was notified by the NTSB. (b)(6) recalls seeing parts in the training trailer, and recalls seeing the parts being put back into the workshop on the shelving unit with the other items from the engines.

(b)(6)
COLUMBIA HELICOPTERS

IN-PERSON INTERVIEW
JANUARY 21, 2009

(b)(6) is the Engine Shop Lead Mechanic. (b)(6) was tasked on August 13th to assist with the examination of the fuel control units – (b)(6) job was to take about the FCU. When (b)(6) started with the FCU, it had already been removed from the engine. (b)(6) started on the first FCU (not sure which engine it was from) and once disassembled (b)(6) left it overnight in the cordoned off area on a table. (b)(6) then returned on August 14th and finished the second unit. The parts were left on top of plastic bags (similar to heavy-duty zip lock bags) and photographed. (b)(6) then boxed the units into separate boxes labeled as engine #1 and engine #2 in the cordoned off area. (b)(6) then assumed he was finished with his assignment.

Then on August 15th (b)(6) was asked to go out to the training trailer and assist with the discussion on the direction of the investigation, (b)(6) was asked specific questions about the fuel control unit and was then asked to bring parts from the boxes (not the entire box) into the trailer. All the parts were in zip lock bags. (b)(6) was asked to disassemble the pressure regulator valve in the training trailer. Once the NTSB was finished, Mike carried the parts backs to the boxes, it took him several trips between the training trailer and the workshop to do so. He believed he had everything from the training trailer back to the boxes in the workshop. He sealed the boxes with tape and went back to work on his regular duties. He cannot say for certain if he saw the bag of the missing parts, and he cannot recall if he placed that specific bag of parts back into the labeled boxes on the workshop area. He did recall that only specific parts of the FCUs were in the training trailer, and that those parts did get passed around through the investigation group often as they were discussing the items and the accident. He could not say which parts those were.

He was asked by Columbia / NTSB to assist in looking for the missing parts, and he did search the training trailer and workshop area and did not find them. He had been the one to clean up the training trailer and did not remember seeing anything left behind when he took everything back to the workshop. On Sept. 9th he did participate with the NTSB IIC on a conference call regarding the accident; however, he has not had any other contact with anyone else regarding the accident.

(b)(6) believed that engine #296024 had the FCU #49882 with a metal cap. (b)(6) stated (b)(6) recalled this because (b)(6) had to cut away the metal safety wire in order to remove the cap to look inside the unit. (b)(6) did not see this metal cap inside the training trailer when (b)(6) cleaned up. (b)(6) also recalled from his memory that the other engine (serial number #295-120 was linked to FCU #72835BR and had the phenolic cap because the safety wire was still in place – and did not need to be cut for the inspection, because the plastic cap had burned/melted away in the accident. That is how (b)(6) could tell which FCU had which cap. (b)(6) had packaged the plastic exemplar cap because it was brought into the training trailer for the team to see, and since it was there (b)(6) boxed it up with the items for the NTSB to have when they opened the box.

(b)(6)
COLUMBIA HELICOPTERS

IN-PERSON INTERVIEW
JANUARY 21, 2009

(b)(6) was involved in the engine tear-down but not the FCU specific examination. (b)(6) stated the engines had been kept in a staging area, that was quarantined on 2 shelves of a stand-alone shelving unit.

(b)(6) was asked to package up the parts once the NTSB had left Columbia. (b)(6) had waited for Mr. Struhsaker to give instructions on where to send the parts from when the NTSB left on 8/15 until 8/21 when (b)(6) received the email with addresses.

(b)(6) was filmed by an employee of Columbia as (b)(6) unwrapped the shelving unit, displayed the items on a long table, then re-bagged, sealed and signed across the seal of the bags. (b)(6) also was filmed as (b)(6) placed larger parts or the sealed bags into new boxes for shipment. (b)(6) also opened sealed boxes that had been on the shelving unit that contained parts that had been examined during the NTSB inspection at Columbia the week prior (Aug. 13-15).

(b)(6) did receive a call from Mike Hauf of the NTSB when the boxes arrived in Washington, DC and there was a discussion of some parts that were missing from the shipment. (b)(6) and other Columbia employees searched the areas where the engines and FCUs had been, which was the workshop and the training trailer. They did not find the parts.

Side Note – At this point in the interview, the following information was provided by Columbia Helicopters, Inc.

> (b)(6) of Daniels, Fine, Israel, Schonbuch, and Lebovits, LLP (outside Counsel to Columbia) and (b)(6) (Columbia Helicopter's General Counsel) explained that Columbia videotaped and took still photographs of the items being packaged because they recognized that there would be potential litigation as a result of the accident and they wanted to make sure the items they were left with after the NTSB's teardown and examination were shown to the be items that were boxed and sent. They were concerned about showing the custody of the items as they were boxed from Columbia in the event there were problems when they were received after shipping.

NTSB STATEMENT

Good morning. My name is Michele Beckjord, I am currently employed as a Senior Project Manager with the National Transportation Safety Board. I am calling you today as part of an administrative investigation on behalf of the Safety Board's Managing Director. An administrative investigation is an agency investigation that is not conducted for the purpose of law enforcement or criminal prosecution. This particular administrative investigation entails impartial gathering and compiling of relevant evidence and testimony regarding the disappearance of several parts involved in the LAX08PA259 aviation accident investigation, being conducted by the NTSB.

As part of this administrative investigation I am requesting to interview you on issues relevant to this investigation as you participated in the NTSB investigative activities between the dates of August 12th, 2008 through present day as party representative for Sikorsky Aircraft Corporation.

The NTSB recognizes that as a Sikorsky Aircraft Corporation employee you are not employed by, and do not work for, the United States government, you are not required to participate; however the Safety Board appreciates your participation on behalf of Sikorsky Aircraft Corporation and your willingness to provide information related to the matters at hand.

(b)(6) TELEPHONE INTERVIEW SIKORSKY HELICOPTERS
JAN. 29, 2009 11:30 am EST

(b)(6) was the representative for Sikorsky Helicopters (aircraft manufacturer) for the accident and was sent to accident site on August 6, 2008. (b)(6) worked for 5 days at the scene and then flew with the team on the U.S. Forest Service King Air airplane to Portland, Oregon and accompanied the NTSB and parties to the Aurora, Oregon location of Columbia Helicopters. (b)(6) was an observer during the engine and fuel control unit disassembly and took photo's but did not participate as (b)(6) is more familiar with the airframe aspects rather than the engines.

(b)(6) believes he was present in the training trailer on August 15th for the NTSB debriefing meeting. (b)(6) recalled he had finished his work and was busy finishing his notes. (b)(6) was an observer, and cannot recall if the fuel control units or parts were brought into the trailer that day.

During the August 13th and 14th engine and fuel control examination and inspection, (b)(6) did not feel the workshop area and process was in any way chaotic or that there was any loss of control by the NTSB of the inspection area. (b)(6) understanding was that the parts that are now missing had been bagged and were awaiting shipment to the NTSB.

(b)(6) did recall while the parties were at Columbia Helicopters, the Carson representatives ((b)(6) could not recall exactly who) did state to him that they would not have brought the engines to Columbia because of past issues with Columbia but did not elaborate. It was said in passing and no other concrete information given. (b)(6) said it was apparent there was friction between Carson and Columbia but no direct information that there was a disagreement between the two companies.

Outside of the meetings at NTSB's headquarters in Washington, DC as part of the investigation and in the presence of all parties, (b)(6) has not had any further contact with either Carson Helicopters Services or Columbia Helicopters since he was at the facility on August 15th, 2008.

NTSB STATEMENT

Good morning. My name is Michele Beckjord, I am currently employed as a Senior Project Manager with the National Transportation Safety Board. I am calling you today as part of an administrative investigation on behalf of the Safety Board's Managing Director. An administrative investigation is an agency investigation that is not conducted for the purpose of law enforcement or criminal prosecution. This particular administrative investigation entails impartial gathering and compiling of relevant evidence and testimony regarding the disappearance of several parts involved in the LAX08PA259 aviation accident investigation, being conducted by the NTSB.

As part of this administrative investigation I am requesting to interview you on issues relevant to this investigation as you participated in the NTSB investigative activities between the dates of August 12th, 2008 through present day as party representative for GE Aviation.

The NTSB recognizes that as a GE Aviation employee you are not employed by, and do not work for, the United States government, you are not required to participate; however the Safety Board appreciates your participation on behalf of GE Aviation and your willingness to provide information related to the matters at hand.

(b)(6) PHONE INTERVIEW GE AVIATION
JANUARY 29, 2009 10:36 am EST

(b)(6) is a Flight Safety Investigator for GE. (b)(6) was the GE party representative on the Carson Helicopter accident investigation in Weaverville, CA that occurred on August 5, 2008. (b)(6) has been with GE for 22 years and has spent 12 years in (b)(6) current position.

(b)(6) has worked with the NTSB on multiple occasions with many different investigators from the Office of Aviation Safety, both headquarters and regional. This is (b)(6) first accident investigation with Jim Struhsaker, the IIC or Mike Hauf the Airworthiness / Powerplants group chair.

(b)(6) was notified of the accident and arrived on-scene on August 8th and immediately met with the IIC at the hotel and was brought up to speed on the facts. (b)(6) did go to the accident scene on August 9th and on August 11th. Then (b)(6) traveled with the team, Carson, U.S. Forest Service to Columbia Helicopters in Aurora, Oregon aboard the U.S. Forest Service plane. (b)(6) was glad that Columbia offered their services for the work on the engines and fuel control units because they were the closest to the accident scene and they had worked on the Carson helicopters previously. (b)(6) was unaware of any the issues in the relationship between Carson and Columbia.

Once they were at Columbia, (b)(6) participated in the engine examination and the fuel control unit examination on August 13th and 14th as well as discussions afterward the same days in the training trailer. During the examination he did take photographs, pointed out items of interest to the group. (b)(6) observed the fuel control unit being disassembled by the technical person from Columbia, the left engine (engine #1) and fuel control unit was disassembled and examined on August 13th and the right engine and fuel control unit (engine #2) was disassembled and examined on August 14th. The fuel control unit examination and disassembly was done in parallel to the engines. (b)(6) remained with the fuel control units during the inspections. (b)(6) recalled that when the NTSB decided to further examine specific parts as the engines or FCU's were disassembled, the parts were placed in bags. During August 13th and 14th there was a lot of discussion and interest in the housing, a particular part of the fuel control unit. Carson was certain that the engine had stopped during the flight and there was a lot of discussion during those two days about the parts of the fuel control unit and the part they may have played in that discussion of a possible cause. Carson was adamant that the FCU failed during flight and contributed to the loss of engine power and crash. (b)(6) stated there was a lot of discussion of this theory and the FCU's on the 13th and 14th, but this discussion shifted to other areas on the 15th when they continued the discussions, although Carson did not have a representative present. However, by the 15th the discussion had shifted and there was less support behind this as a cause, and therefore they felt the parts that are missing were not as critical.

(b)(6) did participate in the discussions on August 15th in the training trailer and those discussions did involve the fuel controls. (b)(6) did recall that parts of the fuel control units were brought into the training trailer but (b)(6) was not sure which ones and exactly which day. (b)(6) recalls that clear, plastic bags with engine or fuel control unit parts from the previous two days of inspections were brought into the training trailer on 8/15. However, (b)(6) could not recall actually seeing the individual parts within the bags, only the bags themselves. In addition, (b)(6) did not touch or examine the parts on 8/15 so (b)(6) cannot recall specifically if the now missing parts were actually in the trailer that day. (b)(6) did state he thinks parts were removed from bags to be looked at, but cannot say for certain which parts. (b)(6) believes these parts were the ones that the NTSB wanted to have a further look at, but (b)(6) did not recall specifically seeing the parts that subsequently went missing as being in the bags in the trailer on August 15th. Again, (b)(6) does recall that by the 15th in the discussions in the trailer the parts that have gone missing were no longer being considered as an issue. While parts were removed from bags and reviewed while in the trailer, (b)(6) cannot recall exactly which parts those were and cannot say with certainty that the parts that have gone missing were actually seen, touched or present in the trailer on August 15th.

(b)(6) was staying in the same hotel as the NTSB group and went to dinner with everyone the night of the 15th. (b)(6) recalls the representative from Carson did not return to the Columbia location to participate on the 15th but did attend dinner with the group.

(b)(6) maintains that work they have performed since the Columbia engine and fuel control unit examination have shown that the parts that are missing were not important to the likely probable cause of the helicopter accident. (b)(6) believes the parts simply went missing during the shuffle of all the parts in examination, training trailer and being boxed up.

END

VOLUNTARY STATEMENT

I, (b)(6) make the following voluntary statement to *Michele Beckford and Christopher Voeglie*, via teleconference call and they have advised me that he/she is conducting an official investigation regarding the LAX08PA259 Weaverville, California Carson Helicopters accident. I am making this statement without threat or promise and of my own free will.

See attached email correspondence for affirmation of above written summary of interview.

By my signature below I acknowledge that I have read and understood my statement consisting of this page and other pages. I have made all the changes and corrections I desire to make and have initialed each change I have made.

See email

Signature and date

Beckjord Michele

From: (b)(6)
Sent: Thursday, February 19, 2009 7:10 AM
To: Beckjord Michele
Subject: RE: Carson Helicopter Interview

Michele,

I can affirm my agreement with your notes as written, with only two minor corrections:

- Change GE Transportation to GE Aviation.
- I went to the accident scene on 9th Aug, and again on 11th Aug.

Regards,
(b)(6)

From: Beckjord Michele [mailto:michele.beckjord@ntsb.gov]
Sent: Wednesday, February 18, 2009 6:10 PM
To: (b)(6)
Subject: Carson Helicopter Interview

Good afternoon (b)(6)

Would you mind reviewing these typed up notes I took during our phone interview? I would like to make sure I accurately reflected in the notes I took the conversation we had.

Please feel free to make any changes you wish to reflect your recollections of the interview. The NTSB considers this to have been a voluntary statement, which we greatly appreciate.

If you are comfortable doing so, I have included a "voluntary statement" signature page at the end for you to fill out. This is up to you.

Or you can send back the notes with your changes and in your accompanying email just affirm your agreement with the notes as written.

Much appreciated, and warm regards,
Michele Beckjord

Michele Beckjord
Senior Accident Investigator
National Transportation Safety Board
4760 Oakland Street, Suite 500
Denver, CO 80239
303-373-3510

(b)(6)

U.S. FOREST SERVICE HELICOPTERS

TELEPHONE INTERVIEW
FEB. 17, 2009 3:00 pm MST

(b)(6) is a helicopter pilot and is the National Helicopter Program Manager, out of the Boise, Idaho office, for the U.S. forest Service. (b)(6) participated as a party representative for the Forest Service during the NTSB accident investigation of the Weaverville, CA helicopter accident. This accident is case number LAX08PA259 and occurred on August 5, 2008.

(b)(6) did work at the accident scene and did travel with the NTSB and team to the Columbia Helicopters, Inc. facility in Aurora, Oregon. From August 13-14th, 2008 (b)(6) observed the teardown of the FCU's. He recalls there were 5 Carson representatives present (3 mechanics and 2 pilots).

(b)(6) did not participate directly in the tear down, only observed. Then on August 15th, (b)(6) and (b)(6) fellow U.S. Forest Service employee did check in at the training trailer for the morning meeting, but then departed the facility around 9:30-10am to drive back to Redding, California.

From what (b)(6) observed on August 13-14 during the teardowns, there was nothing unusual about the activities or anyone there. (b)(6) did note that people were very interested in the FCU's from (b)(6) observations.

(b)(6) recalled that the NTSB had worked with Columbia to have well-controlled access to the workshop and the engines and FCU's. (b)(6) hrough the beliefs / observations were going toward the possibility of engine failure while he was there observing.

(b)(6) did not have any other items to add to the interview.

(b)(6)
U.S. FOREST SERVICE

TELEPHONE INTERVIEW
FEB. 17, 2009 3:00 pm MST

(b)(6) is an Aviation Safety Inspector for the Southwestern Regional Office of the U.S. Forest Service and (b)(6) office is in Albuquerque, NM. (b)(6) participated as a party representative for the Forest Service during the NTSB accident investigation of the Weaverville, CA helicopter accident. This accident is case number LAX08PA259 and occurred on August 5, 2008.

(b)(6) did work at the accident scene and did travel with the NTSB and team to the Columbia Helicopters, Inc. facility in Aurora, Oregon. From August 13-14th, 2008 (b)(6) observed and took notes during the engine and FCU teardowns and examinations.

(b)(6) departed the Columbia facility on August 15th, 2008 with his colleague (b)(6) in the morning to head back to Redding, California. (b)(6) did not recall being present for any activity on the morning of the 15th in the training trailer.

(b)(6) has participated in NTSB investigations before, and did not feel that there was anything unusual about the teardowns or activities on August 13-14th. (b)(6) felt it was pretty normal. (b)(6) recalled the group stayed together during the engine and FCU teardowns.

(b)(6) did note that (b)(6) felt it "weird" that Carson was setting up the activities, the whole thing from the teardown, who would do it, when, the location, and who was going to pay for it. (b)(6) felt that to (b)(6) was weird. (b)(6) thought Carson was driving a lot of the decisions during the on-scene work.

(b)(6) did not have any other items to add to the interview.

VOLUNTARY STATEMENT

I, _____ make the following voluntary statement to _____ who has advised me that he/she is conducting an official investigation regarding _____.

I am making this statement without threat or promise and of my own free will.

By my signature below I acknowledge that I have read and understood my statement consisting of this page and ____ other pages. I have made all the changes and corrections I desire to make and have initialed each change I have made.

_____

Signature and date

ATTACHMENT #2

AIRWORTHINESS GROUP CHAIRMAN'S FIELD NOTES

17 Pages
(Includes Cover Sheet)

AIRWORTHINESS GROUP CHAIRMAN'S FIELD NOTES - POWERPLANTS

A. ACCIDENT:

NTSB Accident Number: LAX08PA259
Location: Northwest of Redding, California
Date: August 05, 2008
Time of Accident: About 7:41 PM Pacific Daylight Time (PDT)
Aircraft: Sikorsky S-61N Helicopter
Registration Number: N612AZ
Serial Number: 61297

B. AIRWORTHINESS GROUP

B.1 Members

I concur that the contents of these Field Notes, generated during this phase of the investigation involving a Sikorsky S-61N Helicopter, accurately reflects the information gathered during the examination of the accident aircraft's number 1 engine by the Airworthiness Group.

	NAME	SIGNATURE
Airworthiness Group Chairman:	Mike Hauf National Transportation Safety Board Washington, DC 20594 Work: (202) 314-6396 Email: haufm@ntsb.gov	
Group Member:	Chris Lowenstein Chief of Aircraft Safety Investigation Sikorsky Aircraft Corporation Stratford, CT (b)(6)	
Group Member:	Steve Metheny Carson Helicopter Services, Inc Executive Vice President Grants Pass, OR (b)(6)	
Group Member:	David Gridley GE Transportation Aircraft Engines Lynn, MA (b)(6)	
Group Member:	John S. Fisher FAA Flight Standards Portland FSDO (b)(6)	
Group Member:	Rob Vanhorn U.S. Forest Service Safety Inspector --Airworthiness (b)(6)	

AIRWORTHINESS GROUP CHAIRMAN'S FIELD NOTES - POWERPLANTS

C. SUMMARY

On August 5, 2008, at 1941 Pacific Daylight Time, a Sikorsky, S-61N helicopter, N612AZ, experienced a loss of power to the main rotor during takeoff initial climb, and subsequently impacted trees and terrain near Weaverville, California. Post impact fire destroyed the helicopter. The airline transport pilot and 8 passengers were fatally injured, and the commercial copilot and 3 passengers were seriously injured. The helicopter was being operated under contract to the United States Forest Service by Carson Helicopter Services, Inc., as a public-use flight. Visual meteorological conditions prevailed for the cross-country flight that was originating at the time of the accident. A company visual flight rules (VFR) flight plan had been filed. The helicopter was departing from Helispot 44 (H-44, elevation 5,935 feet) en route to Helispot 36 (H-36, elevation 2,516 feet) when the accident occurred.

The helicopter had been assigned to transport approximately 50 wildland firefighter helitack crewmembers out of the Trinity Alps Wilderness of the Shasta Trinity National Forest due to forecasted worsening weather conditions. The helicopter had completed two trips, and had gone to Trinity Helibase to refuel. After it had refueled, it returned to H-44 for its third load of passengers. During departure, the helicopter impacted trees and subsequently terrain, coming to rest on its left side. A post crash fire consumed the aircraft.

During the on-scene phase of the investigation, the helicopter's two CT58-140-2 turboshaft engines were recovered from the remote accident site by helicopter and transported by road to Columbia Helicopters, Inc., located in Aurora, Oregon for further investigation. Representatives from Columbia Helicopters, Inc. disassembled the number 1 engine on August 13, 2008, under the supervision of the NTSB and witnessed by safety investigators from the Federal Aviation Administration, Columbia Helicopters, Inc, General Electric Aviation Engines, Sikorsky Aircraft, and Carson Helicopter Services, Inc. Both disassembled engines were then boxed by Columbia Helicopters, Inc[1] and shipped to Plain Parts, Inc. in Pleasant Grove, CA.

D. DETAILS OF THE INVESTIGATION – ENGINE #1

D.1 General:

1. As received by Columbia Helicopters, Inc. the subject engines were delivered, on August 13, 2008. Both engines remained attached and restrained to a shipping pallet. The engines were secured by Columbia until the arrival of the investigative participants.
2. Under the observation of the investigation participants, the engines were transferred to an area where they could be photographed and documented.

[1] No investigative representation was present at the time that Columbia Helicopters, Inc packaged and shipped the engine components.

AIRWORTHINESS GROUP CHAIRMAN'S FIELD NOTES - POWERPLANTS

3. The Airworthiness Group's initial examination of the "as received" engines consisted of performing a detailed visual examination of the exterior of each engine. The purpose of the inspection was to identify and document the physical condition of all controls and vanes

D.2 General External Inspection – Engine #1:

1. The data plate on the power section of the engine contained the following information:

Information on engine data Plate
General Electric Model Number: CT58-140-2 Serial Number: GE-E295-120C C indicates engine was converted by customer bulletin.(CEB No. 200) The maintenance records indicate that this was completed at light overhaul. The engine was topped to -1 specification. The engine data plate was not updated.

2. There was no evidence of any casing penetrations due to rotating part separations.

3. The exterior of the engine had experienced exposure to high thermal temperatures, with most accessories and external components damaged. Most of the external fuel, oil lines and electrical harnesses had been compromised due to thermal exposure. The fuel control unit remained attached to the engine. P-3 air lines were thermally damaged however remaining portion of lines appeared to be properly attached. The main throttle spindle was positioned against its full open throttle position stop. The emergency throttle linkage was observed in the closed position.

> Note: During the on-scene examination of the engine, the engine speed control flex cable assembly was intact from the FCU to the engine deck. The engine speed control flex cable assembly remained connected to the fuel control unit input linkage. The engine speed control flex cable assembly was observed properly installed and contained within the clamps attaching it to the engine. The main throttle spindle was positioned against its full open throttle position stop. To facilitate the removal of the engine from the wreckage, the engine speed control flex cable assembly was disconnected from the fuel control unit by removing the bolt that attaches the cable to the fuel control unit. The emergency throttle linkage remained connected to the fuel control unit.

4. Variable Guidevane (VG) System.

- The variable inlet guide vanes (IGVs) were noted to be at or near the closed position. (On-scene IGVs were also noted in the closed position)
- On-scene and during the examination at Columbia the SVA -Stator Vane Actuator - was found in the fully retracted position, i.e. <65% Ng.
- Stator Vane actuator feedback cable pilot valve end was observed closed.

AIRWORTHINESS GROUP CHAIRMAN'S FIELD NOTES - POWERPLANTS

- Safety wire was noted on the Stator vane actuator's top and forward mounting bolts. The safety wire was cut and removed to facilitate further disassembly.
- During the examination, a technician disconnected the SVA from the actuator linkage and the actuator mount. The IGV actuator piston for the variable stator vanes was also seized.
- Under the supervision of the GE representative, Columbia removed the piston from the actuator and then sectioned the actuator housing into two pieces to allow for an internal inspection.
- The piston was examined for witness marks. One possible witness mark was observed 1/2 inch from end on the piston indicating that it was positioned at open (>95% NG) during impact.
- According to the GE representative, During normal engine operation on a standard day, the variable stator vanes modulate between fully open at about 95% gas generator speed and above (high power) to fully closed at about 64% gas generator speed and below (low power). Engine idle speed is about 56% gas generator speed, during which the vanes are fully closed. As the gas generator speed drops through 64% during a normal engine shutdown, reducing fuel pressure causes the actuator piston to fully retract and the vanes rotate to fully closed and remain there during coast down.

5. Compressor section:

- Compressor section – all stages of the compressor blades have FOD damage. Leading edge and/or tip curls. Some trailing edge damage was noted.
- Stage 1: FOD found as follows:
  - Tip of stage 1 blade @ 3 o'clock curl and tear
  - Stage 1 blade tip @ 11 o'clock curl and tear, @ 9 o'clock tip curl and tear and leading edge FOD.
  - @ 6 o'clock into the leading edge, @ 6:30 position leading edge tear and curl.
- Loose fine light brown dirt was observed throughout the compressor.
- With the turbine section disconnected, noted that the compressor section rotates, but has obvious rubbing. The compressor section was only rotated about ¼ turn to see if it would be free to rotate.

6. Combustion assembly:

- Fuel manifold intact and normal.
- Combustion chamber caked with fine light brown dirt.
- Combustion liner is caked with fine light brown dirt.
- At 10 o'clock position on the rear combustion frame it has black sooty deposits going aft and down.

- Fine light brown dirt was observed accumulated in the combustion casing cooling air path, not the primary gas path.

7. Gas Generator Turbine

- Stage 1 turbine wheel shows rotational over temperature on the blades, the wheel diameter measures about 9.200 inches vs. 9.700 inches nominal. FOD was also observed between the blades.
- Re-solidified metal splatter was observed on the Stage 1 turbine casing.
- Stage 1 wheel rear cooling plate was observed warped approx 1/8 inch aft around the full circumference (360 degrees).
- Stage 1 turbine wheel has a black melted material on its leading edge.
- Dirt was removed from the Stage1 turbine wheel 2nd stage nozzle area; it was placed into plastic storage bag to be tested later (if needed)
- All safeties were intact on the forward stationary seal.
- Stage 2 turbine blades (all) exhibited rubbed tips.
- Stage 2 rear cooling plate is normal and the beryllium sealing ring was intact.
- Stage 2 turbine wheel fasteners were all normal.
- Coupling shaft and stage 2 front cooling plate was seized to 2nd stage turbine wheel.
- Stage 2 nozzle trailing edges have heat distortion in the way of waviness, as a result of an over-temperature condition.
- Stage 2 turbine casing coated with fine brown dirt.
- All T5 probes (installed in the 2nd stage turbine casing) are intact.
- Turbine locknut pin installed, but was bent. Took 80 ft/lbs to break the turbine lock nut loose for extraction, lock nut appears normal.
- Turbine rear shaft with #3 bearing looked normal for the heat conditions and the #3 bearing was dry, heat distress inner race and rollers rotate.
- Air to oil seal in #3 turbine nozzle area has molten metal.
- The #2 bearing lock nut broke free at 200 ft/lbs.
- #3 turbine nozzle area, #2 turbine showed show transfer wear marks from power turbine wheel.
- Turbine air seal intact.
- Turbine shaft bolt normal, this shaft bolt-breakaway torque was 180 ft/lbs.

8. Power Turbine:

- The power turbine could not be rotated; there was not any evidence of FOD damage, but resolidified molten metal was observed between the 10:00 and 11:00 position of power turbine rotor. Severe fire damage to the power turbine assembly.
- The power turbine accessory drive housing was thermally damaged.

AIRWORTHINESS GROUP CHAIRMAN'S FIELD NOTES - POWERPLANTS

9. Exhaust/Rear Drive area

- The exhaust casing was covered in white ash (magnesium oxide) and the casing was thermally damaged. The power turbine assembly (exhaust casing, power turbine rotor, rear support, and main drive shaft) was removed from the engine. The rear support was intact but bent. The main drive shaft could not be rotated. The isolator was melted away, however the isolator bolts remained attached to the rear support and yoke on main gearbox input housing.

10. Fluids and Bearings:

The engine was found to be completely dry of oil and fuel. The oil tank is an annular-shaped cylinder mounted to the front of the engine. The main oil tank remained attached to the engine; it had impact damage and was leaking oil. The tank was removed to gain access to the front frame of the engine.

- Input coupling assembly has no signs of rotational scoring.
- Engine oil filter (clean) observed loose due to gasket being thermally destroyed, no oil present in oil tank, oil filter dry and shows burn marks.
- #2 bearing seal normal.
- #2 oil jet is normal.

11. Scavenge System:

- No metal noted on auxiliary sump tee fitting magnetic plug.
- #3 scavenge Magnetic plug thermally destroyed.
- Power turbine accessory drive (#4 scavenge) chip detector thermally destroyed.

12. Front frame accessory drive

- Front frame accessory drive bevel gears engaged and normal, no tooth wear, backlash is ok.
- Normal break away torque was noted on ARP locknut.

13. Accessory drive gear box

- Could not rotate accessory drive gearbox and/or fuel control unit through radial drive shaft when they were still attached to the fuel pump. Upon disassembly the accessory drive gearbox and fuel control unit rotated freely.
- No metal noted on accessory drive gearbox magnetic plug.
- Fuel control spline appears normal.
- Fuel control radial drive shaft intact

AIRWORTHINESS GROUP CHAIRMAN'S FIELD NOTES - POWERPLANTS

14. Centrifugal fuel purifier.

- Centrifugal fuel purifier has no evidence of fuel, but has heavy thermal damage internally.

15. Fuel Filters

- Fuel Control Filter clean, dry, exhibited heat distress.
- Static fuel filter clean, dry, exhibited heat distress.

16. Fuel Control Unit

A data plate was attached to the engine fuel controller and contained the following information:

Information on engine Fuel Control Unit (FCU) data Plate
HAMILTON STANDARD Part Number: 725725-6 Model Number:JFC26 Serial Number:72835BR HS INT CODE: CEB261267288

- Fuel control spline turns freely.
- No obvious wear noted on any splines.
- #3 roller bearing seized, excessive heat damage.
- Fuel control has melted seals in it, the control linkage moves freely and everything appears to be normal. Inside of fuel control is discolored due to heat.
- Fuel control pressure regulating valve diaphragm is melted and the pressure regulating valve (PRV) is seized.
- An external visual inspection indicates no obvious damage (other than thermal) on the flow divider.
- Aspirator and bellows group:
    - A metal position adjusting cover encased the aspirator housing; the position adjusting cover was lockwired in place. The lead seal was missing (assumed melted)
    - The lockwire was removed and the metal position adjusting cover was removed. Upon removal of the cover, the aspirator and bellows assembly were no longer being retained by the internal retaining ring (it failed). The helical compression springs (item 5), spring retainers (item 4), and the temperature sensing bellows assemblies (item 6), fell out of the temperature housing (item 12).

AIRWORTHINESS GROUP CHAIRMAN'S FIELD NOTES - POWERPLANTS

17. Fuel Pump:

- The fuel pump remained connected to the engine accessory gear casing assembly and the fuel control casing. The fuel pump was disconnected from the accessory gear casing assembly and the fuel control casing to facilitate examination.
- Fuel pump drive shaft coupling was seized; it could not be rotated by hand pressure.
- Under the supervision of the NTSB and the GE rep, a Columbia technician removed the cover on the fuel pump.
- Examination indicated that the drive shaft coupling shear was intact; it had not sheared.
- Re-solidified spherical metal globules were observed between the bearing cover and the shaft end of the pumping gear.
- The booster driven gear could be rotated by hand and its shear section was intact.
- No fuel was present within the pump.
- Fuel pump has thermally damaged seals within it. Inside of fuel pump is discolored due to heat.

18. Flow Divider

- An external visual inspection indicates no obvious damage (other than thermal) on the flow divider.

AIRWORTHINESS GROUP CHAIRMAN'S FIELD NOTES - POWERPLANTS

A. ACCIDENT:

NTSB Accident Number: LAX08PA259
Location: Northwest of Redding, California
Date: August 05, 2008
Time of Accident: About 7:41 PM Pacific Daylight Time (PDT)
Aircraft: Sikorsky S-61N Helicopter
Registration Number: N612AZ
Serial Number: 61297

B. AIRWORTHINESS GROUP

B.1 Members

I concur that the contents of these Field Notes, generated during this phase of the investigation involving a Sikorsky S-61N Helicopter, accurately reflects the information gathered during the examination of the accident aircraft's left and right engines by the Airworthiness Group.

	NAME	SIGNATURE
Airworthiness Group Chairman:	Mike Hauf National Transportation Safety Board Washington, DC 20594 Work: (202) 314-6396 Email: HaufM@ntsb.gov	
Group Member:	Chris Lowenstein Chief of Aircraft Safety Investigation Sikorsky Aircraft Corporation Stratford, CT (b)(6)	
Group Member:	Levi Phillips Carson Helicopter Services, Inc Director of Maintenance Grants Pass, OR (b)(6)	
Group Member:	David Gridley GE Transportation Aircraft Engines Lynn, MA (b)(6)	
Group Member:	John S. Fisher FAA Flight Standards Portland FSDO (b)(6)	
Group Member:	Rob Vanhorn U.S. Forest Service Safety Inspector – Airworthiness (b)(6)	

AIRWORTHINESS GROUP CHAIRMAN'S FIELD NOTES - POWERPLANTS

C. SUMMARY

On August 5, 2008, at 1941 Pacific Daylight Time, a Sikorsky, S-61N helicopter, N612AZ, experienced a loss of power to the main rotor during takeoff initial climb, and subsequently impacted trees and terrain near Weaverville, California. Post impact fire destroyed the helicopter. The airline transport pilot and 8 passengers were fatally injured, and the commercial copilot and 3 passengers were seriously injured. The helicopter was being operated under contract to the United States Forest Service by Carson Helicopter Services, Inc., as a public-use flight. Visual meteorological conditions prevailed for the cross-country flight that was originating at the time of the accident. A company visual flight rules (VFR) flight plan had been filed. The helicopter was departing from Helispot 44 (H-44, elevation 5,935 feet) en route to Helispot 36 (H-36, elevation 2,516 feet) when the accident occurred.

The helicopter had been assigned to transport approximately 50 wildland firefighter helitack crewmembers out of the Trinity Alps Wilderness of the Shasta Trinity National Forest due to forecasted worsening weather conditions. The helicopter had completed two trips, and had gone to Trinity Helibase to refuel. After it had refueled, it returned to H-44 for its third load of passengers. During departure, the helicopter impacted trees and subsequently terrain, coming to rest on its left side. A post crash fire consumed the aircraft.

During the on-scene phase of the investigation, the helicopter's two CT58-140-2 turboshaft engines were recovered from the remote accident site by helicopter and transported by road to Columbia Helicopters, Inc., located in Aurora, Oregon for further investigation. Representatives from Columbia Helicopters, Inc. disassembled the number 1 engine on August 13, 2008, under the supervision of the NTSB and witnessed by safety investigators from the Federal Aviation Administration, Columbia Helicopters, Inc, General Electric Aviation Engines, Sikorsky Aircraft, and Carson Helicopter Services, Inc. Both disassembled engines were then boxed by Columbia Helicopters, Inc[1] and shipped to Plain Parts, Inc. in Pleasant Grove, CA.

D. DETAILS OF THE INVESTIGATION – ENGINE #2

D.1 General:

1. As received by Columbia Helicopters, Inc. the subject engines were delivered, on August 13, 2008. Both engines remained attached and restrained to a shipping pallet. The engines were secured by Columbia until the arrival of the investigative participants.
2. Under the observation of the investigation participants, the engines were transferred to an area where they could be photographed and documented.

[1] No investigative representation was present at the time that Columbia Helicopters, Inc packaged and shipped the engine components.

AIRWORTHINESS GROUP CHAIRMAN'S FIELD NOTES - POWERPLANTS

3. The Airworthiness Group's initial examination of the "as received" engines consisted of performing a detailed visual examination of the exterior of each engine. The purpose of the inspection was to identify and document the physical condition of all controls and vanes.

D.2 General External Inspection – Engine #2:

1. A data plate was attached to the engine and contained the following information:

Information on engine data Plate
General Electric Model Number: CT58-140-2 Serial Number: GE-E296024 T.C. IE3 P.C. 107

2. There was no evidence of any casing penetrations due to rotating part separations.

3. The exterior of the engine had experienced moderate exposure to high thermal temperatures as compared to engine number 1, with most accessories and external components thermally damaged. Most of the external fuel, oil lines and electrical harnesses had been compromised due to thermal exposure. The fuel control unit remained attached to the engine. P-3 air lines were thermally damaged however remaining portion of line appeared to be properly installed. The main throttle spindle was positioned against its full open throttle position stop. The emergency throttle linkage was observed in the closed position. Emergency throttle measured at 1.76 inches indicating it is in the shut off position.

> Note: During the on-scene examination of the engine, the engine speed control flex cable assembly was intact from the FCU to the engine deck. The engine speed control flex cable assembly remained connected to the fuel control unit input linkage. The engine speed control flex cable assembly was observed properly installed and contained within the clamps attaching it to the engine. The main throttle spindle was positioned against its full open throttle position stop. To facilitate the removal of the engine from the wreckage, the engine speed control flex cable assembly was disconnected from the fuel control unit by removing the bolt that attaches the cable to the fuel control unit. The emergency throttle linkage remained connected to the fuel control unit.

4. Variable Guidevane (VG) System.

- A large section of the Stator Vane actuator support mount was broken into several pieces, not all of which were found. The idler link was not found.

AIRWORTHINESS GROUP CHAIRMAN'S FIELD NOTES - POWERPLANTS

- The variable inlet guide vanes (IGVs) were noted to be at or near the closed position. (On-scene IGVs were also noted in the closed position)
- On-scene and during the examination at Columbia the SVA -Stator Vane Actuator - was found in the fully retracted position, i.e. <65% Ng.
- Stator Vane actuator feedback cable pilot valve end was connected and observed closed.
- Safety wire was noted on the Stator vane actuator's top and forward mounting bolts. The safety wire was cut and removed to facilitate further disassembly.
- During the examination, a technician disconnected the SVA from the actuator linkage and the actuator mount. The IGV actuator piston for the variable stator vanes was also seized.
- Under the supervision of the GE representative, Columbia removed the piston from the actuator and then sectioned the actuator housing into two pieces to allow for an internal inspection.
- The piston was examined for witness marks and none were found.
- According to the GE representative, During normal engine operation on a standard day, the variable stator vanes modulate between fully open at about 95% gas generator speed and above (high power) to fully closed at about 64% gas generator speed and below (low power). Engine idle speed is about 56% gas generator speed, during which the vanes are fully closed. As the gas generator speed drops through 64% during a normal engine shutdown, reducing fuel pressure causes the actuator piston to fully retract and the vanes rotate to fully closed and remain there during coast down.
- Stator vane rigging is on the C mark
- No resistance on the fuel control unit pilot valve arm.
- Radial drive shaft to accessory was intact and no damage noted.
- Fuel control's pilot valve linkage was all intact, pilot valve piston was seized. The temperature sensing bellows cover is missing, safety wire was still intact.
- The following internal components of the aspirator and bellows were not observed inside of housing but were later identified at rest on the engine firewall. The bellows assembly, helical compression spring, and spring retainer. The internal retaining ring could not be found.
- The T2 tubes did not have any indication of thermal damage, however thermal damage was indentified in the T2 housing.

5. Compressor section:

- A stage 1 blade has moderate tip curl and a second blade has a small tear.
- Four adjacent inlet guide vanes has minor trailing edge curl in the direction of rotation, at the 12:30 to 2:00 location.

AIRWORTHINESS GROUP CHAIRMAN'S FIELD NOTES - POWERPLANTS

- Gas generator spins freely.
- Front frame accessory drive has oil leak into starter.
- Front frame accessory drive has oil present.
- Oil noted in the Accessory Gear box flange, upper to lower casing.
- Evidence of soot throughout the compressor assembly, on all flow path surfaces. The soot was more pronounced towards the forward compressor blades.
- No dirt was observed in the compressor section as compared to engine number 1.
- No other compressor damage noted; no compressor rubbing.

6. Combustion assembly:

- Fuel manifold intact and normal.
- Combustion case @ 2:00 position is dented.
- Igniter plug @ 2:00 is intact and no damage.
- Exciter box is fire distressed, and outer case is compromised.

7. Gas Generator Turbine

- Stage 1 nozzle has black soot on all vanes. Black soot can easily be wiped off.
- Stage 1 turbine blades do NOT exhibit any rubbing or over temperature damage.
- There was no blade tip damage.
- All safeties were intact on the forward stationary seal.
- 2nd stage turbine has loose material and debris on it aft end.
- Turbine lock nut cap retainer intact.
- No visible rub marks or scoring of 2nd stage turbine blades.
- .825 inches H drop on shaft bolt.
- Stage 2 turbine blades did NOT exhibit any rubbing or over temperature distress damage.
- All four cooling plates were normal and the beryllium sealing ring was intact.
- Stage 2 turbine wheel fasteners were all normal.
- All T5 probes (installed in the 2nd stage turbine casing) are intact.
- Turbine locknut pin installed. Took 80 ft/lbs to break the turbine lock nut loose for extraction, lock nut appears normal.
- Turbine rear shaft with #3 bearing looked normal
- Air to oil seal in #3 turbine nozzle looked normal.
- The #2 bearing lock nut broke free at 165 ft/lbs.
- #3 turbine nozzle area, #2 turbine looked normal
- Turbine air seal intact.

AIRWORTHINESS GROUP CHAIRMAN'S FIELD NOTES - POWERPLANTS

- Turbine shaft bolt normal, this shaft bolt-breakaway torque was 165 ft/lbs.

8. Power Turbine:

- The power turbine could not be rotated; there was not any evidence of FOD damage, but resolidified molten metal was observed between the 10:00 and 11:00 position of power turbine rotor. Severe fire damage to the power turbine assembly.
- After the removal of the re-solidified molten metal, the power turbine could be rotated freely through its full rotation by hand pressure.
- Power turbine has evidence of oil in sump area.
- Power turbine accessory drive Nf gear box chip detector is wet, oil is present and gear box turns with difficulty by hand. All seals were thermally damaged. Material was found on the magnetic plug, the material was removed and identified as small pieces of carbon.
- During the on-scene activities, the engine was removed with the high speed shaft and input spur and input pinion still connected. During the engine inspection at Columbia, the high speed shaft was inspected and no scoring was observed on the splined coupling.
- The NF flex cable was intact and could be rotated by hand.
- The PT accessory radial drive shaft and all gears were intact

9. Exhaust/Rear Drive area

- The exhaust casing was slightly damaged. The power turbine assembly (exhaust casing, power turbine rotor, rear support, and main drive shaft) was removed from the engine. The rear support was intact but bent. The isolator was thermally destroyed, however the isolator bolts remained attached to the rear support and yoke on main gearbox input housing.

10. Fluids and Bearings:

- Evidence of oil was found throughout the engine. The oil tank is an annular-shaped cylinder mounted to the front of the engine. During the examination at Columbia, the oil tank was not attached to the engine.
- During the on-scene activities, the oil tank remained attached to the engine. To facilitate removal of the engine, the oil tank was disconnected from the engine and placed within the main wreckage. Oil was observed within the tank; as the tank was removed, oil drained out of the tank onto the ground.
- All five mainline bearings were in good condition and oil wetted.
- The oil filter was clean and dry.

11. Scavenge System:

- No metal noted on accessory drive gearbox chip detector.

- No metal noted on auxiliary sump tee fitting magnetic plug.
- #2 and #3 bearings magnetic plugs are clean.
- Oil is present in #2 bearing auxiliary sump.

12. Front frame accessory drive

- Front frame accessory drive bevel gears engaged and normal, no tooth wear, backlash is ok.
- Normal break away torque was noted on ARP locknut.

13. Accessory drive gear box

- Could not rotate accessory drive gearbox and/or fuel control unit through radial drive shaft when they were still attached to the fuel pump. Upon disassembly the accessory drive gearbox and fuel control unit rotated freely.
- Fuel control spline appears normal.
- Fuel control radial drive shaft intact.
- Oil pump was free to rotate.
- Oil noted in the accessory gearbox.

14. Centrifugal fuel purifier.

- Centrifugal fuel purifier has no evidence of fuel, but has heavy thermal damage internally.

15. Fuel Filters

- Fuel Control Filter clean, moist, exhibited heat distress on section of filter.
- Static fuel filter clean, dry, exhibited heat distress.

16. Fuel Control Unit

A data plate was attached to the engine fuel controller and contained the following information:

Information on engine Fuel Control Unit (FCU) data Plate
HAMILTON STANDARD Part Number: 725725-5 Model Number: JFC26 Serial Number: 49882

- Fuel control spline turns freely.
- No obvious wear noted on any splines.
- Fuel control has melted seals in it, the control linkage moves freely and everything appears to be normal. Inside of fuel control is discolored due to heat.

AIRWORTHINESS GROUP CHAIRMAN'S FIELD NOTES - POWERPLANTS

- Fuel control pressure regulating valve diaphragm is melted and the pressure regulating valve (PRV) is seized.
- Aspirator and bellows group:
  - The T2 bellows adjusting cover which would normally encase the aspirator housing was not present; the T2 bellows adjusting cover lockwire remained intact and in place. The lead seal was missing (assumed melted).

17. Fuel Pump:

- The fuel pump remained connected to the engine accessory gear casing assembly and the fuel control casing. The fuel pump was disconnected from the accessory gear casing assembly and the fuel control casing to facilitate examination.
- Part number: 5002183P02
- Serial Number: SUS03569BR
- Fuel pump drive shaft coupling was seized; it could not be rotated by hand pressure.
- Under the supervision of the NTSB and the GE rep, a Columbia technician removed the cover on the fuel pump.
- Examination indicated that the drive shaft coupling shear was intact; it had not sheared.
- Re-solidified spherical metal globules were observed between the bearing cover and the shaft end of the pumping gear.
- The booster driven gear could be rotated by hand and its shear section was intact.
- No fuel was present within the pump.
- Fuel pump has thermally damaged seals within it. Inside of fuel pump is discolored due to heat.

18. Flow Divider

- An external visual inspection indicates no obvious damage (other than thermal) on the flow divider.

ATTACHMENT #3

CARSON HELICOPTERS, INC. FIELD NOTES

- Written by (b)(6) [redacted]
- Given to NTSB per party system
- Documentation of FCU teardown observations

*Contains personal opinion of Carson Helicopters, Inc. employee. These personal observations are not shared by, or agreed to, by other parties in the Airworthiness Group. Therefore, the personal analytical statements contained herein are not reflected in NTSB Field Notes – only the factual documentation of the damage that was agreed to by the group were subsequently included in the NTSB Airworthiness Group Field Notes signed by entire team.

5 Pages
(Includes Cover Sheet)

NTSB Accident Investigation For Aircraft N612AZ Date 8/13/2008

Number 1, SN 295-120C, Engine tear down and inspection at Columbia Helicopters in Aurora, OR.

Emergency throttle in the closed position. Normal throttle in the full throttle position , against the stop.
High speed dive shaft bent, and rear support bent.
Input coupling has no signs of rotational scaring.
90 degree Nf gear box housing is thermally destroyed.
Fuel control unit, SN 72835R.
Static fuel filter gone.
#3 scavenge Mag plug missing
#4 scavenge Mag plug missing
Inlet Guide Vane (IGV) actuator seized.
FOD found for the following
tip of stage 1 blade @ 3 o'clock curl and tear
Stage 1 blade tip @ 11 o'clock curl and tear, @ 9 o'clock tip curl and tear and leading edge Fod
@ 6 o'clock into the leading edge, @ 6:30 position leading edge tear and curl.
#2 turbine blades has rubbed tips indicating rotation at the time of the rub.
All T5 probes are intact.
#3 turbine nozzle area, #2 turbine showed show transfer wear marks from power turbine wheel.
Air to oil seal in #3 turbine nozzle area has molten metal.
Turbine locknut pin installed.
Engine oil filter observed loose, no evidence of gasket, no oil present in oil tank, oil filter dry and shows burn marks.
Mag plug from Accessory drive gear box shows no metal or oil.
Stator Vane actuator feedback cable pilot valve end observed closed.
Centrifugal fuel pump has no evidence of fuel , but has heavy thermal damage internally
Fuel control radial drive shaft intact
Nr shaft from gear box into the power turbine is intact
Power turbine has no fod evidence but has molten metal between 10:00 and 11:00 position. Server fire damage to the power turbine.
Fuel control unit accessory gear box has good integrity. Fuel control spline appears normal.
Fuel pump seized and shafts intact.
Fuel control spline turns freely.
No wear on any splines.
#3 roller bearing seized, excessive heat damage.
Data plate was taken off the #1 engine and given to Mike Hauf of the NTSB.
H drop .822
Turbine lock nut pin was bent. Took 80 ft/lbs to break the turbine lock nut loose for extraction, lock nut appears normal.
Turbine rear shaft with #3 bearing look normal for the heat conditions.
Stator vane actuator's top and forward mounting bolt was a little loose after safety wire was cut.
#2 rear cooling plate is normal and the beryllium sealing ring was intact.
#2 turbine stage wheel fastener all normal.
Coupling shaft and stage 2 front cooling plate seized to #2 turbine wheel.
Stage 2 nozzle trailing edges have heat distortion in the way of waviness, a result from over temp..
1st stage turbine wheel show severe rotational overtemp, the wheel measures about 9.200 inches.

Fine light brown dirt is excessively accumulated in the combustion casing cooling air path, not the primary gas path.
#1 stage turbine wheel has a black melted material on its leading edge.
All safeties were intact on the forward stationary seal.
Stage 1 wheel rear cooling plate warped approx 1/8 inch aft around the full circumference (360 degrees).
Turbine air seal intact.
Turbine shaft bolt normal, this shaft bolt break away torque was 180 ft/lbs.
#2 bearing seal normal.
#2 oil jet is normal.
Front frame accessory drive bevel gears engaged and normal, no tooth wear, blacklash is ok.
Whole turbine section disconnected , noticed that the compressor section spins but has obvious rubbing, only rotated about ¼ turn to see if it would be free to spin.
#2 bearing lock nut broke free at 200 ft/lbs.
Fuel control has melted seals in it, the control linkage moves freely and everything appears to be normal. Inside of fuel control is dis-colored due to heat.
Fuel control pressure regulating valve diaphragm is melted and the PRV is seized.
Flow divider observed to be normal considering heat damage.
#1 Engine stage 2 nozzle area has dirt removed and placed into plastic storage bag to be tested later.
#1 Engine compressor section – all stages of the compressor blades have fod damage.
Stator vane actuator rod has impact mark possibly, 0.5 inches from aft end, the marks align with casing guides.
#1 Engine fuel manifold intact and normal.
#1 engine combustion chamber caked with fine light brown dirt.
#1 engine combustion liner is caked with fine light brown dirt.
At 10 o'clock position on the rear combustion frame it has black sooty deposits going aft and down.
End of #1 Engine notes

NTSB Accident Investigation For Aircraft N612AZ Date 8/14/2008

Number 2, SN 296024D, Engine tear down and inspection at Columbia Helicopters in Aurora, OR.

Oil noted in the Accessory Gear box flange, upper to lower casing.
Stator Vane actuator idler link melted and mostly missing.
Exciter box is fire distressed, and outer case is compromised.
Trailing edge curl on 12:30 to 2:00 position of the Inlet guide vane.
Stage 1 blade has large tip curl @ 2:00 position, and stage 1 blade@11:00 has a tear.
Front frame accessory drive has oil leak into starter.
C mark on stage 3
Stator vane is on the C mark
Oil present
Emergency throttle @ 1.76 inches indicating it is in the shut off position.
Power turbine accessory drive Nf gear box mag plug is wet, oil is present and gear box does turn hard, material was found on the mag plug, the material was removed and has small pieces of carbon on it. It was bagged for examination.
#3 bearing chip plug, had oil present and fuzz material on plug.
Main oil filter dry, spring installed.
Static fuel filter has evidence of heat on the filter, evidence of moisture.
Centrifical fuel filter shows signs of heat distress, and is dry and signs of heat damage.
Power turbine has evidence of oil in sump area, no signs of damage and turns slightly.
#3 nozzel has no damage
P-3 air line no damage
Stator vane actuator feedback cable pilot valve end is connected and in the closed position.
No resistance on the fuel control unit pilot valve arm.
One mount stud on accessory broke out during removal.
Radial drive shaft to accessory was intact and no damage.
Oil is present in #2 bearing aux sump.
T5 harness intact no discrepencies.
Combustion case @ 2:00 position is dented.
Igniter plug @ 2:00 is intact and no damage.
Fuel flow divider intact.
2nd stage turbine has loose material and debris on it aft end.
Turbine lock nut cap retainer intact.
No visible rub marks or scoring of 2nd stage turbine blades.
.825 inches H drop on shaft bolt.
Fuel pump seized and thermally damaged.
165 ft/lbs to break away torque on turbine shaft bolt nut.
Burrilum air seal intact on 2nd stage aft.
#3 bearing rotates with ease.
Gas generator spins freely.
Front frame accessory drive has oil present.
Stage 1 turbine wheel intact, no signs of rubbing, blade tip damage does not exists, has black sooting but can be wiped off.
Stage 1 nozzle has black soot on all vanes.
150 ft/lbs break away on the turbine shaft bolt.
#2 bearing lock nut break away torque 165 ft/lbs

Compressor rotors all look good.
Stage 1 compressor blade had fod damage and 4 blades are damaged on the inlet guide vanes.

Fuel Control
Fuel control's pilot valve linkage was all intact, pilot valve piston was seized. The temp sense bellows cover is missing, safety wire still intact. Its internal components, plunger, spring and bellows are missing. There was heavy smoke and fire damage inside the housing. All internal linkage apperared to be connected and accounted for.

Do to the evidence of this engine, it appears that the #2 engine was not running during aircraft impact with the ground.

ATTACHMENT #4

ITEMS INCLUDED IN THIS ATTACHMENT:

- Table of Contents
- Letters Carson Helicopters, Inc. to NTSB
- Emails
- Columbia Helicopters, Inc. work order

16 Pages
(Includes Cover Sheet)

TABLE OF CONTENTS – ATTACHMENT #4

1. October 31, 2008 letter from David M. Nadler of Dickstein Shapiro, LLC, counsel to Carson Helicopters, Inc. addressed to NTSB General Counsel, Mr. Gary Halbert.
   - [Dickstein Shapiro document number DSMDB.2512205.01]

2. September 3, 2008 letter from (b)(6) [redacted] of Carson Helicopters, Inc. addressed to NTSB Investigator-In-charge, Mr. James Struhsaker.
   - [Carson Helicopter's Inc. document number DSMDB-2492918v01.]

3. Not dated - confidential written request from Carson Helicopters, Inc. to NTSB to undertake specific actions regarding the preservation, securing and obtaining of important documentary and other evidence deemed by Cason to be relevant to the investigation of the LAX08PA259 accident. Sent around the date of August 27, 2008.
   - [Carson Helicopters, Inc. document number DSMDB-2489358v02]

4. August 22, 2008 email from (b)(6) [redacted] of Carson Helicopters, Inc to Mike Hauf, NTSB requesting documentation in report that the engines were not packed up at Columbia Helicopters before Carson Helicopters, Inc. left. Also requesting a Carson representative be on site when the fuel control units arrive in Washington, DC to do a visual inspection of the items to ensure they arrive "in the same condition as we last saw then in Oregon".

5. August 22, 2008 email from (b)(6) [redacted] of Columbia Helicopters, Inc. to NTSB's Investigator-In-Charge providing tracking numbers for shipments of fuel control units and other parts from accident helicopter LAX08PA259. These tracking numbers and shipment information is part of the evidence custody / tracking information.

6. January 27, 2009 email from (b)(6) [redacted] for Carson Helicopters, Inc to Michele Beckjord, NTSB acknowledging that Carson paid for the FedEx shipping of boxes containing fuel control units from Columbia Helicopters, Inc. to the NTSB in Washington, DC. The email also acknowledges that "*we see no way any parts could have come out of the box during transit, and there was no damage to the parts inside the box, as they were contained in separate sealed plastic bags.*"

   This email refers to a second fuel control shipment with damage of parts due to packaging. This second shipment is the fuel control unit that had been removed from the accident helicopter prior to the accident, had remained at Columbia and was sent directly from Columbia to Hamilton Sundstrand for examination. This fuel control unit had not been examined by the NTSB while at Columbia, and the NTSB IIC or Airworthiness group chairman did not take custody or control of this fuel control unit at any time.

7. January 20, 2009 copy of Columbia Helicopters, Inc. Work Order and invoice for payment showing the employees assigned to the LAX08PA259 accident from august 11-18. Those employees with direct access to the fuel control units were interviewed as part of this administrative investigation.

DICKSTEINSHAPIROLLP

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October 31, 2008

VIA E-MAIL AND FACSIMILE (202-314-6090)

Gary Halbert
General Counsel
National Transportation Safety Board
490 L'Enfant Plaza, S.W.
Washington, DC 20594

Re: NTSB Identification: LAX08PA259
Aircraft: Sikorsky S-61N – N612AZ
Date: August 5, 2008
Location: Weaverville, CA

Dear Mr. Halbert:

This firm is counsel to Carson Helicopters, Inc. ("Carson"). As you may know, Carson was the operator of the helicopter (N612AZ) involved in the above-referenced accident.

The purpose of this letter is to request that the NTSB conduct an investigation of the events and circumstances surrounding the handling of the fuel control units related to the helicopter. These fuel control units include the two units recovered from the helicopter after the accident and a unit that had previously been removed from the helicopter. All of these units were serviced by Columbia Helicopters, Inc. ("Columbia"), the only authorized maintenance facility for these units in the United States and a direct competitor of Carson in the helicopter services industry.

At the direction of NTSB, on August 13-14, 2008, the two fuel control units recovered after the accident were disassembled and inspected at Columbia's overhaul facility in Aurora, Oregon, and were left bagged and shelved at Columbia on August 15, 2008. These units remained in the sole custody of Columbia for several days until the NTSB directed that they be sent to NTSB Headquarters. An inspection of these units at NTSB Headquarters on August 28, 2008 revealed several irregularities with both of these fuel control units. These units had been packaged by Columbia in two separate boxes, not in their original bags, and were missing numerous parts that had been present during the initial teardown of these units on August 13-14. Many parts critical to any analysis of the role these fuel control units played in the accident were missing from the units shipped by Columbia to NTSB Headquarters. The boxes shipped to NTSB Headquarters also contained additional parts that were not present when the units were initially disassembled on Columbia's overhaul facility, and other parts had been switched between the two containers.

In addition to the missing and additional parts, the #1 bellows section/assembly was in the box with the #2 fuel control and the #2 bellows section/assembly was in the box with the #1 fuel control. These two units and associated parts were originally separated in plastic bags and placed on separate shelves when left by NTSB personnel at Columbia. These discrepancies were immediately apparent to the NTSB investigation team members and the different condition of the parts was documented with photographs.

Additionally, at the time of the accident, Columbia was in possession of another Carson fuel control unit that had been removed from the helicopter prior to the accident and sent to Columbia for repair. The NTSB requested that this fuel control unit be sent from Columbia to the NTSB investigative team at Hamilton Standard's (the unit manufacturer) facilities in Connecticut along with any associated inspection and repair documentation. That unit was unpacked in the presence of the NTSB investigative team, including fuel control experts from Hamilton Standard.

Upon opening the package, the team discovered that the unit had been completely disassembled, down to the smallest parts, and was literally in hundreds of pieces -- with every part stripped and cleaned. The parts were commingled in two plastic bags. The dozens of intricate, small parts from the interior of the fuel control housing were thrown together in these plastic bags in a very haphazard and damaging manner. The Hamilton Standard fuel control experts stated that they would not certify this unit to be re-assembled or overhauled because of probable damage to many parts from the manner in which they were packed and shipped and that the unit was now scrap. In addition to the disassembled parts being thrown loosely and haphazardly into plastic bags, there was no paperwork or documentation accompanying this fuel control unit. It was therefore impossible to ascertain when the unit was disassembled or cleaned, or whether any parts had been serviced. The lack of documentation from Columbia also makes it impossible to determine the condition of the unit as it was received or the possible reasons for the failure of this fuel control unit to perform properly.

In addition to the improper handling and documentation of the fuel control units themselves, Columbia included a small container of aircraft fuel with the unit shipped to Hamilton Standard. This container of aircraft fuel was not properly packaged and the package in which Columbia shipped the unit and the container of aircraft fuel was not properly labeled as containing dangerous goods as required by relevant Federal hazardous materials transportation law. 49 U.S.C. §§ 5101, et seq.

In regards to the missing parts, we understand that the NTSB may have contacted Plain Parts of Sacramento, California, to determine whether the missing parts were somehow sent to be stored with the Helicopter's engines and the remainder of the wreckage. On Tuesday, October 28, 2008, the boxes in storage at Plain Parts were opened in the presence of witnesses from the investigation team (including Carson). Upon opening these boxes, which up to that time had been sealed, the investigation team's first order of business was to conduct an exhaustive search of the contents of the boxes to attempt to locate the missing parts. The investigative team

exhaustively sorted through all of the individual parts in the box and searched the packaging material but were unable to find any of the missing parts. While examination of the materials at Plain Parts was a useful step, it did not resolve this matter in any way. These parts -- which may be crucial to a determination of the ultimate cause of the accident -- now appear to be permanently missing. There also continues to be no explanation for the apparent switching of parts between the bags that contained the fuel control units or the inclusion of new parts that were not part of the original assemblies.

We are very concerned about the manner in which these fuel control units were handled. Columbia's conduct with regard to these fuel control units raises serious questions about the handling and chain of custody of the fuel control units which may have a material effect on the NTSB's investigation into the cause of the accident. We have addressed this matter in prior correspondence with the NTSB's Senior Investigator, Jim Struhsaker. However, given the potential implications of this issue, we believe that a full investigation under the auspices of your office is warranted. We respectfully request the opportunity to meet with you to discuss this matter at your earliest opportunity. I will call your office to schedule an appointment.

Thank you for your cooperation.

Sincerely,

[redacted]

David M. Nadler
Counsel to Carson Helicopters, Inc.

cc: James Struhsaker

CARSON HELICOPTERS INC.

~~CONFIDENTIAL~~

3 September 2008

Via Email

Mr. Jim Struhsaker
Senior Investigator, Team Leader
National Transportation Safety Board

Re: "Iron 44" Firefighting Accident

Dear Jim:

Carson Helicopters, Inc. appreciates the opportunity to serve as a member of the NTSB investigation team of the Carson S61 helicopter (N612AZ) accident that occurred in California on 5 August 2008 (the "Iron 44" firefighting accident). We are writing to request that the NTSB conduct an investigation of the events and circumstances related to the handling of the engine fuel control units of the helicopter from the initial disassembly at Columbia Helicopters in Oregon on 13-14 August 2008 to the inspection of those units following their transfer to NTSB Headquarters in Washington, DC on 28 August 2008.

At the direction of NTSB, on 13-14 August 2008, the fuel control units were disassembled and inspected at the Columbia Helicopters overhaul facility in Aurora, Oregon and were left bagged and shelved at Columbia Helicopters on 15 August 2008. As you know, the fuel control units on the N612AZ were previously overhauled by Columbia Helicopters, which is the only authorized maintenance facility for these units in the United States.

The Carson team left Columbia Helicopters' facility on 14 August 2008 to attend a memorial service for the firefighters killed in the accident. The remaining NTSB members left Columbia Helicopters' facility on the afternoon of 15 August 2008. The units remained in the custody of Columbia Helicopters until you directed that they be sent to NTSB Headquarters in Washington, D.C. late the following week.

An inspection of the fuel control units at NTSB Headquarters on 28 August 2008 by members of the NTSB investigation team (including Carson , NTSB, and GE) revealed several apparent irregularities with both of the fuel control units. The units were packaged, unbagged, in two separate boxes sent from Columbia Helicopters to the NTSB lab.

The units appear to have been altered from the condition they were in on 15 August 2008, as verified by NTSB witnesses and photographs taken when the units were disassembled at Columbia Helicopters.

The following anomalies have been noted:

<u># 1 Fuel Control</u>
T2 bellows metal cap missing
T2 bellows snap ring missing
T2 bellows assembly missing
Cap screw near T2 bellows missing
Plastic end cap cover inserted in parts bag that was not part of original assembly

<u>#2 Fuel Control</u>
Cap screw near T2 Bellows missing
Internal bellows lever temp sensing (Item #1 fig.9 in accessories overhaul and parts catalog) for fuel control SEI-185 missing.

All of these parts were present during the teardown of the units performed at Columbia on 14 August. The # 1 fuel control bellows section never had a plastic end cap until it arrived with one in the bag in Washington, DC (and the original metal cap is gone).

In addition to the missing parts, the #1 bellows section/assembly was in the box with the #2 fuel control and the #2 bellows section/assembly was in the box with the #1 fuel control. These two units and associated parts were originally separated in plastic bags and placed on separate shelves when left by NTSB personnel at Columbia Helicopters. These discrepancies were immediately apparent to the NTSB investigation team members, and the different condition of the parts was documented with photographs. In regards to the missing parts, we understand that the NTSB intends to contact Plain Parts of Sacramento, CA, where the engines are presently being stored in unopened boxes with the remainder of the wreckage. We request that the boxes be opened only in the presence of witnesses from the investigation team (including Carson) and with full documentation of their contents. While examination of the materials at Plain Parts is a useful step, we do not believe that it is sufficient to resolve the matter as there can be no assurance that any parts found at that facility will be the actual parts from the N612AZ. It also will not explain the apparent switching of parts between the bags that contained the fuel control units or the inclusion of new parts that were not part of the original assemblies.

As you know, the fuel control units are directly relevant to the NTSB's investigation of the cause of the accident and, in particular, whether one of the engines lost power and that inquiry has not been concluded. Accordingly, we respectfully request that the NTSB conduct an investigation of the circumstances related to the handling of the fuel control units, including the chain of custody and control of the units from disassembly at Columbia Helicopters in Oregon to inspection of the units in Washington, DC, to determine why their condition upon receipt at the NTSB lab was significantly different from what existed upon conclusion of the initial teardown on 15 August 2008.

We stand ready to continue to assist and support the investigation process.

Best regards,

(b)(6)

Copy to: All Members of Investigation Team

CARSON
HELICOPTERS INC.

~~CONFIDENTIAL~~

25 September 2008

Via Email
Mr. Jim Struhsaker
Senior Investigator, Team Leader
National Transportation Safety Board

Re: "Iron 44" Firefighting Accident

Dear Jim:

Carson Helicopters, Inc., would like to take this opportunity to update you on the status of the fuel control unit from N612AZ that was removed from the aircraft in May 2008 prior to the 5 August accident. That control unit was removed from the aircraft after power issues on an engine and it was subsequently sent to Columbia Helicopters's repair facility for inspection and overhaul.

The NTSB requested that this fuel control unit and all associated paperwork be sent from Columbia Helicopters to the NTSB team in Connecticut for arrival the week of 15-19 September 2008. The unit was unpacked in the presence of the NTSB accident team members on 18 September. This team included fuel control experts from GE and Hamilton Standard, the original manufacturer.

Upon opening the package, the team discovered that the unit in question had been completely disassembled, down to the very smallest parts. The unit was literally in hundreds of pieces, and every part had been stripped and cleaned. The parts were deposited loosely in two plastic bags, which were in turn put in a cardboard box. The dozens of intricate small parts from the interior of the fuel control housing were thrown together in the plastic bags such that there was damage to some of the very small parts. The Hamilton Standard fuel control experts offered the opinion that they would not ever certify this unit to be re-assembled or overhauled because of probable damage to many parts due to the manner in which they were packed and shipped.

In addition to the disassembled parts being thrown loosely and haphazardly into plastic bags in an unassigned and jumbled fashion, there was absolutely no paperwork or documentation accompanying the fuel control unit. It was impossible to ascertain when the unit was disassembled or cleaned, or whether any parts had been serviced or not. The lack of documentation from Columbia also does not provide any information about the as received condition of the unit or the possible reason(s) for its failure to perform properly.

This type of handling of extremely expensive and sensitive parts is, at the very least, highly irresponsible; combined with the known issues concerning Columbia's botched return of the earlier accident fuel control units (documented by NTSB reports and photos and our letter to you of 3 September 2008), we are very disturbed by the consistent pattern of damage and mishandling of parts by Columbia Helicopters. Both sets of fuel control shipments have exhibited 1) component damage and missing parts, 2) mishandling and/or improper disassemblage of parts, and 3) lack of documentation for the very parts that are important to this accident investigation.

It is our belief that this mishandling of evidence needs to documented and addressed in a full and fair fashion with Columbia by the NTSB investigative team .

Best regards,

(b)(6)

~~CONFIDENTIAL~~

Proposed NTSB Action Items
NTSB ID No. LAX08PA259
S-61N (U.S. Civil Registry No. N621AZ)

Carson Helicopters Inc. ("Carson"), a member of the NTSB Investigation Team, respectfully requests that the NTSB Team undertake the following actions to preserve, secure and obtain important documentary and other evidence that is relevant to the investigation in this matter.

We believe that the following items are important for the Board's proper investigation of the accident, and that each item is relevant to determining the cause of the accident. Under 49 C.F.R. § 831.9, the NTSB is authorized to obtain the documents. Pursuant to 49 C.F.R. § 831.6 and NTSB policy, Carson requests that any documents produced at the direction of the NTSB in the course of this investigation be deemed exempt from public disclosure under the Freedom of Information Act, 5 U.S.C. §552, or under any other applicable statute, regulation, or policy.

1. Carson requests that the NTSB direct Columbia Helicopters, General Electric, and Sikorsky to each hold, preserve, and maintain in its ordinary course of business, and issue a document request for, each of the following categories of information within one-year prior to the date of the accident (August 5, 2008):

a. Any and all records, including but not limited to, FAA service tags or other documents evidencing airworthiness, work orders, and maintenance actions and records, regarding all Hamilton Standard Model 725725-5 or -6 Fuel Controls for use on General Electric Model CT58-140 turboshaft series engines provided for service by Carson, or any other vendor or operator;

b. Any and all records regarding the removal of any General Electric Model CT58-140 turboshaft series engine, and any work performed on the engine, prior to the engine's scheduled overhaul or maintenance date; and

c. A list of all vendors and operators who have used Columbia Helicopters to provide overhaul and maintenance services on Hamilton Standard Model 725725-5 or -6 Fuel Controls for use on General Electric Model CT58-140 turboshaft series engines.

2. Carson requests that the NTSB direct General Electric, Hamilton Standard, and Columbia Helicopters to hold, preserve, and maintain in their ordinary course of business, and issue a document request for, any commercial engine bulletin ("CEB"), service letter, service bulletin, internal memoranda, and airworthiness directive, in their possession, custody or control, regarding Hamilton Standard Model 725725-5 or -6 Fuel Controls for use on General Electric Model CT58-140 turboshaft series engines, including the fuel control's T-2 bellows component and/or regarding the use of metal versus plastic dust caps on that component.

3. Carson requests that it be present at any further disassembly and/or testing of the engines and the fuel controls on the accident aircraft.

Beckjord Michele

From: Hauf Michael
Sent: Saturday, August 23, 2008 5:15 AM
To: Struhsaker Jim
Subject: FW: REPORT REQUEST

Jim,

Isn't hindsight wonderfull!!
I was just thinking, if Columbia has not packed up the equipment, specifically the fuel control units yet, it might be a good idea for either FAA or NTSB oversite to ensure the integrity of the equipment and that everything is properly labeled. If needed, I could fly back for a day and help out.

Mike

From: (b)(6)
Sent: Fri 8/22/2008 11:49 PM
To: Hauf Michael
Cc: (b)(6)
Subject: REPORT REQUEST

Mike.

I forgot to ask that there be something mentioned in the report about the engines not being packed-up at Columbia Helicopters when we left.

We would also request to have a Carson representative on site when the fuel controls arrive to do a visual inspection of the items to ensure they arrived in the same condition as we last saw them in Oregon.

Thank you,
(b)(6)
Carson Helicopters, Inc

Beckjord Michele

From: Struhsaker Jim
Sent: Saturday, August 23, 2008 9:32 AM
To: Hauf Michael; Keliher Zoe
Subject: FW: Engine Parts Shipping

James F. Struhsaker
Senior Air Safety Investigator
Kailua-Kona, HI 96740
[redacted]
(253)275-2880 Fax

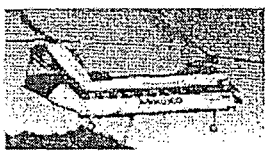
-----Original Message-----
From: (b)(6) [redacted]
Sent: Friday, August 22, 2008 12:13 PM
To: Struhsaker Jim
Cc: (b)(6) [redacted]
Subject: Engine Parts Shipping

Jim,

The shipments for the fuel control units and the two free wheeling units left today and these are the tracking numbers. The two engines are all packaged and will ship Monday.

Fuel Control NTSB 23766 fed ex 9761 1819 1550 2nd day
Fuel Control NTSB 23766 fed ex 9761 1819 1549 2nd day
Freewheeling Units Helicopter support 23767 fed ex 9761 1819 1538 2nd day

COLUMBIA HELICOPTERS
(b)(6) [redacted]
14452 Arndt Road NE, Aurora, Oregon 97002
(b)(6) [redacted]



Beckjord Michele

From: (b)(6)
Sent: Tuesday, January 27, 2009 10:27 AM
To: Beckjord Michele
Cc: (b)(6)
Subject: shipping info on Carson fuel control parts

Hi, Michele:

Thanks for your time in Grants Pass at our facility last week regarding the missing and swapped fuel control parts. Further to your question about who paid for the shipping, we have looked into that here. It appears that Columbia billed our Fedex account in Perkasie when they shipped the parts on 22 August, so Carson paid the shipping.

As to your question about filing a claim, we did not realize at the time that our fedex account paid for the shipping; and more importantly, the box was sealed and the parts were sealed inside multiple plastic bags inside the box. We see no way any parts could have come out of the box during transit, and there was no damage to the parts that were inside the box, as they were contained in separate sealed plastic bags. On the second fuel control, the damage to the small parts were due to the fuel control being completely dis-assembled and all the small parts being put in two plastic bags together inside the box. We don't know what claim we could have filed with Fedex on either count, since the missing, damaged and swapped parts did not reach that condition due to shipment, but rather as a result of the way they were packaged.

Give me a call if I can provide any other information.

Best regards,

(b)(6)
Carson Helicopters Inc.
(b)(6)

Columbia Helicopters, Inc.
Aurora, OR

Work Order Hard Copy
W.O. #: P5444

Wrk Grp	Date Ordered	Date Required	Date Closed	Cmp ?	Whs	W/O Type/ Category	M/R ?	Repair Status	Description / Stock No	Var	S/N	Mfg. S/N	Order Qty
ENG	08/11/2008	09/11/2008	08/20/2008	Yes		Non-Inventory Customer	N	Inspect	ENGINES	(5201)			1.0

Tran. Date	Inst.	Stock No/Emp No	Description / Name	Var	S/N	Trans. No.	Type	Qty	Hours	Cost/Rate	Extension
08/11/2008	31	[redacted]	[redacted]				[redacted]		2.50	[redacted]	[redacted]
08/12/2008	31								2.00		
08/12/2008	31								1.20		
08/13/2008	010					MIS0084532008		4.0			
08/13/2008	31								4.30		
08/13/2008	31								2.00		
08/13/2008	31								2.80		
08/13/2008	31								8.00		
08/14/2008	31								5.00		
08/14/2008	31								0.50		
08/14/2008	31								0.50		
08/14/2008	31								6.50		
08/15/2008	31								8.00		
08/15/2008	31								6.70		
08/15/2008	31								2.50		
08/18/2008	31								0.50		
08/18/2008	31								2.00		
08/18/2008	31								2.20		
								Totals for 08/2008:	*57.20*	*Total:*	[redacted]
								WORK ORDER TOTALS:	*57.20*	*Total:*	

Instruction Summary

Inst.	Description	Std Hours	Hours	Cost	Curr Std	Comment
010	PARTS ISSUED (inventory)	0.0	0.0	[redacted]	0.0	
015	PARTS PURCHASED (non-Inventory)	0.0	0.0		0.0	
31	PRELIMINARY INSPECTION	0.0	57.2		0.0	
	TOTAL:	0.0	57.2		0.0	

Labor Summary by Shop

Cost Center	Shop WG Code and Description		Hours	Cost
082	ENG	ENGINE SHOP	52.20	[redacted]
083	QCI	QUALITY CONTROL/INSP.	5.00	

Work Order Hard Copy
W.O. #: P5444

Wrk Grp	Date Ordered	Date Required	Date Closed	Cmp ?	Whs	W/O Type/ Category	M/R ?	Repair Status	Description / Stock No	Var	S/N	Mfg. S/N	Order Qty
ENG	08/11/2008	09/11/2008	08/20/2008	Yes		Non-Inventory Customer	N	Inspect	ENGINES	(5201)			1.0

W/O P5444 Totals: Mat'l Cost: [redacted] Labor Hrs: 57.2 Labor Cost: [redacted] Other Cost: 0.00 Total Cost: [redacted]

2201: _____
2206: _____
2207: _____
6918 130: _____
7204: _____
6950: _____
2331: _____
_____
_____

2201: _____
4980 050: _____
4980 051: _____
4980 053: _____
4980 054: _____
4980 055: _____
4980 056: _____
4980 057: _____
4980 058: _____

4980 059: _____
4980 060: _____
4980 061: _____
4980 063: _____
4980 064: _____
4980 065: _____
4980 066: _____
4980 067: _____
4980 068: _____

4980 069: _____
4980 070: _____
4980 080: _____
4980 082: _____
4980 083: _____
4980 084: _____
_____
_____
_____

Columbia Helicopters, Inc.
MAILING ADDRESS: P.O. BOX 3500 PORTLAND, OR 97208
LOCATION: Aurora Airport, Aurora, Oregon 97002
PHONE: (503) 678-1222 FAX: (503) 678-5841

FAA & EASA APPROVED
REPAIR STATION
#CHIR823C

NTSB
75-1027 HENRY ST.
STE. 111A, PMB 403

KAILUA-KONA HI
96740
UNITED STATES

Invoice Date: 08/26/2008

(b)(4)

NTSB REQUESTED T58 CRASH INVESTIGATION
WO# P5444
(NOTE: THIS IS 1/2 THE BILL - USFS TO PAY THE OTHER 1/2)
Engine teardown

TOTAL USD. (b)(4)

MECHANICS LIEN: If this invoice is for labor and parts rendered for the repair or overhaul of equipment, Columbia Helicopters, Inc. reserves the right to file a lien against the above described equipment for the services herein detailed if balance not paid within statutory period

TERMS: Unless otherwise agreed to in writing, each invoice is payable within ten days of its date. A finance charge computed by a "PERIODIC RATE" of 1 1/2% per month for an "ANNUAL PERCENTAGE RATE" of 18% will be made on all balances more than thirty days old, unless applicable law requires a lesser percentage in which case the maximum rate permitted by law shall be charged.

Acct Number: 300074

-AIRCRAFT MAINTENANCE SERVICES
-CONSTRUCTION & OIL INDUSTRY REPORT
-STEEL & WOOD POWER LINE ERECTION
-AERIAL CRANE SERVICE

Invoice No.
057664

PLEASE PAY BY INVOICE

LAX08PA259- Key # 68616

ATTACHMENT #5

This one page document is the handwritten inventory of "missing" items written by Carson Helicopters, Inc. (b)(6) [redacted] on August 28, 2008 at NTSB headquarters.

This inventory was taken when the boxes containing the LAX08PA259 helicopter fuel control units were opened at NTSB after having been shipped from Columbia Helicopters, Inc. directly to NTSB.

2 Pages
(Includes Cover Sheet)

8/28/08

NTSB WA DC

Present Mike Hauf

(b)(6)

Fuel Control

#1 Fuel Control

T2 Bellows metal cap missing

T2 Bellows snap ring missing

T2 Bellow ~~assy~~ assembly is missing

Cap screw near T2 Bellows missing

#2 Fuel Control

~~Internal Bellows to 3D cam actuator rod missing~~

Cap screw near T2 Bellows missing

Internal Bellows lever temp sensing ~~rod~~ (Item #1 fig 9 in assesories overhaul and parts catalog) for fuel control SEI-185

Also #1 Bellows section/Assy was in the box with the #2 fuel control and the #2 Bellows section/Assy was in the box with the #1 fuel Control. That is how they were shipped from Columbia Helicopters.

ATTACHMENT #6

GE AIRCRAFT ENGINES [redacted]

"Accessories Overhaul and Parts Catalog" (Fuel Control)

1. T2 bellows metal cap [redacted] *Position Adjusting Cover*
2. T2 bellows snap ring [redacted] *Internal Retaining Ring*
3. T2 bellows assembly [redacted] *Temperature Sensing Bellows Assembly*
4. Cap Screw near T2 bellows [redacted] *Spring Retainer*
5. Internal bellows lever temp sensing [redacted] *Temperature Sensing Lever*

9 Pages
(Includes Cover Sheet)

ATTACHMENT #7

1. NTSB (b)(4)
   a. [redacted]

2. (b)(4),(b)(6) [redacted]

(b)(4),(b)(6) [redacted]

21 Pages
(Includes Cover Sheet)

PHOTOGRAPH LOG (NTSB) LAX08PA259

Photographs of engine and fuel control unit missing parts

NTSB#1 Photograph taken August 15, 2008
Side-by-side comparison of fuel control unit #1 (left engine) and fuel control unit #2 (right engine) taken on workbench in cordoned off area in Columbia Helicopters, Inc workshop location.

NTSB#2 Photograph taken August 14, 2008 at 1348 hours
Close-up photograph of left engine (engine #1) fuel control unit #1 showing metal Position Adjusting Cover (metal dust cap) on top of the wrench. Also visible in the photo is the Spring Retainer, part #574414. These pieces were not visible in videotape or still photography taken by Columbia when the FCU#1 parts were packaged for shipping on 8.21.08.

NTSB#3 Photograph taken August 14, 2008
Close-up photograph taken of engine #2, fuel control unit #2 component parts during the teardown examination, visible in photograph is the missing item #5, the internal lever temp sensing component part. This piece is not visible in videotape or still photography taken by Columbia when the FCU#2 parts were packaged for shipping on 8.22.08.

NTSB#4 Photograph taken August 9, 2008
Close-up photograph taken of engine #2, fuel control unit #2 component parts located in situ under engine #2 at accident site. These parts have been identified by GE Aviation and Carson in the photograph, and that they were not available at Columbia Helicopters, Inc. during the teardown examination.

PHOTOGRAPH LOG (NTSB) LAX08PA259

Photographic of chain of custody from accident scene then transport to Columbia Helicopters, Inc. facility for teardown examination.

NTSB#5 Photograph taken August 11, 2008
Picture of one engine with fuel control unit attached placed on tarp at accident scene.

NTSB#6 Photograph taken August 11, 2008
Picture of engines with fuel control units attached being removed from accident scene. The engines were removed from the accident helicopter, placed on wooden pallets, wrapped in plastic, wrapped in tarps, flown by suspended cable via helicopter from the remote accident site to the staging area to be transported via truck for examination.

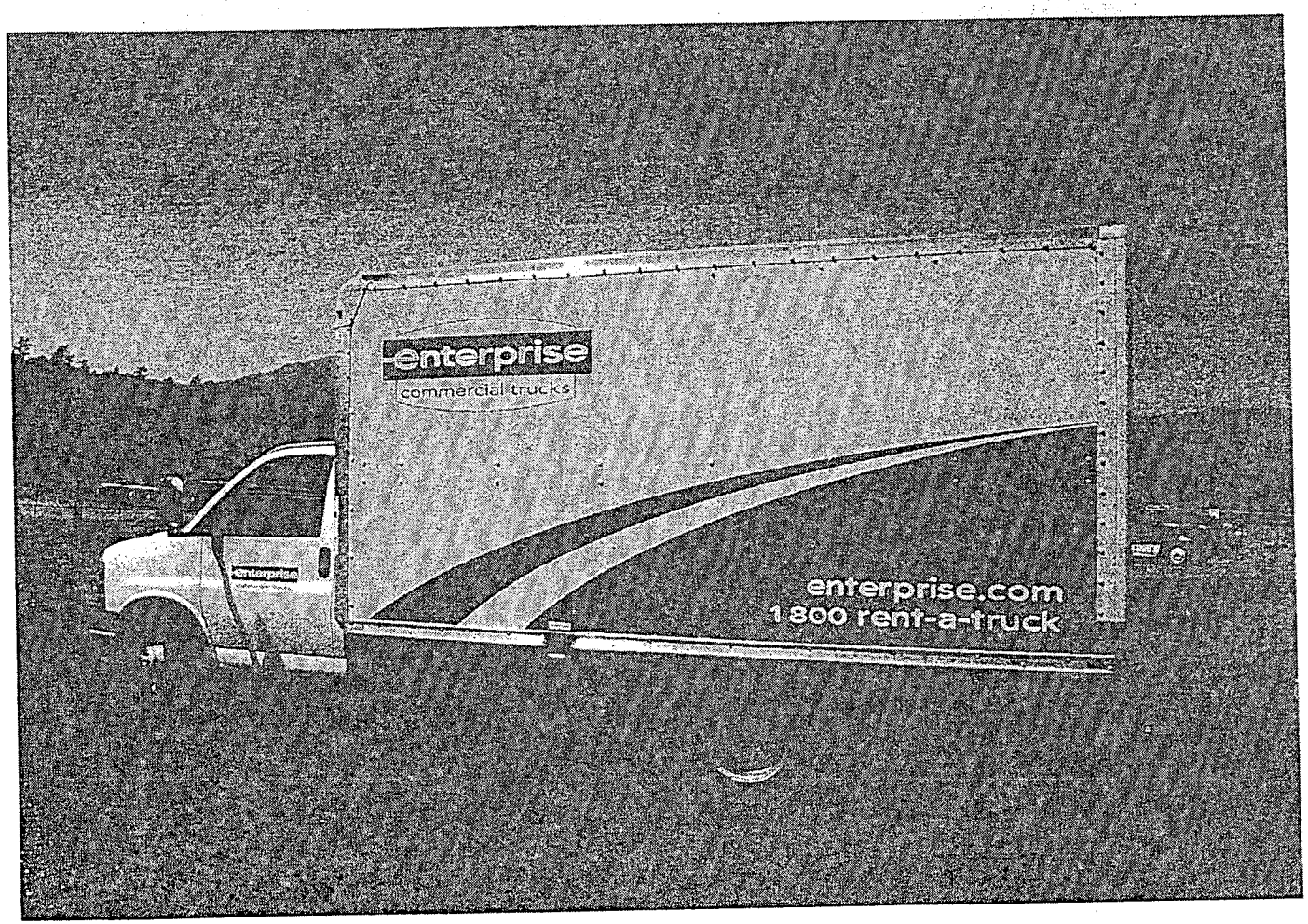
NTSB#7 Photograph taken August 11, 2008
Picture of rental box truck used to take engines and fuel control units from accident location near Weaverville, CA to Columbia Helicopters, Inc. facility in Aurora, Oregon. Photograph was taken for chain of custody of property for NTSB.

NTSB#8 Photograph taken August 11, 2008
Engines on pallet in rental box truck to be driven from accident location to Columbia Helicopters, Inc. facility. This photograph was taken as part of chain of custody for NTSB.

NTSB#9 Photograph taken August 11, 2008
Picture of lock used to maintain security of accident helicopter engine and fuel controls while en route from accident site to inspection facility in Oregon. The vehicle was driven by U.S. forest Service staff, a party to the investigation.

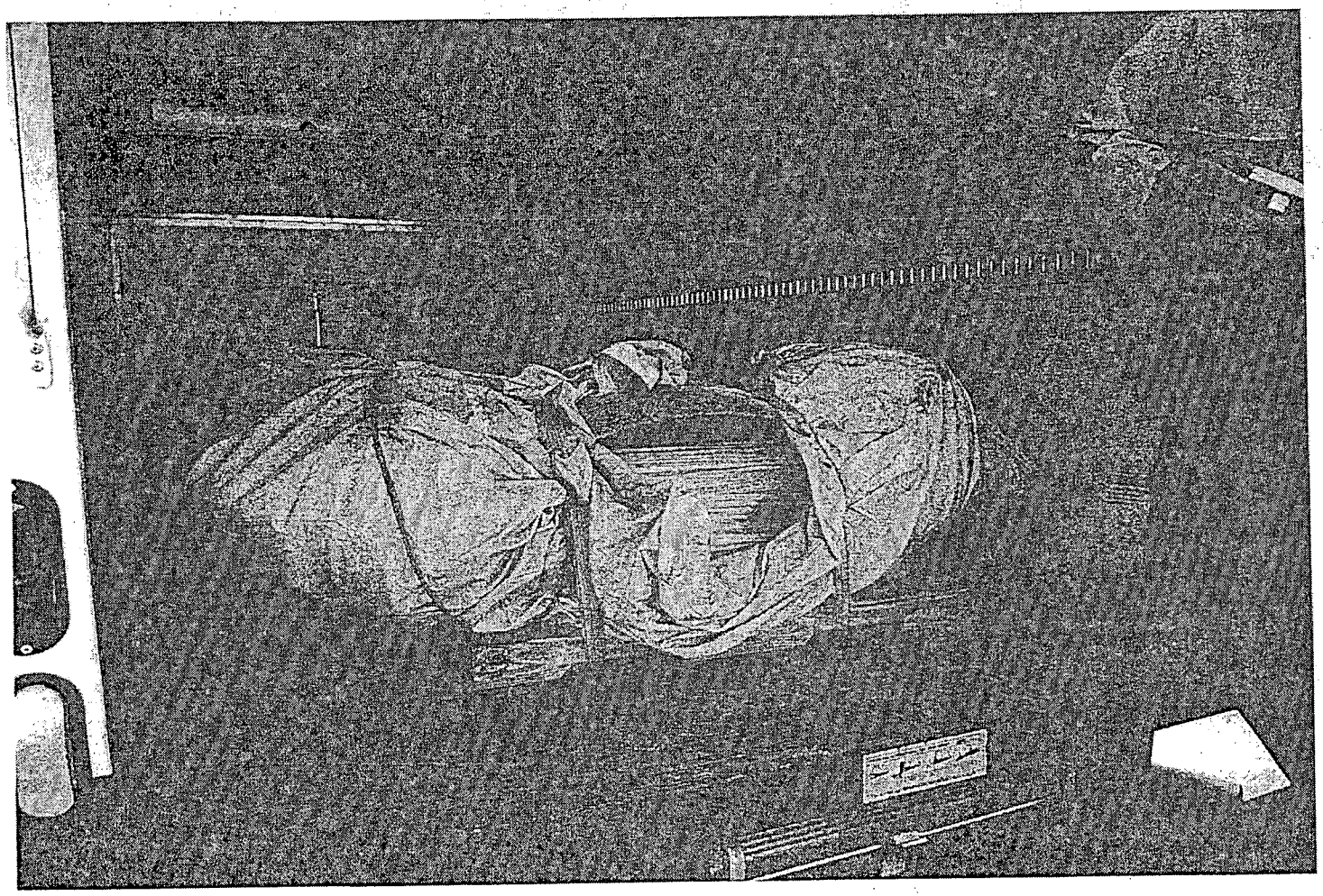
NTSB#10 Photograph taken August 13, 2008
Engines with fuel control units attached on transport pallet in Columbia Helicopters, Inc. workshop facility after they were removed from the rental box truck.

NTSB PHOTO #7



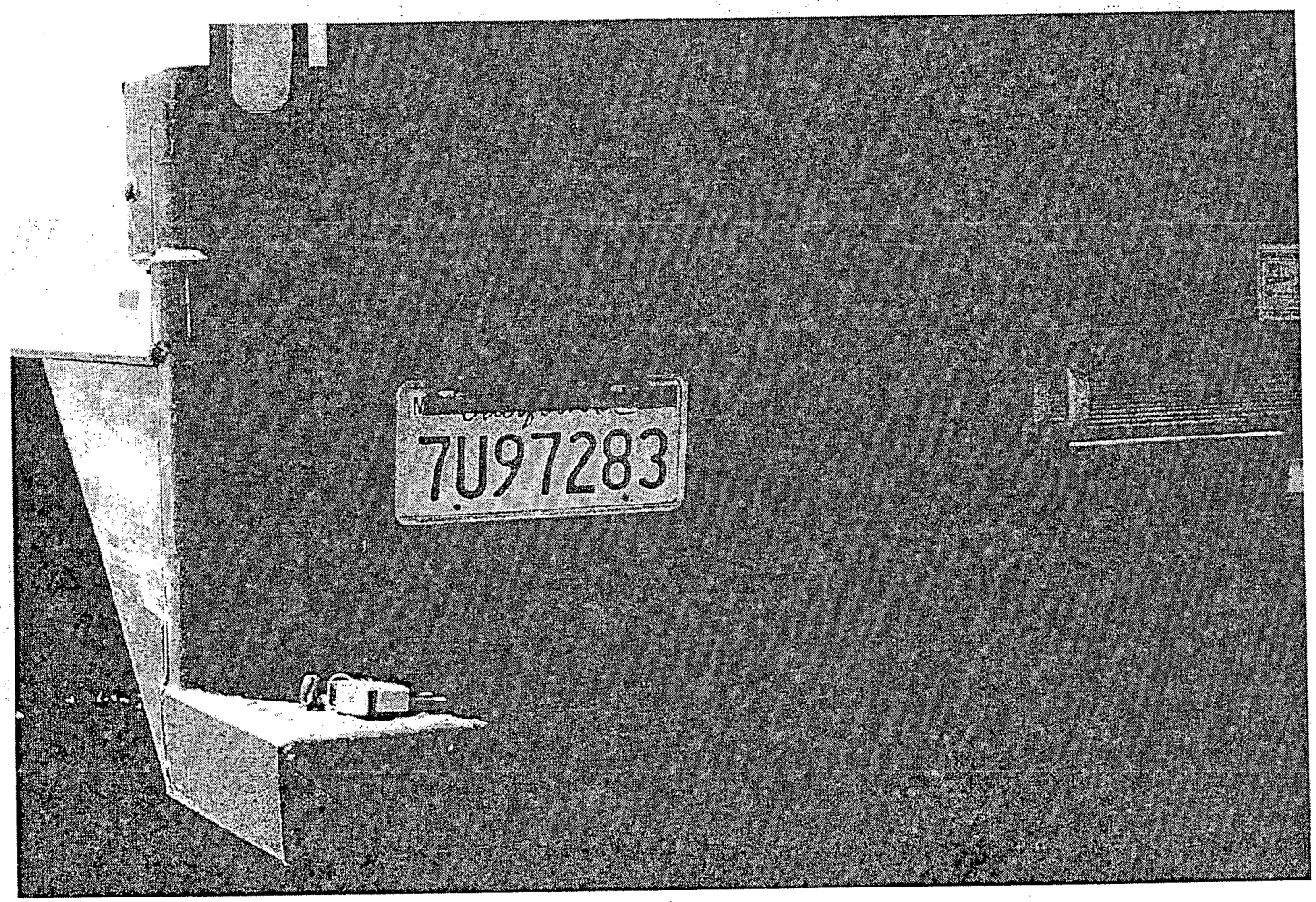
See photo log for description

NTSB PHOTO #8



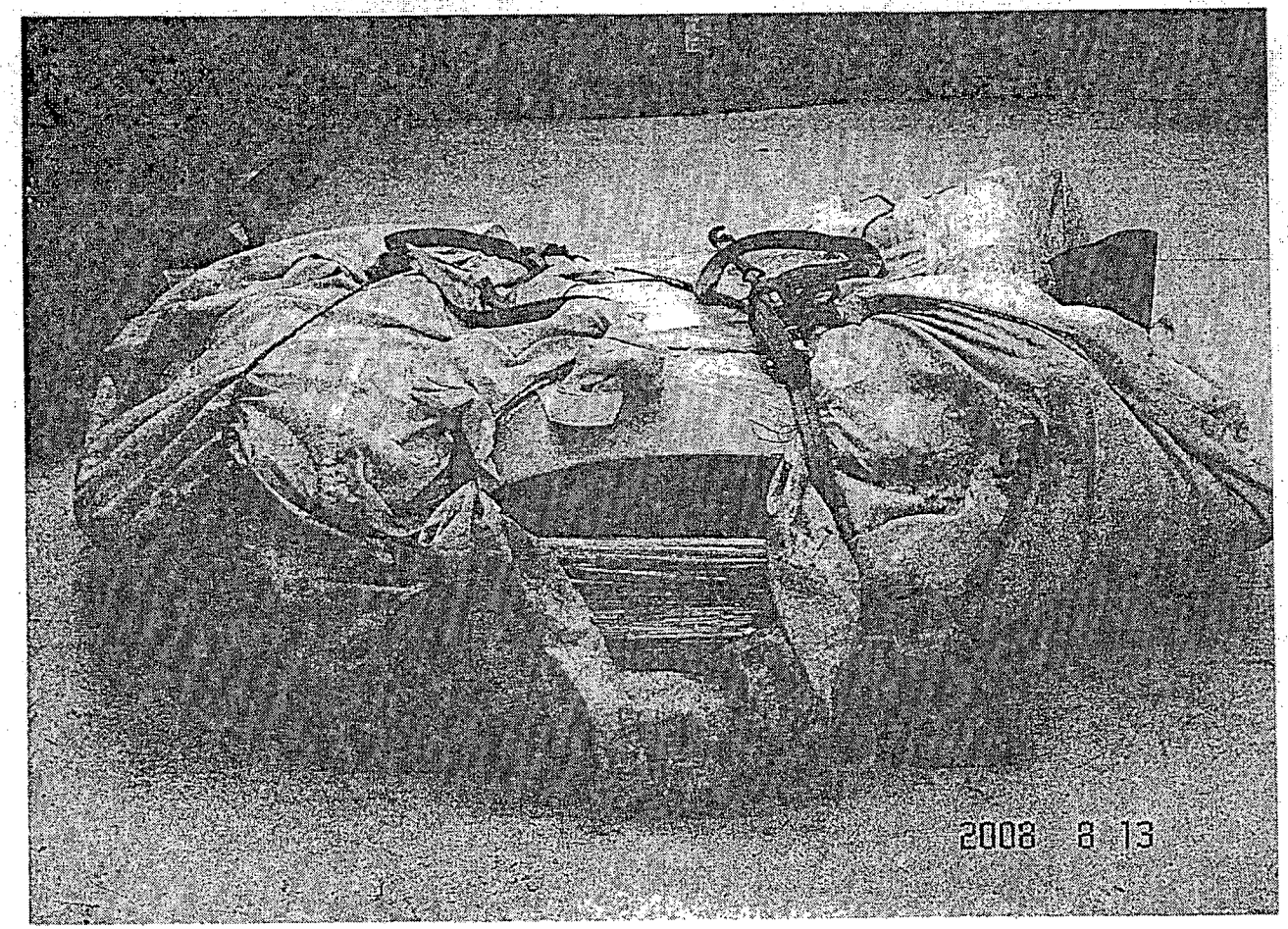
See photo log for description

NTSB PHOTO #9



See photo log for description

NTSB PHOTO #10



See photo log for description

NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594

April 27, 2009

MATERIALS LABORATORY FACTUAL REPORT Report No. 08-121

A. ACCIDENT

Place	: Weaverville, California
Date	: August 5, 2008
Vehicle	: Sikorsky S-61N, N612AZ
NTSB No.	: LAX08PA259
Investigator	: Mike Hauf (AS-40)

B. COMPONENTS EXAMINED

Pieces of the fuel control unit that include the filter assembly; spool and sleeve portion of the pressure regulating valve (PRV); cylinder adapter; thread plug; and particles collected from the PRV that were disassembled from the left and right General Electric CT58-100 turboshaft engines.

C. DETAILS OF THE EXAMINATION

Figure 1 show photographs of pieces from the fuel control unit that include the filter assembly; spool and sleeve portion of the pressure regulating valve (PRV); cylinder adapter; thread plug; and particles collected from the PRV of fuel control from the left and right engines. Pieces of the fuel control unit labeled system 1 were disassembled from fuel control unit part number (P/N) 725725-6, serial number (S/N) 72835BR, of the number 1 (left) engine. Pieces of the fuel control unit labeled system 2 were disassembled from fuel control unit part number (P/N) 725725-5, serial number (S/N) 49882, of the number 2 (right) engine. Figure 2 shows a diagram of a portion of the fuel control assembly. Figure 3 shows a diagram of the aspirator assembly. Pieces of the aspirator assembly for fuel control system 2 were submitted for examination, but the aspirator assembly for fuel control system 1 was not submitted.

Design of the Fuel Filter Assembly

The body of the fuel filter assembly was made from a casting. This assembly contained a removable-cartridge filter assembly and permanent filter assembly, as shown in figure 4. The removable-cartridge filter assembly was made from perforated sheet stock that was formed into a cylinder. The sheet was manufactured with nominal 0.1-inch diameter holes and the ends of the sheet were attached to a ring portion. The bore of the removable-cartridge filter contained two layers of wire screen, referred as the inner and

outer screens. The diameter of the wire for the inner screen was smaller compared to the diameter of the wire for the outer screen. The ends of the sheet stock and wire screens were brazed to the rings. The permanent filter also contained two layers of wire screen (referred as the inner screen and the outer screen). The diameter of the wire for the inner screen was smaller compared to the diameter of the wire for the outer screen. According to a representative from General Electric, the manufacturer of the fuel control unit, the smaller diameter inner screen is specified as a 40-micrometer filter, 325 x 325 mesh x 0.0014-inch diameter wire, and wires are spaced apart to create an opening between 0.0019 inch and 0.0021 inch.[1] The larger diameter outer wire screen is a 50 x 50 mesh x 0.0095-inch diameter wire and is used as a structural support for the smaller diameter inner screen. The ends of the wire screens for the permanent filter also were brazed to the body of the fuel filter assembly.

Design of the Spool and Sleeve Portion of the Pressure Regulating Valve (PRV)

The PRV contains a spool and sleeve portion. The spool was manufactured with four circumferential balance grooves and a smaller diameter groove at the diaphragm end of the spool. When the PRV is in the assembled condition, the spool portion slides within the bore of the sleeve.

Design of the Aspirator Assembly

The aspirator assembly is shown in figures 2 and 3. The position adjusting screw portion is manufactured from tube stock. The position adjusting screw at one end contained an external thread and the other end contained a circumferential internal square groove. The external thread portion is to be attached to the mating internal threads on the temperature sensor housing. The position adjusting screw and housing were manufactured with several drilled holes to accommodate a retaining wire. A position adjusting screw is attached to the temperature housing and the ends of the retaining wire are inserted into the alignment holes of the adjusting screw and housing. The retaining wire locks the position of the position adjusting screw relative to the housing. The temperature sensor bellows assembly is inserted into the end of the position adjusting screw that contains the circumferential internal square groove. A spring is inserted into the temperature sensor bellows assembly, and a retainer is inserted into the bore of the position adjusting screw until the retainer is positioned slightly deeper than the circumferential internal square groove. An internal retaining ring is inserted into the circumferential internal square groove. In the installed condition, the spring applies pressure to the retainer. The internal retaining ring prevents the retainer from sliding out of the position adjusting screw.

Fuel Control from System 1

The removable-cartridge filter assembly was removed from the filter assembly of fuel control system 1. Figure 4 shows a photograph of the disassembled filter from system 2. The filter from system 1 appeared the same as the filter in system 2. Stereo microscope

[1] The conversions are as follows: 325 mesh=0.0017 inch=44 microns. Also, 50 mesh=0.0117 inch=297 microns.

examination of the exterior portion of the removable-cartridge filter revealed that the inner and outer wire screens were visible through the 0.1-inch diameter holes. Straight and curled fibers extended through the open cavities of the inner and outer wire screen, see figures 5 and 6. The inner wire screen also contained irregular block-like particles that were trapped within the cavities of the screen.

The removable-cartridge filter assembly was inserted into the chamber of a scanning electron microscope (SEM). The SEM examination confirmed that irregular block-like particles were embedded within the cavities of the inner screen and that straight and curled fibers extended through the inner and outer screens. The size of the opening for the inner and outer wire screen was measured. For the outer screen, the distance between parallel wires typically measured approximately 250 micrometers (0.01 inch). For the inner screen, the distance between parallel wires typically measured approximately 50 micrometers (0.002 inch). The dimensions of both screens are consistent with the nominal size indicated by the fuel control unit manufacturer. Energy dispersive spectroscopy (EDS) analysis of the wall portion of the cartridge filter produced a spectrum that contained a major elemental peak of iron and minor elemental peaks of chromium and nickel, typical for stainless steel. EDS spectrum of the wire screens showed the same elemental peaks. EDS spectrum of the braze material between the ring portions and the wire screen contained elemental peaks of silver and cadmium. Appendix 1 shows the EDS spectra of various pieces that were analyzed.

A piece of carbon double-sided adhesive tape was inserted into the bore of the removable-cartridge filter assembly and pressed against the inner screen. The tape was then peeled from the filter. Particles from the inner screen were found adhering to the tape. SEM photograph of typical particles that were peeled from the inner filter is shown in figure 7. The adhesive surface of the tape retained irregular block-like particles and straight and curled fibers that were consistent with the size and shape of the particles that were visible within the 0.1-inch holes of the removable-cartridge filter. The length and width of the irregular block-like particles measured as large as 120 micrometers (0.005 inch), when measured either lengthwise or widthwise. The size of a few irregular block-like particles was smaller than 20 micrometers (0.0008 inch), when measured either along the length, width, and thickness. The diameter of the straight fibers varied in size but measured as large as 20 micrometers (0.0008 inch). When looking at various straight rod-like fibers, the following typical diameter sizes were encountered and were measured: 5 micrometer, 10 micrometer, and 40 micrometer. The length of the straight fibers measured as long as 400 micrometer (0.016 inch), whereas, the length of the curled fibers measured as long as 600 micrometers (0.024 inch). Eight particles were analyzed by EDS method. Spectra of the eight particles are shown in Appendix 1.

Figure 8 shows a photograph of a portion of the permanent filter when viewed from the exterior face. This permanent filter contained an inner and outer wire screen. The diameter of the wire and distance between the wires for the inner screen was smaller compared to those for the outer screen. For the outer screen, the distance between parallel wires measured approximately 125 micrometers (0.005 inch). For the inner screen, the distance between parallel wires measured approximately 45 micrometers (0.002 inch),

within the range specified by the manufacturer. Carbon adhesive tape was placed in the bore of the permanent filter. The tape was peeled from the inner screen and particles were found adhering to the tape. SEM examination of the surface of the carbon adhesive tape revealed straight and curled fibers, and irregular block-like particles that were similar to those found in the inner screen of the removable-cartridge filter. The quantity of fibers and irregular block-like particles found on the inner screen was much less than that found on the inner screen of the removable-cartridge filter. The EDS spectra of various fibers and particles that were embedded within the openings of the inner screen from the permanent filter were similar to those from the inner screen of the removable-cartridge filter.

Pressure Regulating Valve (PRV) for System 1

Stereo microscope examination of the spool portion from the PRV of system 1 revealed that the surface of the land in the areas between the balance grooves contained minor score marks that were oriented parallel to the length of the spool (photograph of the longitudinal score marks is not shown). The spool portion contained four circumferential balance grooves. Each of the four circumferential balance grooves contained several fragments of straight fibers, similar to the ones shown in figure 9. The length and diameter of the particles varied. The length of the straight fiber shown in figure 9 measured approximately 60 micrometer (0.0024 inch) and the diameter measured approximately 10 micrometer (0.0004 inch).

The outside diameter of the spool and inside diameter of the sleeve was measured with a micrometer. The measured and specified values for the diameter of the spool and sleeve are shown in Table 1. The outside diameter of the spool at the land portion measured approximately 0.3771 inch, within the range specified in Hamilton Sunstrand (HS) spool engineering drawing 543461. The inner diameter of the sleeve measured between 0.3776 and 0.3778 inch, within the range specified in HS sleeve engineering drawing 734913. The clearance between the spool and sleeve was calculated to be between 0.0004 inch (10 micrometer) and 0.0008 inch (20 micrometer). EDS analysis of the surface of the spool and sleeve each produced a spectrum that contained a major elemental peak of iron and minor elemental peaks of chromium and iron, consistent with the 440C martensitic stainless steel material specified in the HS engineering drawings for the spool and sleeve. The spool and sleeve portions showed no evidence of a crack.

Table 1. Dimensions

	Spool Outside Diameter (inch)		Sleeve Inside Diameter (inch)	
	Specified	Measured	Specified	Measured
System 1	0.3770-0.3772	0.3771	0.3776-0.3778	0.3776-0.3778
System 2	0.3770-0.3772	0.3770-0.3771	0.3776-0.3778	0.3776-0.3778

Particles were collected on-site from the PRV of system 1 and were placed on double-sided adhesive tape and, in turn, the tape was attached to an aluminum stub that served as a rigid base for the collected samples. The as-received stub with the collected

particles is shown in figure 1. SEM examination of the stub revealed particles of similar shape and size to those extracted from the inner screen of the removable-cartridge filter. The EDS spectrum of the particles on the stub were similar to the EDS spectrum of the particles from the inner screen of the cartridge filter, with the exception that EDS spectrum from a fragment in figure 10 showed a major elemental peak of fluoride and carbon. The EDS spectrum of the fluoride-carbon particle is labeled particle 9 in Appendix 1. The fragment in figure 10 appears to be fractured into two major pieces. The total length and total width of the two fluoride-carbon fragments measured as large as 450 micrometers (0.018 inches) in either orientation of measure.

Cylinder Adapter and Thread Plug for System 1

The cylinder adapter and thread plug, both shown in figure 1, contained no evidence of a crack.

Fuel Control from System 2

The surface of the spool from the PRV of system 2 contained score marks that were oriented parallel to the length of the spool. Figures 11 and 12 show photographs of a portion of the longitudinal scouring marks that were found on the surface of the spool between the circumferential balance grooves. The scouring marks appeared more severe compared to those on the surface of the spool from PRV system 1. The width of the more severe score marks measured between 4 and 11 micrometers.

A piece of carbon double-sided adhesive tape was inserted into the bore of the removable-cartridge filter assembly system 2 and pressed against the inner screen. The tape was then peeled from the inner screen. Particles from the inner screen were found adhering to the carbon tape (photograph not shown). Particles also were removed with carbon adhesive tape from the inner wire screen portion of the permanent filter of fuel control system 2. Figure 13 shows an SEM photograph of typical particles that were extricated with carbon adhesive tape from the inner screen of the permanent filter. SEM examination the carbon tapes revealed the inner screens for the removable cartridge and permanent filters contained irregular block-like particles, and straight and curled fibers, that appeared similar to and more numerous than those found in the inner screen of the removable-cartridge filter and permanent filter in system 1. The size of the particles also was consistent with those found in system 2.

SEM examination of particles collected from the PRV in system 2 (submitted on a stub) revealed particles that appeared similar to and more numerous than those found in the stub from system 1, see figure 14. Additionally, the stub from system 2 contained hair-like fibers that were attached to a flat-backing material, as shown in figure 15, that were not found in the stub from system 1. The hair-like fibers that extended from a flat-backing material were not present in the wire screens and stub of system 1. EDS analysis of the hair-like fibers, labeled particle 10 hair-like fibers in Appendix 1, produced a spectrum that contained a major elemental peak of silicon and minor elemental peaks of carbon, oxygen, sulfur, calcium, and zinc. EDS spectrum of the flat-backing material, labeled particle 10

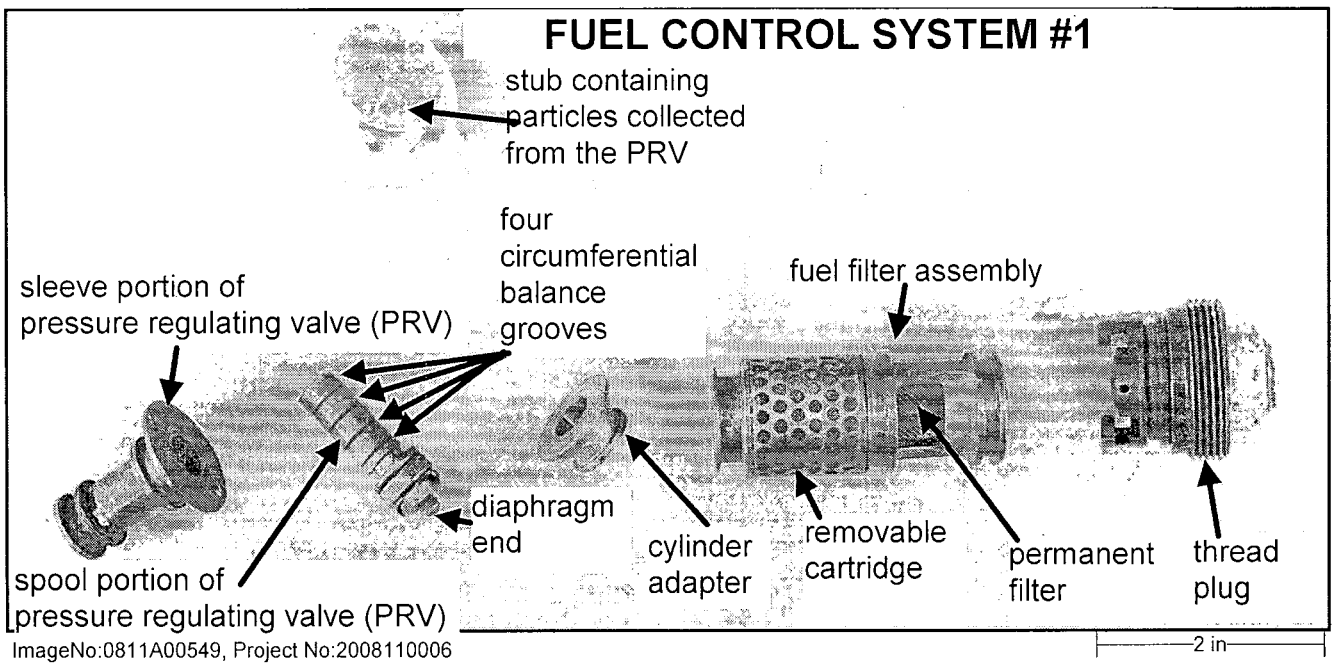
flat-backing material portion in Appendix 1, showed a major peak of carbon and a minor peak of oxygen.

The spool and sleeve portions of the PRV, cylinder adapter, and thread plug contained no evidence of a crack.

Examination of the aspirator assembly revealed that the temperature sensor bellows assembly, spring, retainer, and internal retainer ring were not submitted to the Materials Lab. The wall of the position adjusting screw for the temperature sensor bellows assembly was specified as aluminum alloy 7075 and was to be heat-treated to the T6 condition. The position adjusting screw was attached to the housing portion of the aspirator assembly. The exterior face of the round non-thread end portion of the position adjusting screw exhibited a dent in the area indicated by an unmarked arrow in figure 16. The dent was visible from the inner surface of the position adjusting screw. When looking into the open end of the position adjusting screw, the wall showed evidence of deformation (i.e., was not round). The inner and outer face of the position adjusting screw was covered with soot. Stereo microscope examination of the open end of the position adjusting screw revealed a fracture on the inner face that extended all around the position adjusting screw in the area between the inside corner of the inner circumferential square groove and the open end of the tube (see figure 16). The position adjusting screw was disassembled from the housing and ultrasonic cleaned with a commercial detergent. SEM examination of the position adjusting screw revealed micro-cracks on the inner and outer surfaces of the wall. The circumferential fracture contained intergranular globular features and showed no evidence of fatigue cracking (see figure 17). A radial-longitudinal metallurgical cross-section was made through the wall of the position adjusting screw. Examination of the prepared and etched section revealed a microstructure that contained solid solution melting at the grain boundaries consistent with an overheated aluminum alloy (see figure 18).

Examination of the cylindrical wall portion contained fibers with a cross-weave pattern. The fracture faces showed no evidence of crack arrest marks. EDS analysis of the wall produced a spectrum that contained elemental peaks of carbon and oxygen.

Frank P. Zakar
Senior Metallurgist



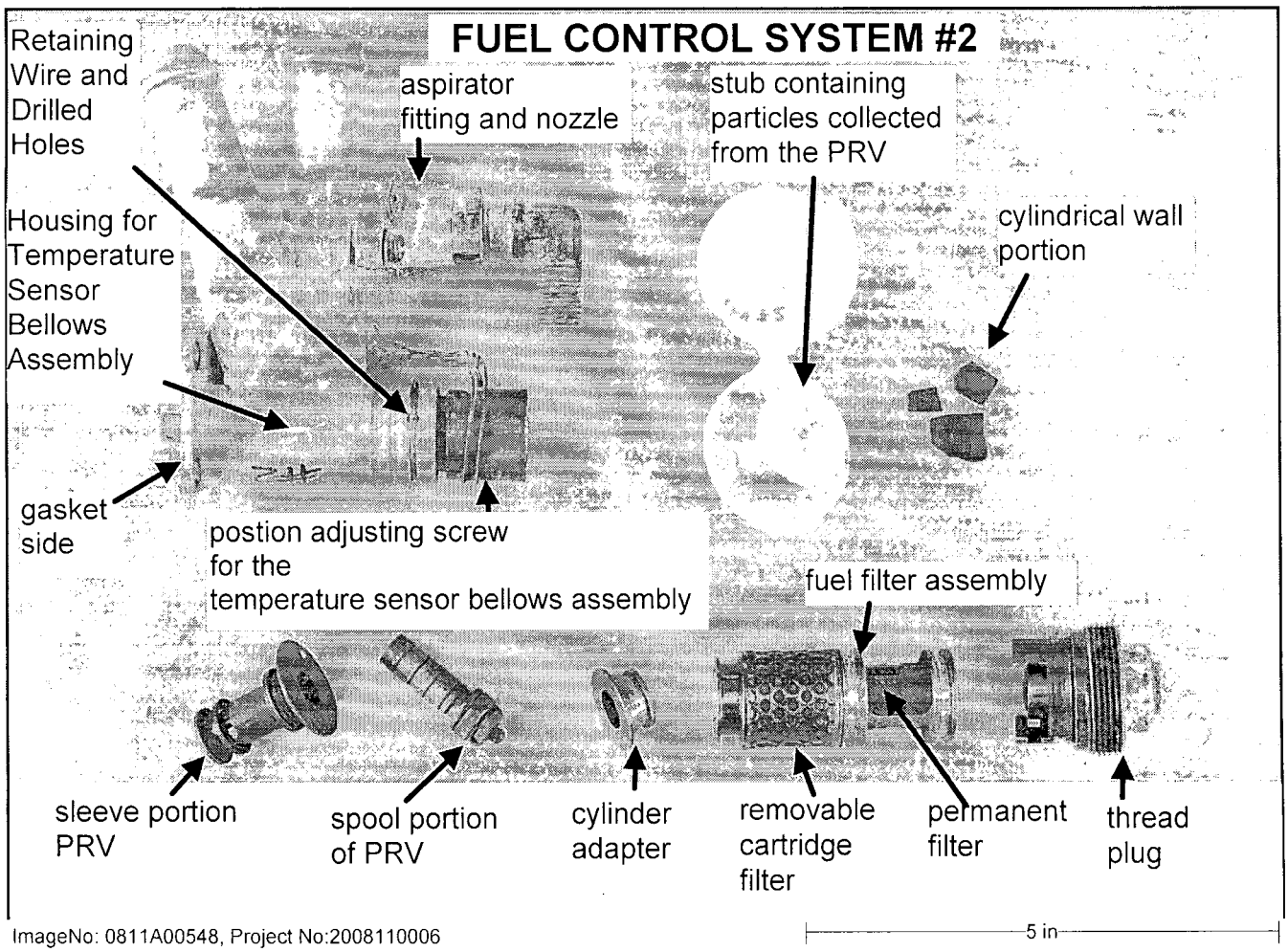


Figure 1. As-received pieces from fuel control systems 1 (upper photograph) and system 2 (lower photograph).

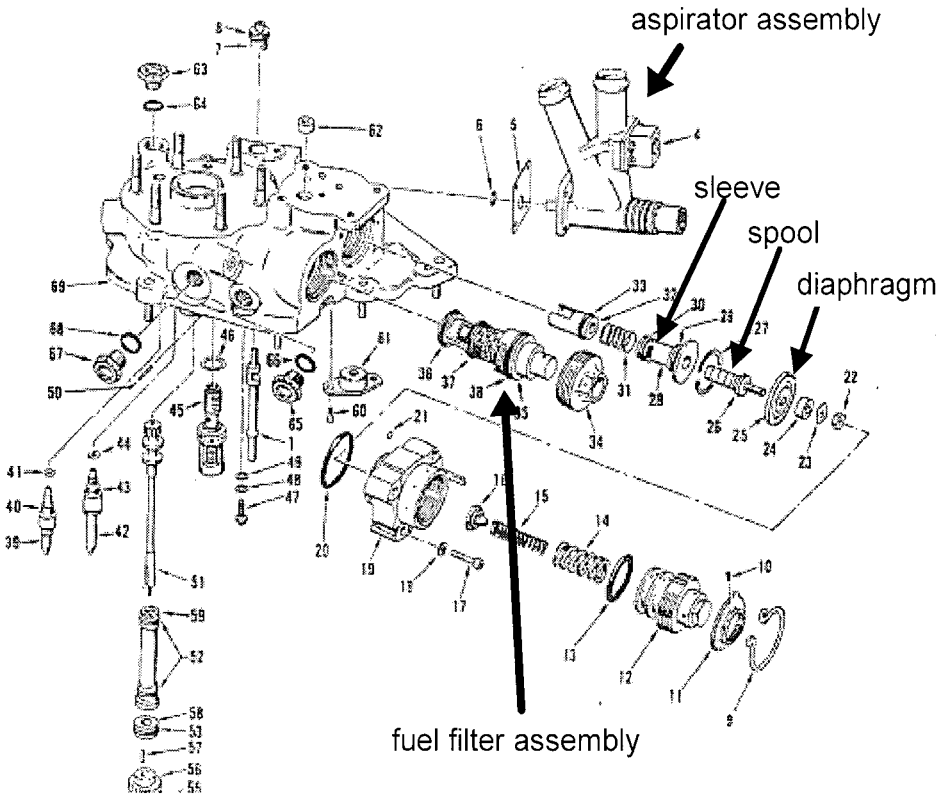


Figure 2. Diagram of a portion of the fuel control unit showing the aspirator assembly and fuel filter assembly.

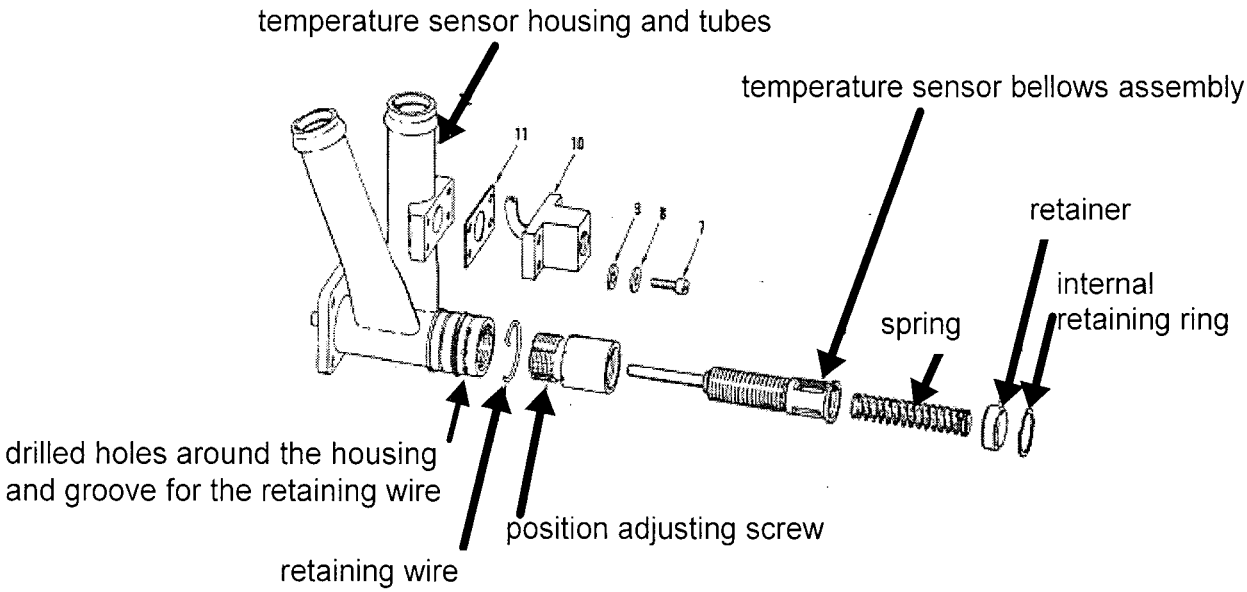


Figure 3. Diagram of the aspirator assembly showing greater detail than shown in figure 1.

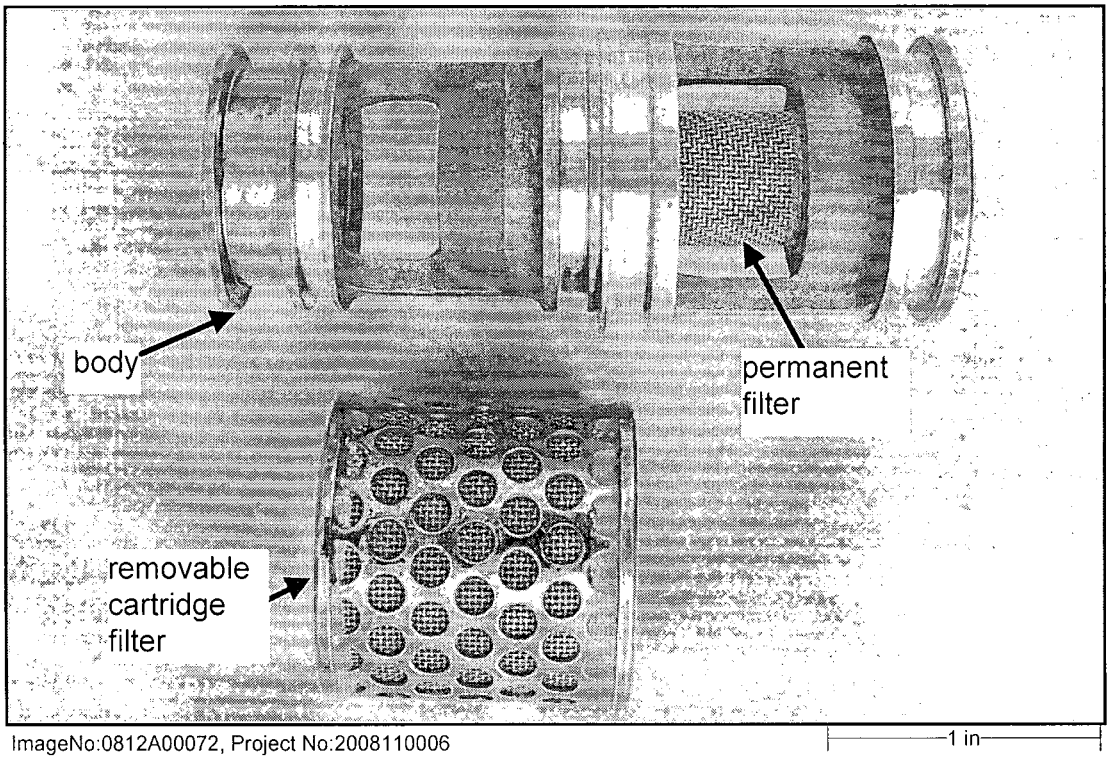


Figure 4. Photograph of the fuel filter assembly from system 2 after the cartridge filter assembly was disassembled from the body.

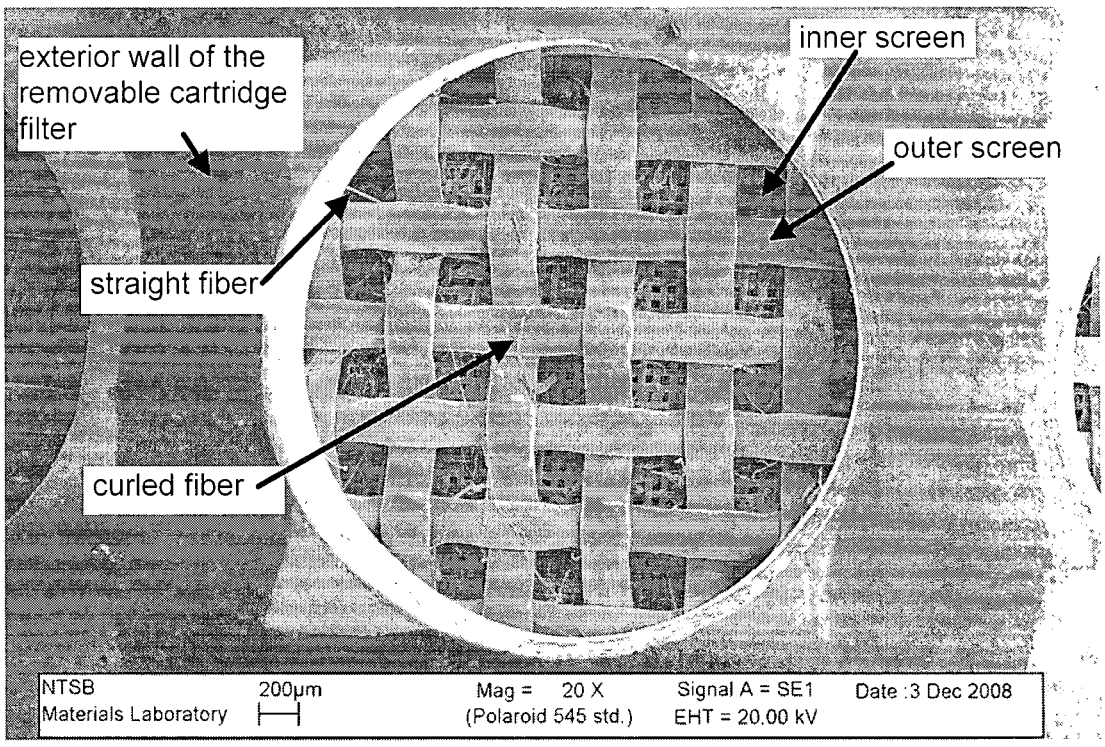


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Figure 5. Scanning electron microscope (SEM) photograph of a portion of the external face of the removable cartridge filter for fuel control system 1. This view shows one of the holes in the wall of the cartridge filter. The bore of the cartridge filter contained two layers of wire screen (referred as the inner and outer screens).

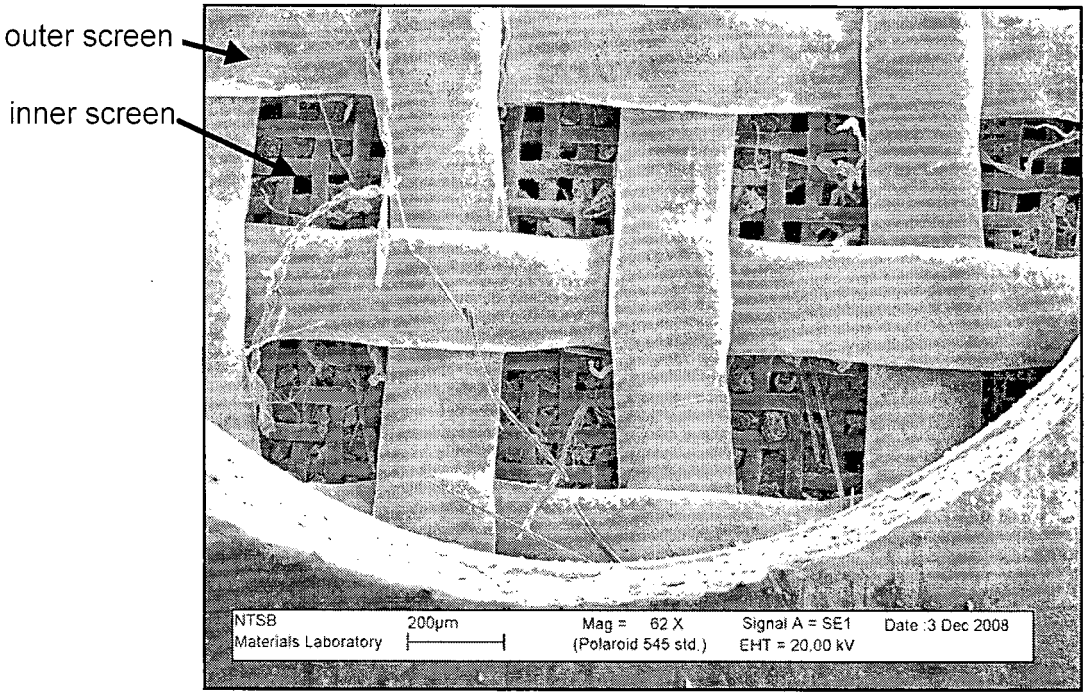

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Figure 6. Higher magnification SEM photograph of a portion of the removable cartridge filter for fuel control system 1 that was shown in figure 5. This view shows particles embedded in the inner and outer screens.

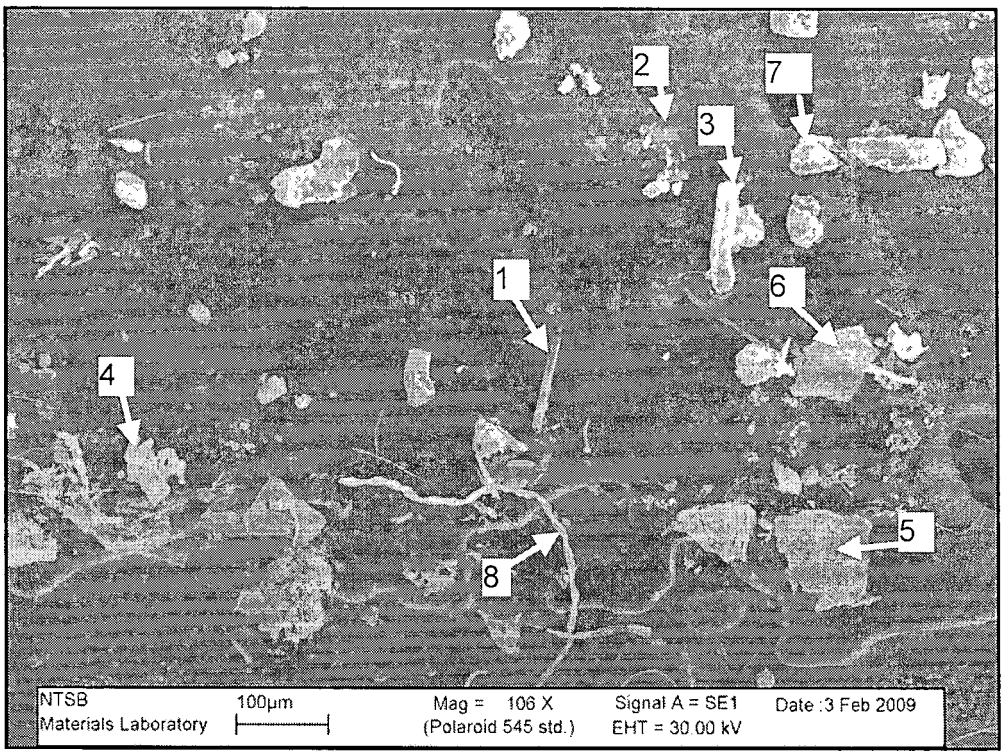

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Figure 7. SEM photograph of particles that were removed with carbon adhesive tape from the inner screen portion of the removable-cartridge filter from fuel control system 1. Background is carbon adhesive tape.

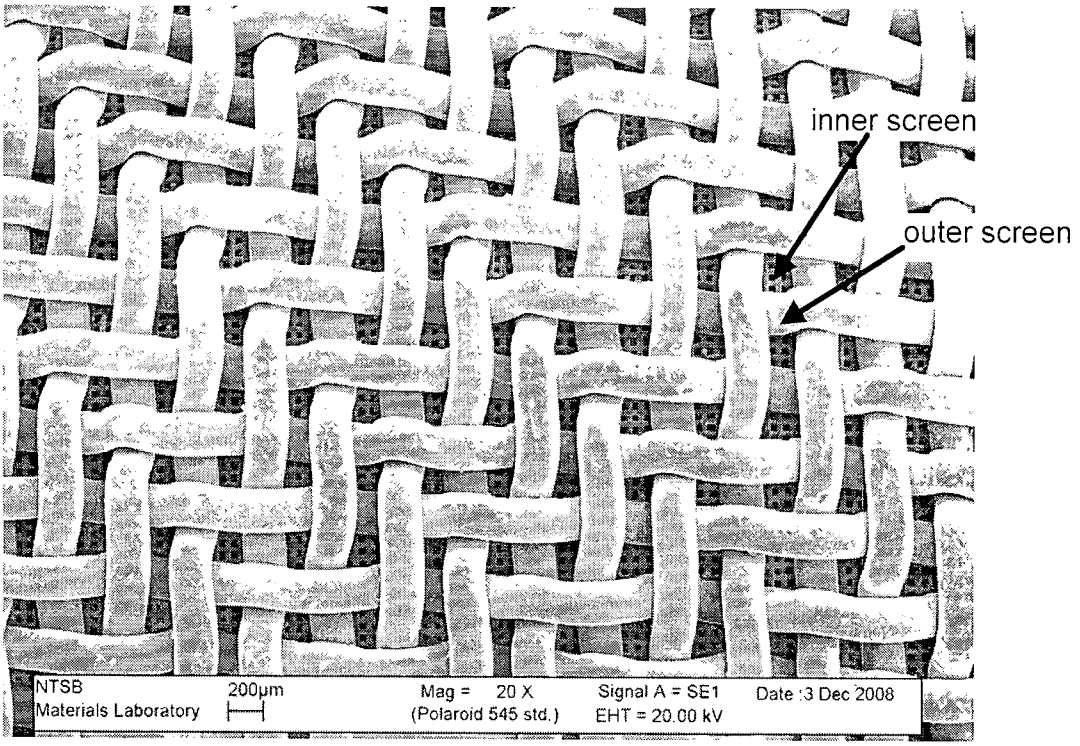

Figure 8. SEM photograph of a portion of permanent filter from fuel filter system 1 showing the outer and inner wire screens.

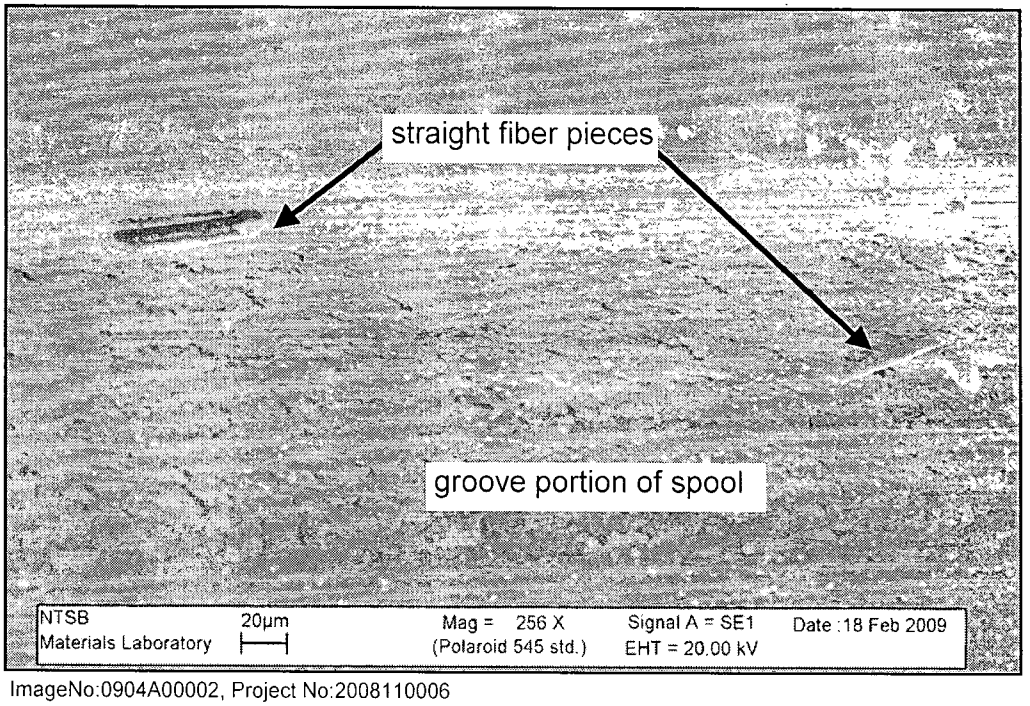

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Figure 9. SEM photograph of a portion of a circumferential balance groove from the spool of PRV system 1. This view shows two straight fibers located in the groove.

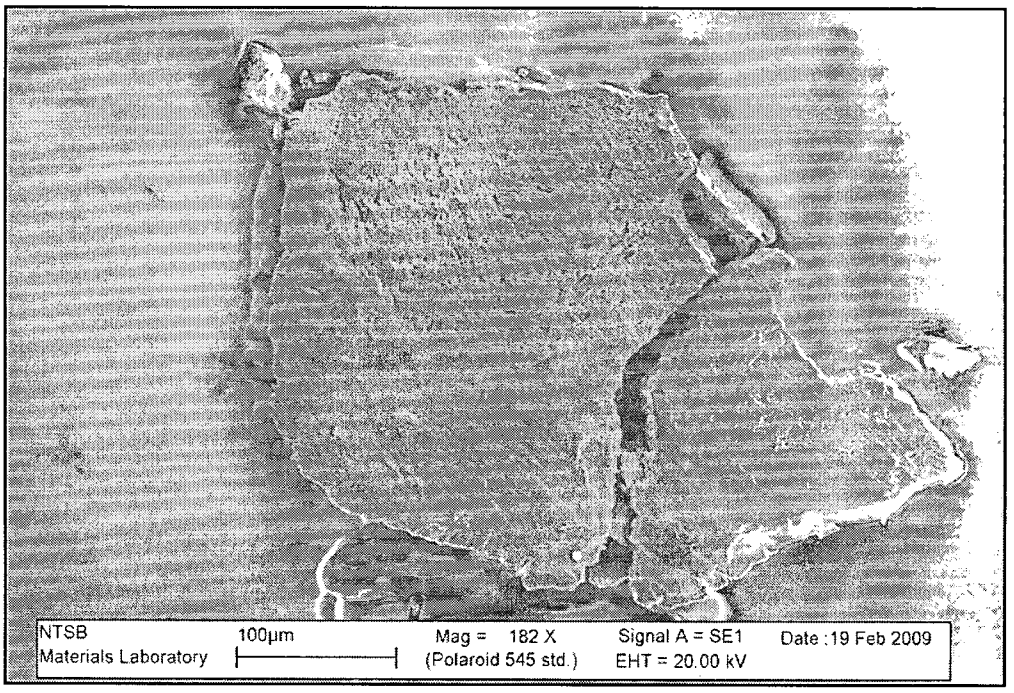

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Figure 10. SEM photograph of one of the particles found on the stub for PRV system 1. The particle fractured into two major pieces. The EDS spectrum from this particle contained elemental peaks of fluoride and carbon.

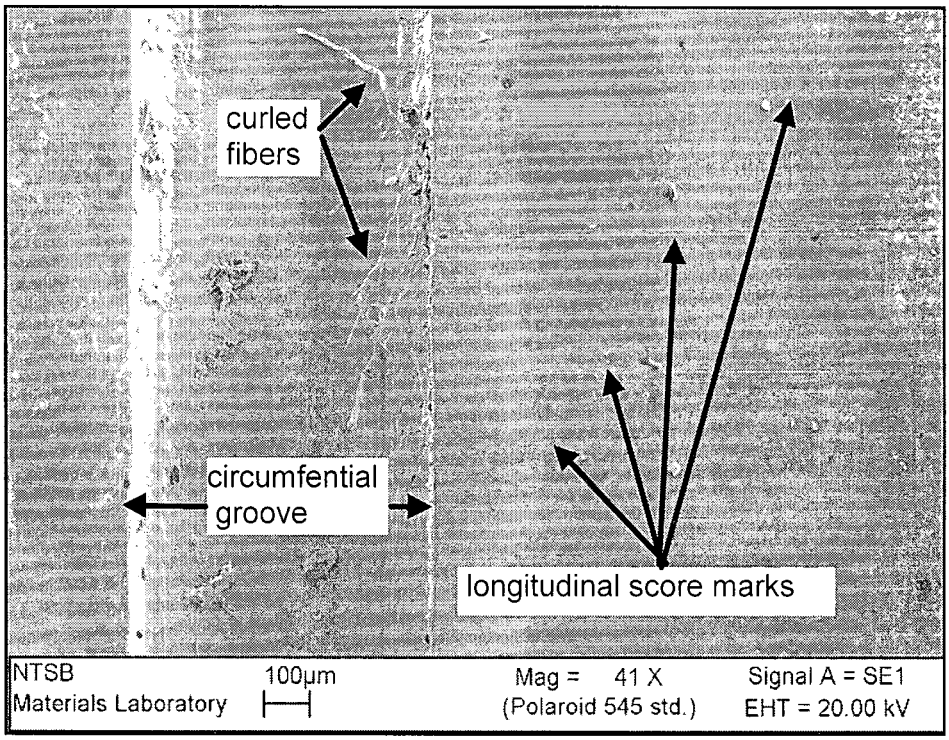

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Figure 11. SEM photograph of a portion of the pool from the pressure regulation valve of system 2 showing one of the circumferential balance grooves. This view shows fibers within the groove in an area located adjacent to the spool surface. The surface also contain several longitudinal score marks that extend from the circumeferential balance groove.

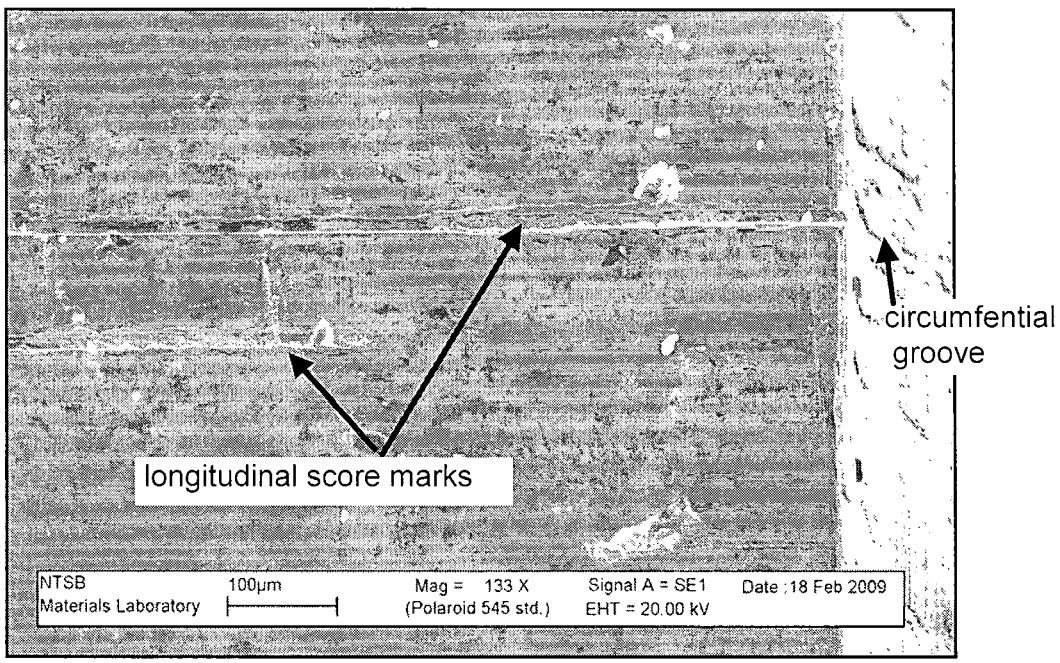

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Figure 12. SEM photograph of a portion of the pool from the pressure regulation valve of system 2 showing one of the circumferential balance grooves. A longitudinal score mark extended from the circumeferential balance groove.

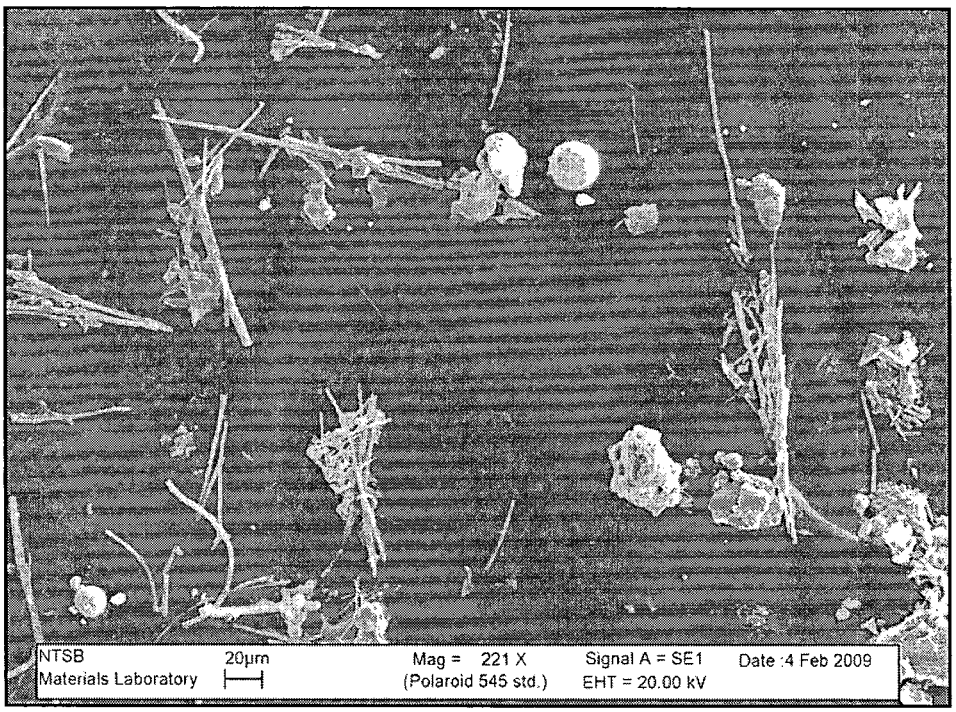

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Figure 13. SEM photograph of particles that were removed from the permanent filter of fuel control system 2. Background is the carbon replica tape.

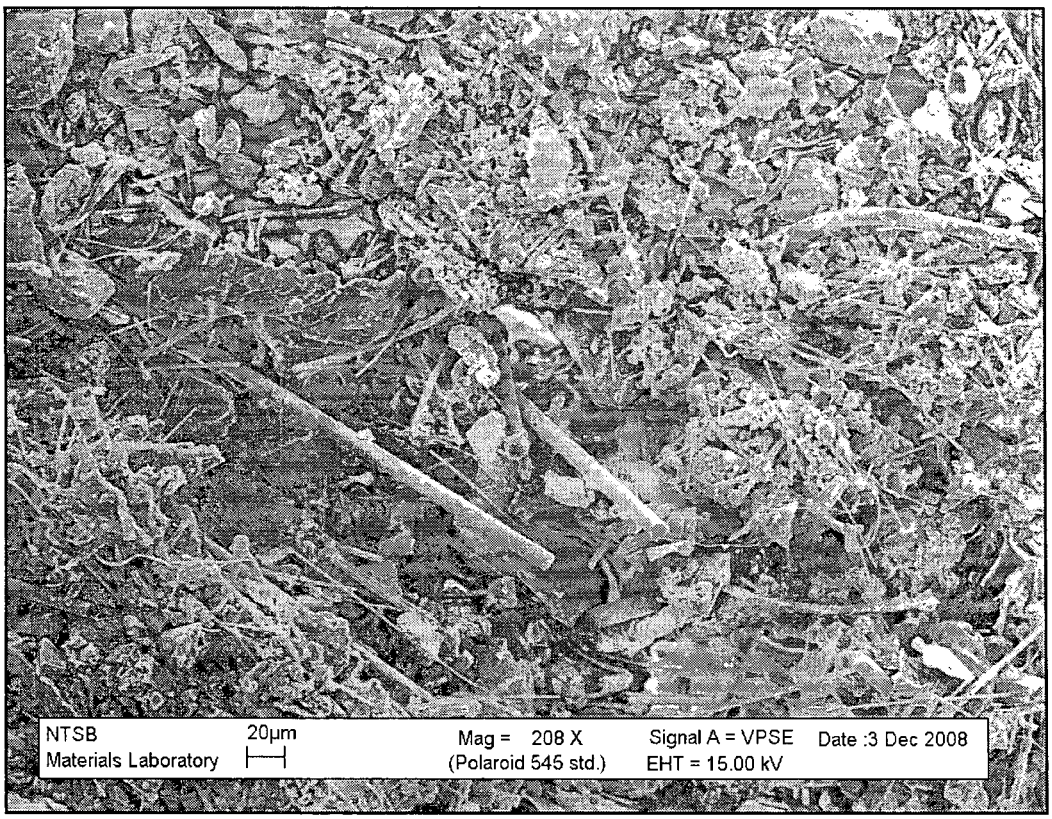

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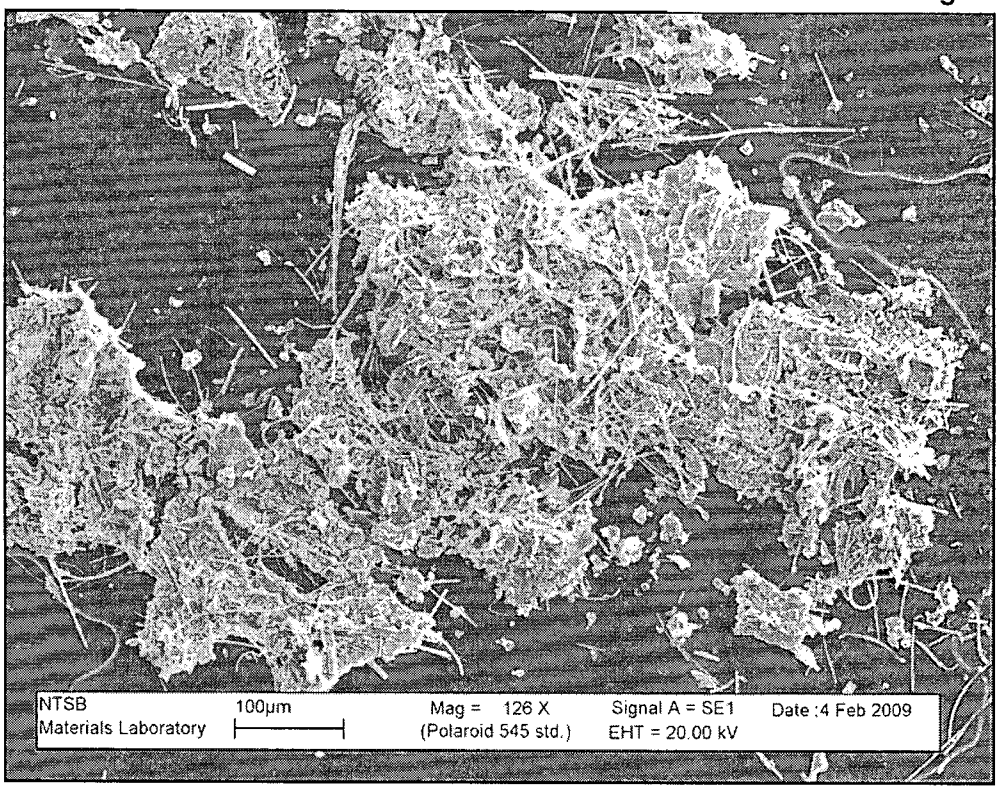
Figure 14. SEM photograph of particles found on the as-received stub that contained particled collected from PRV of system 2. The particles are embedded in adhesive bonded tape.



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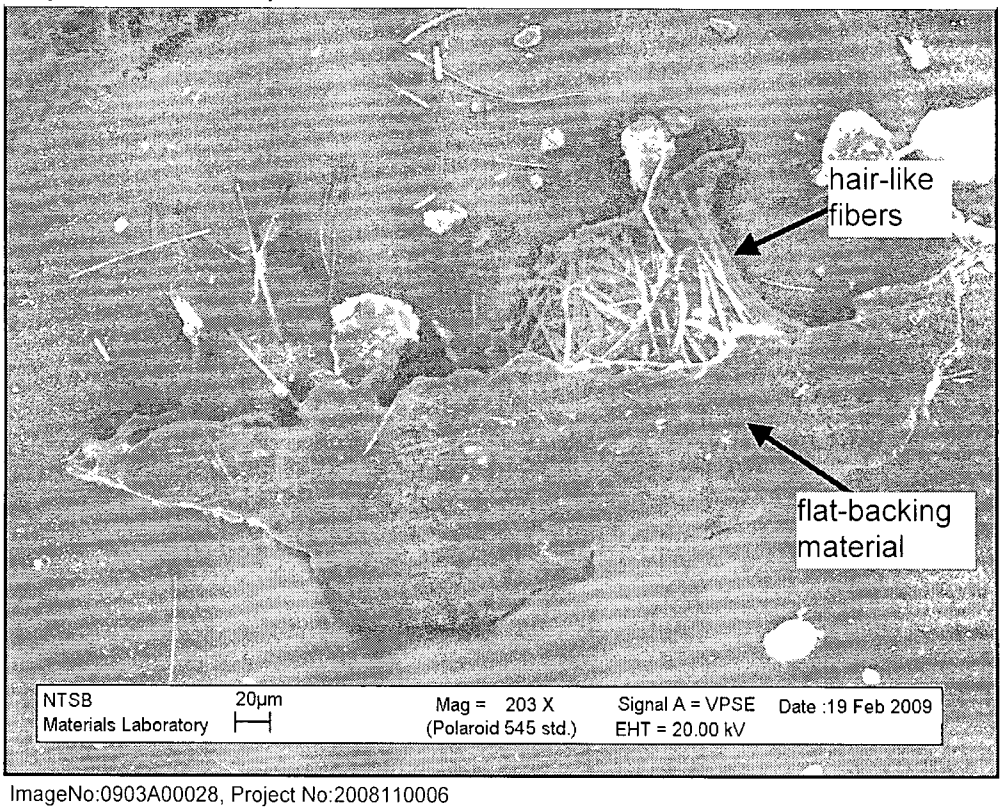

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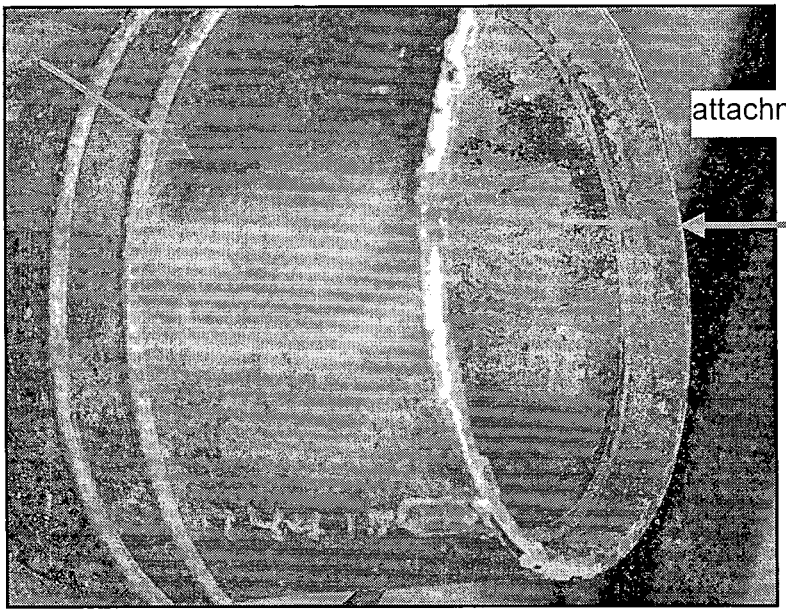
Figure 15. SEM photograph of particles on the tub of PRV system 2 (upper side of page) and a slighty higher magnification view one of the same particles after it was turned upside down to show the hidden back side. The majority of the particles appear to have a flat-backing material with hair-like fibers extending from the flat-backing material portion.



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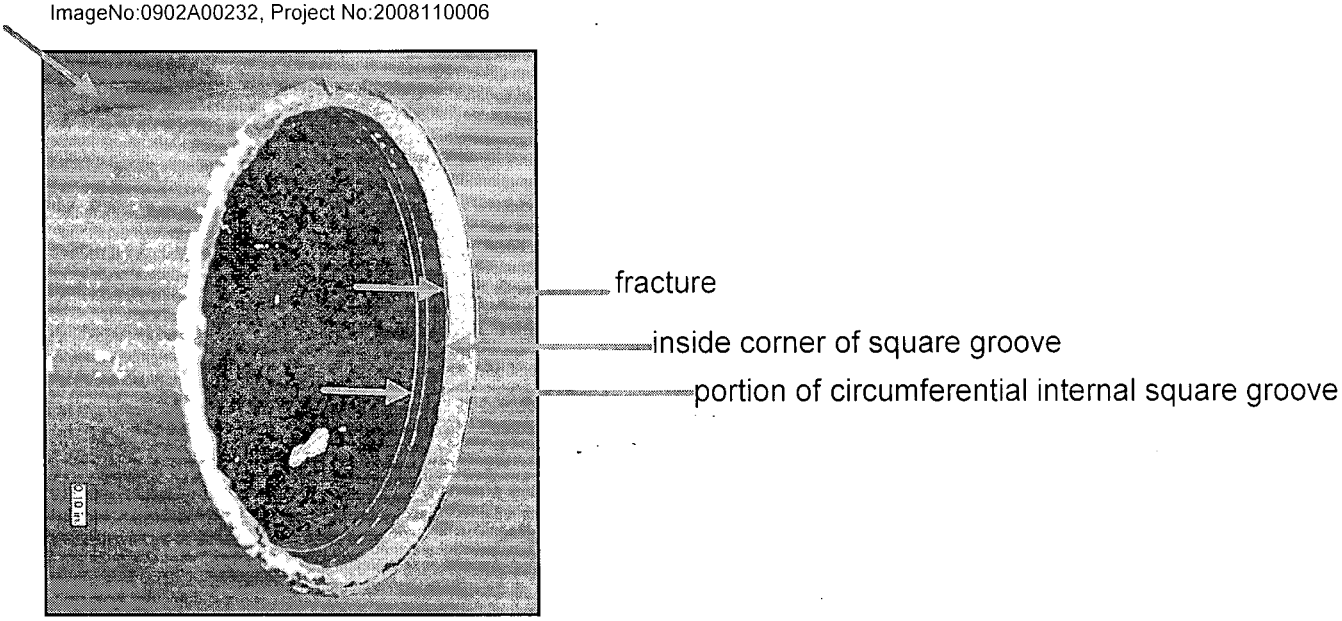

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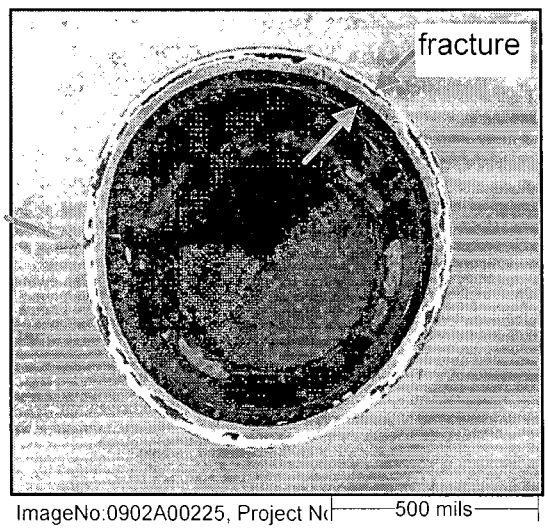

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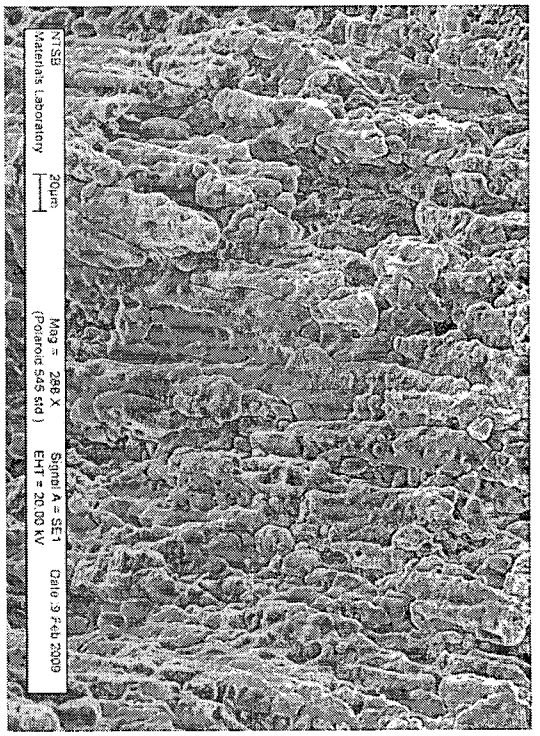
Figure 16. View of the position adjusting screw for the temperature sensor bellows assembly in the as-received condition (upper photograph); side view after disassembly and ultrsonic cleaned with detergent (center photograph); and view looking into the position adjusting screw (bottom photograph). Note the dent in the area indicated by an unmarked arrow. In the assembled condition, an internal retaining ring would have been inserted into the square groove.



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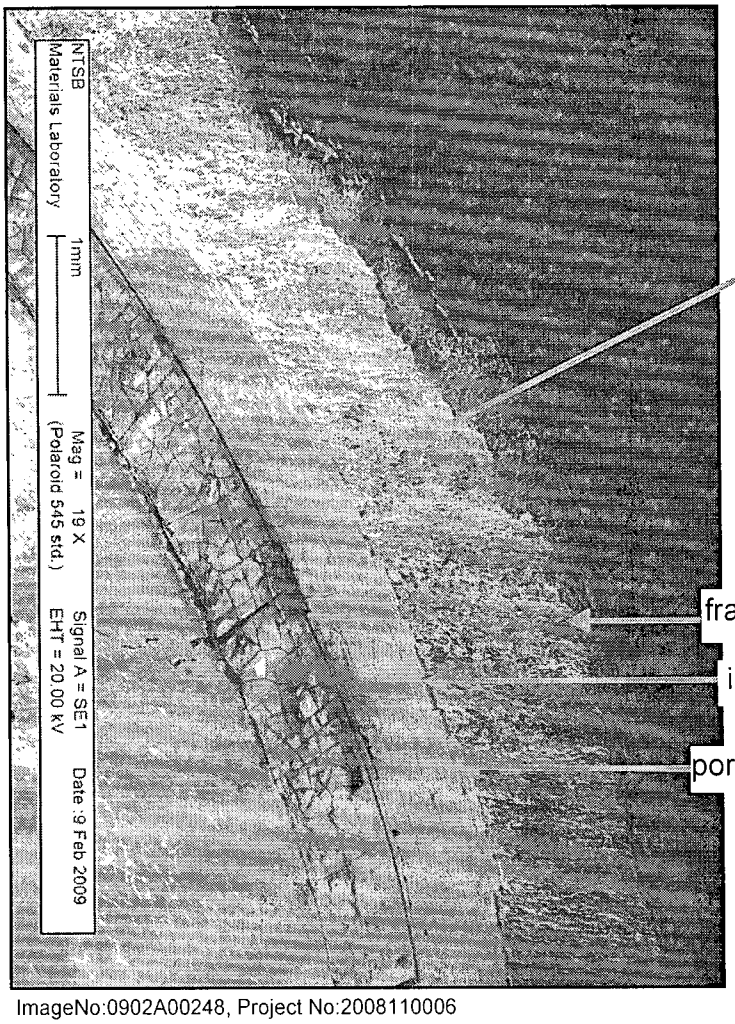


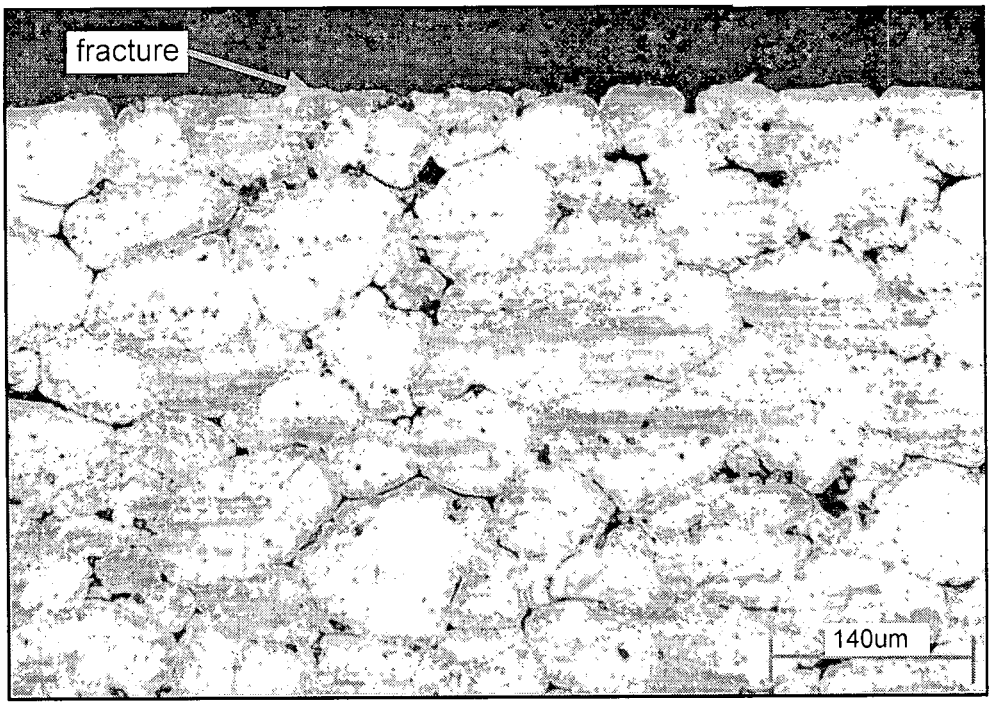
fracture portion

inside corner of square groove

portion of circumferential internal square groove

ImageNo:0902A00248, Project No:2008110006

Figure 17. SEM photographs of a portion of the position adjusting screw for the temperature sensor belows assembly (lower left corner of page) and a higher SEM photograph of the fracture face (upper right corner of page). In the assembled condition, an internal retaining ring would have been inserted into the square groove.



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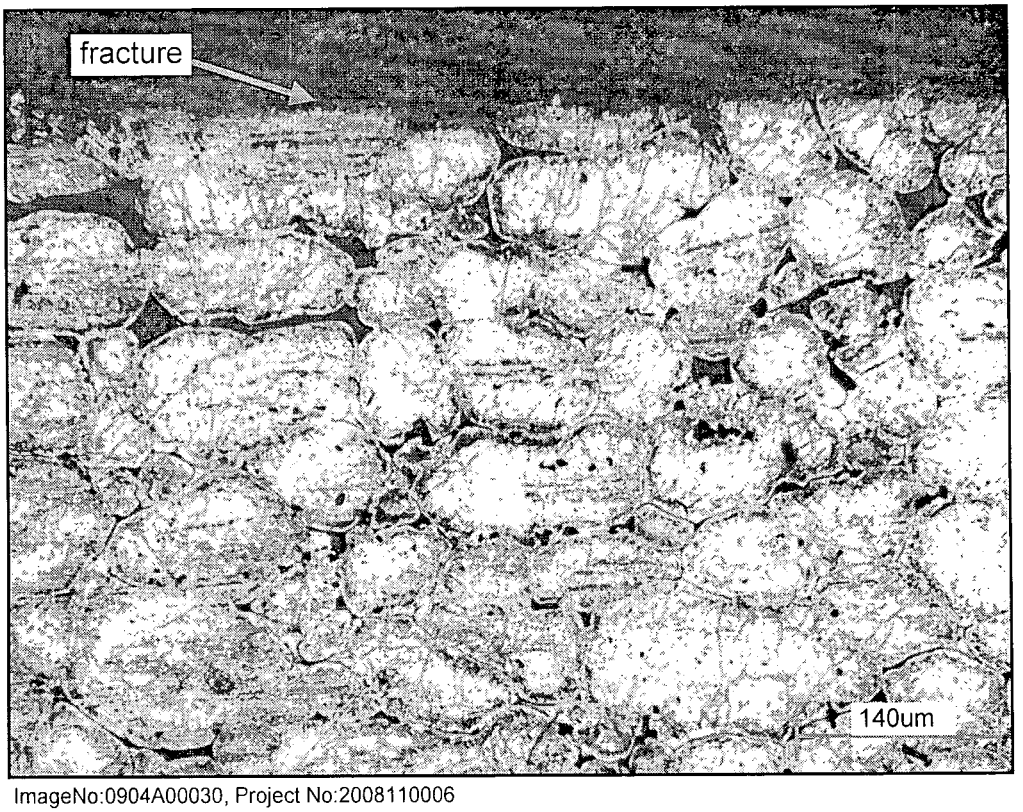

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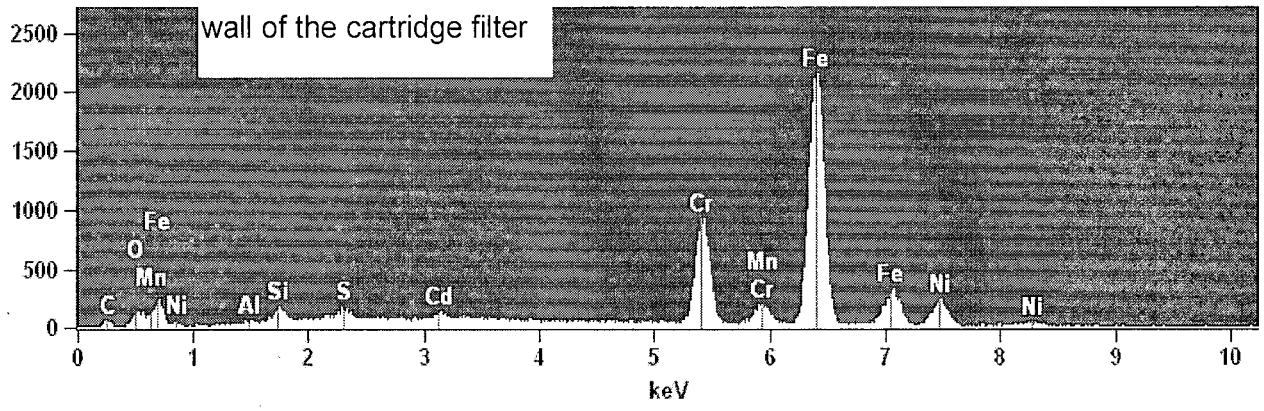
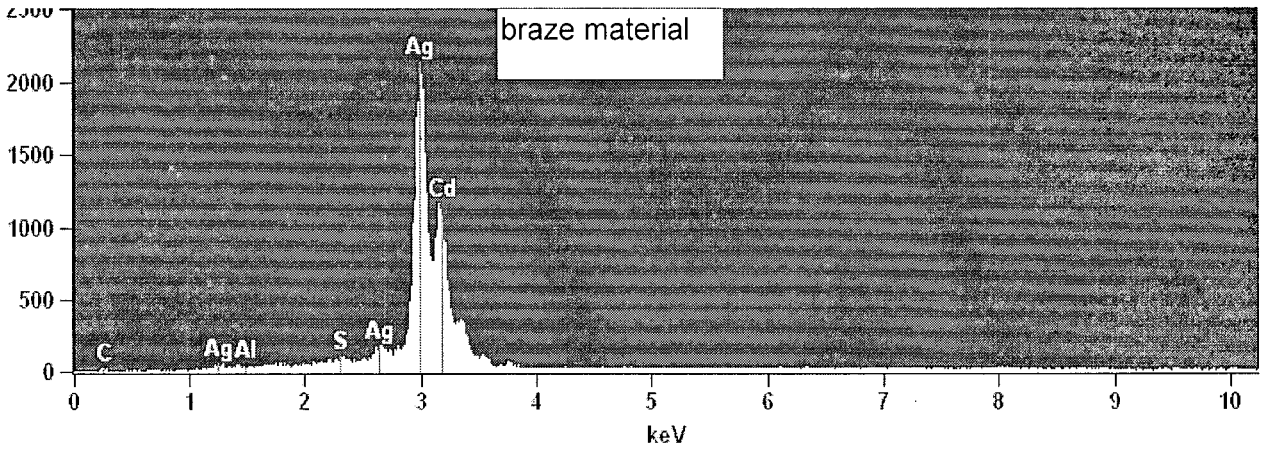
Figure 18. Longitudinal-radial section of the wall portion of the position adjusting screw from the temperature sensor bellows assembly. The microstructure shows an overheated aluminum alloy with solid solution melting at the grain boundaries. The two photographs were taken in an area that was located near each other and adjacent to the fracture face. The area shown on the bottom photograph was etched for a longer period of time compared to the area on the upper photograph. Etched with Keller's reagent.

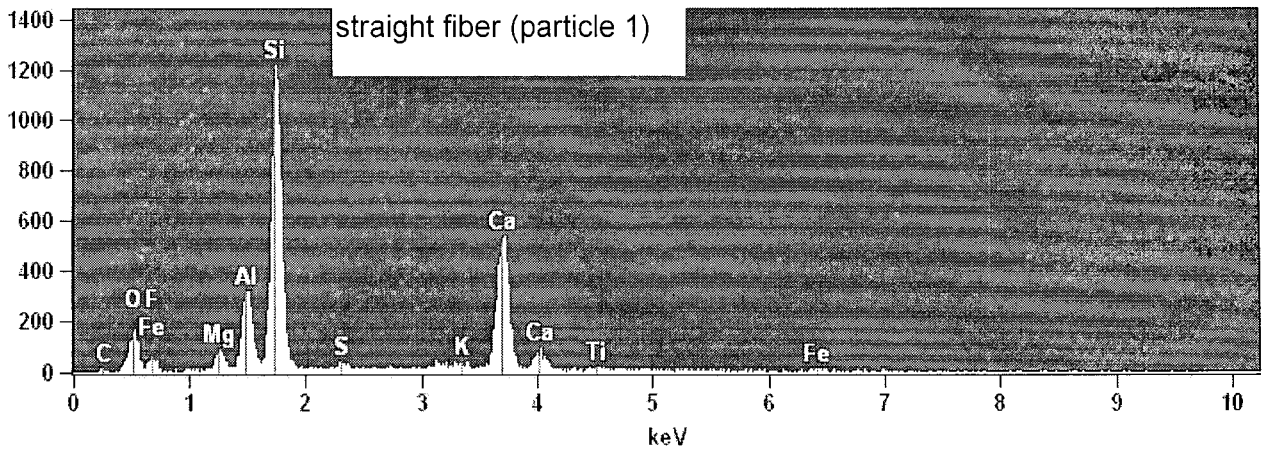
APPENDIX 1



EDS spectrum of the wall from the removable-cartridge filter contained major elemental peaks of iron, chromium, and nickel, and minor elemental peaks of carbon, oxygen, aluminum, silicon, sulfur, and cadmium.

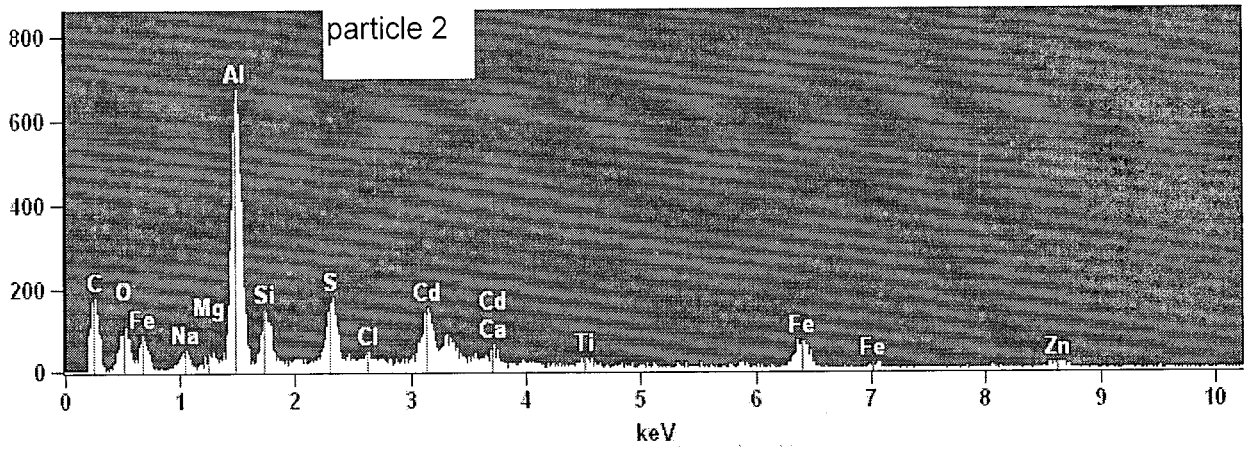


EDS spectrum of the wall of the braze material between the casting and screens contained major elemental peaks of silver and cadmium, and minor peaks of carbon and sulfur.

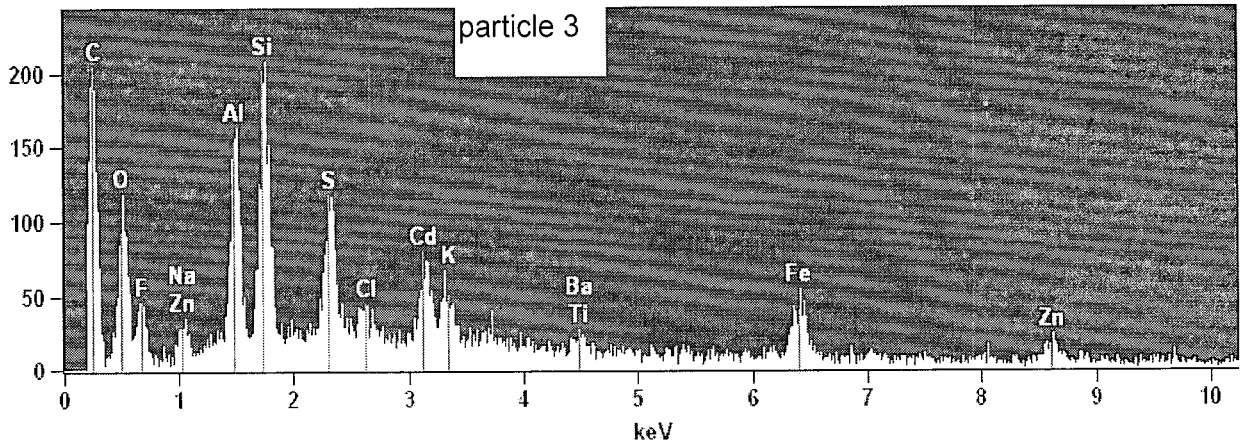


EDS spectrum of the straight fiber (particle 1 in figure 7) contained major elemental peaks of silicon, aluminum and calcium with minor elemental peaks of iron, magnesium, carbon, and oxygen, consistent with e-glass.

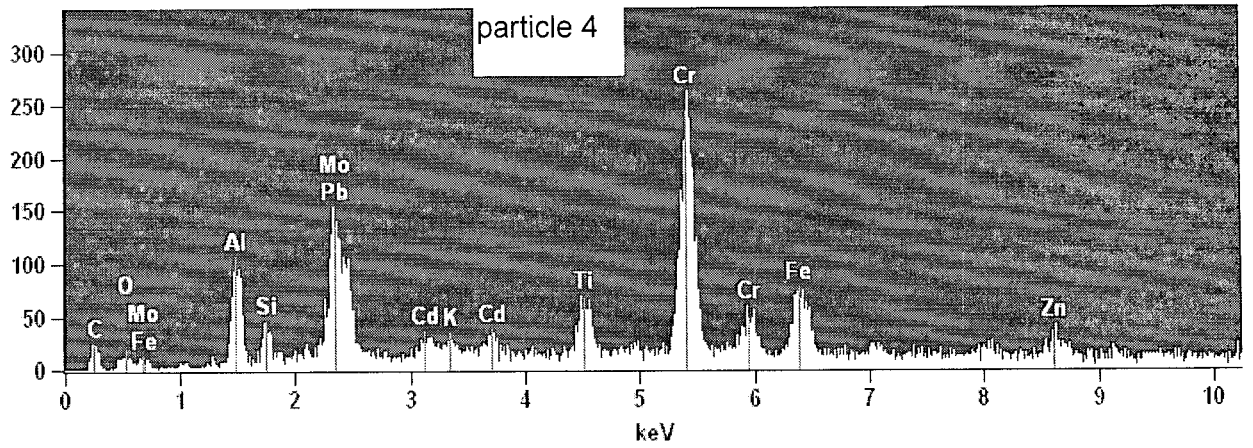
APPENDIX 1



EDS spectrum of particle 2 in figure 7 contained a major peak of aluminum and minor peaks of carbon, oxygen, iron, sodium, magnesium, silicon, sulfur, chloride, cadmium, titanium, iron, and zinc.

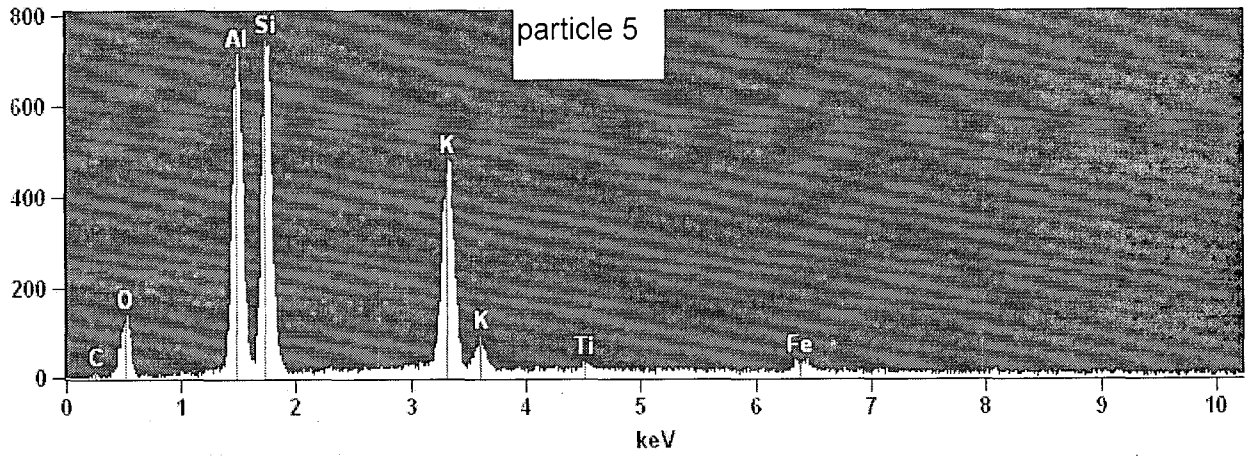


EDS spectrum of particle 3 in figure 7 contained major elemental peaks of silicon, aluminum, and carbon, and minor peaks of fluoride, sodium, zinc, sulfur, choride, cadmium, potassium, titanium, iron and zinc.

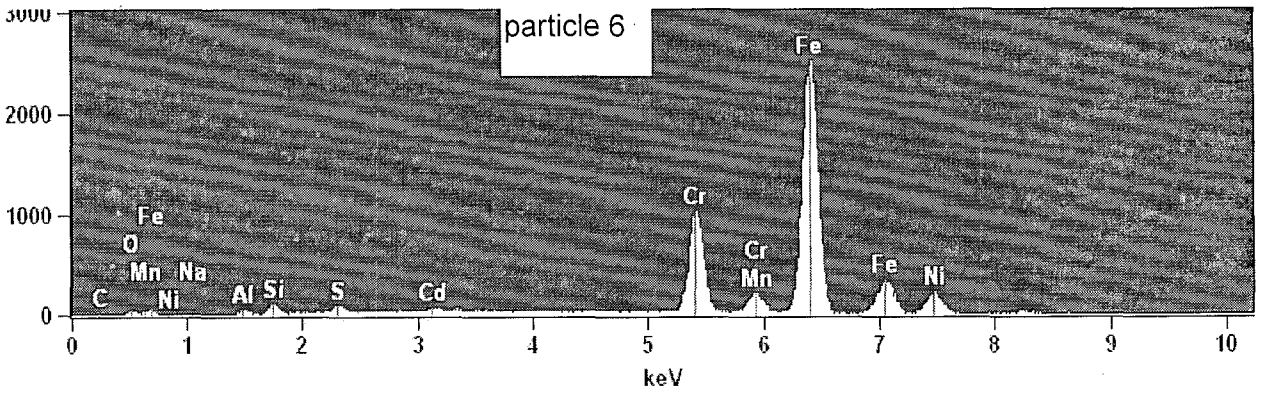


EDS spectrum of particle 4 in figure 7 contained element peaks of iron, nickel, chromium (present in the body of the filter assembly), and elemental peaks of lead, aluminum, silicon, zinc, titanium, carbon, cadmium, and potassium.

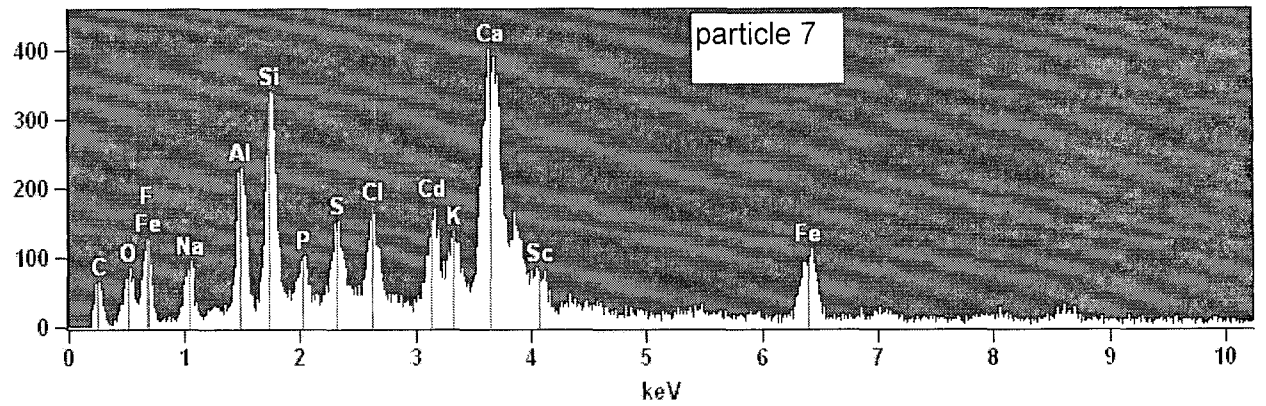
APPENDIX 1



EDS spectrum of particle 5 in figure 7 contained major elemental peaks of silicon, aluminum, and potassium (consistent with Feldspar) and minor elemental peaks of iron, carbon, and oxygen.

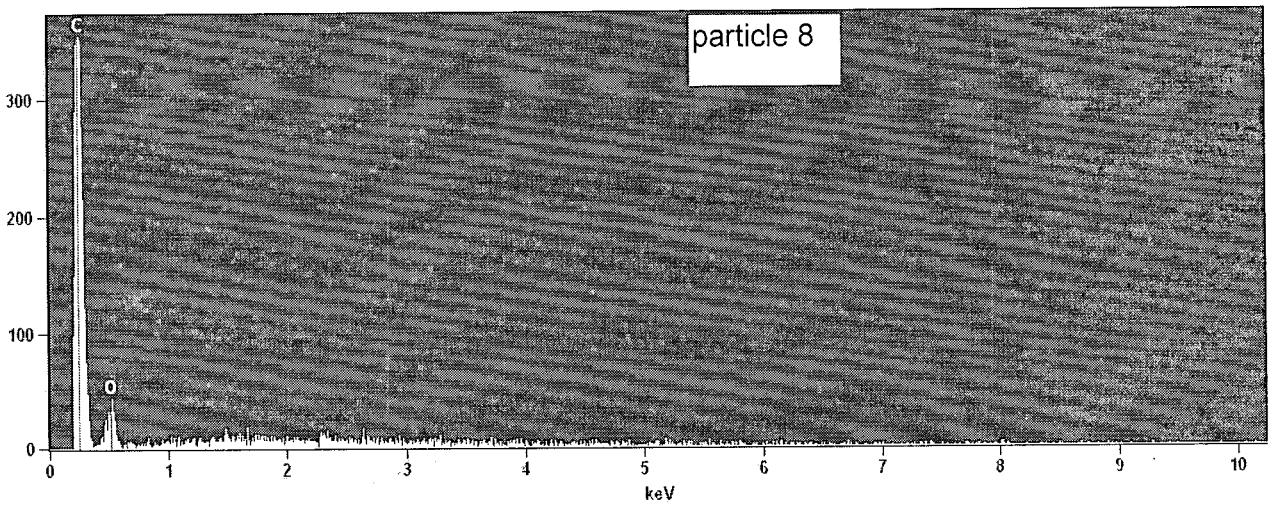


EDS spectrum of particle 6 in figure 7 contained major elemental peaks of iron, chromium, and nickel consistent with stainless steel, and minor elements of oxygen, aluminum, silicon, sulfur, and cadmium.

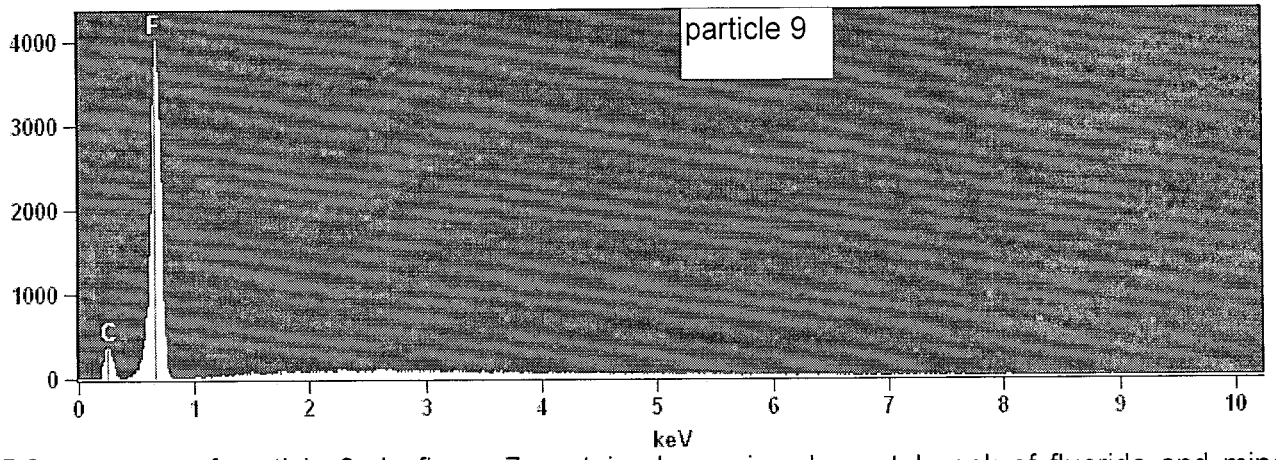


EDS spectrum of particle 7 in figure 7 contained the same elemental peaks as in particle 3 with the exception that the major elemental peaks in this particle were calcium, silicon, and aluminum.

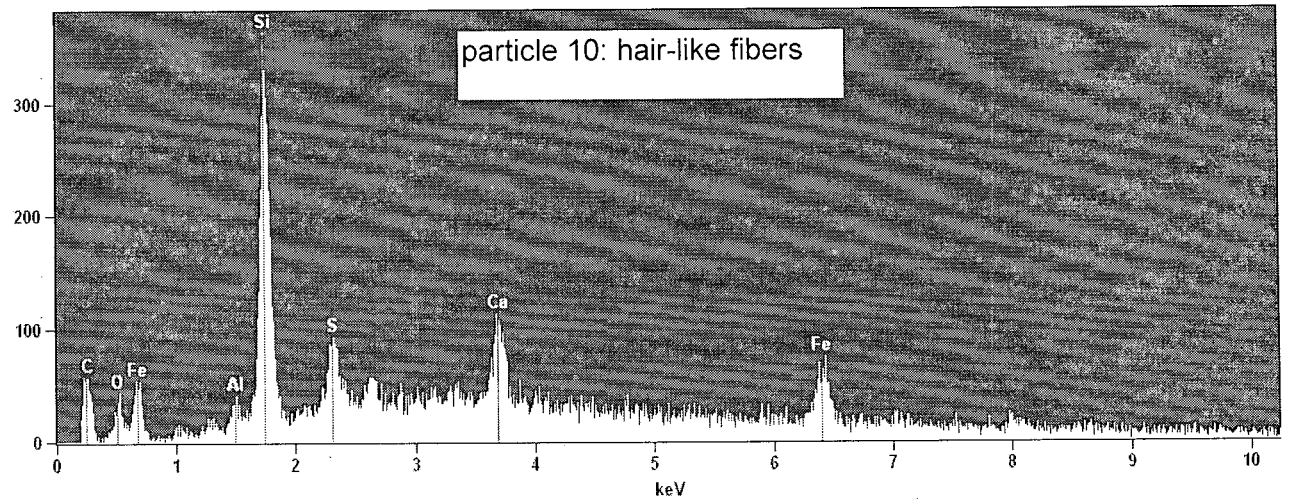
APPENDIX 1



EDS spectrum of particle 8 (curled fiber) in figure 7 contained a major elemental peak of carbon and a minor peak of oxygen.

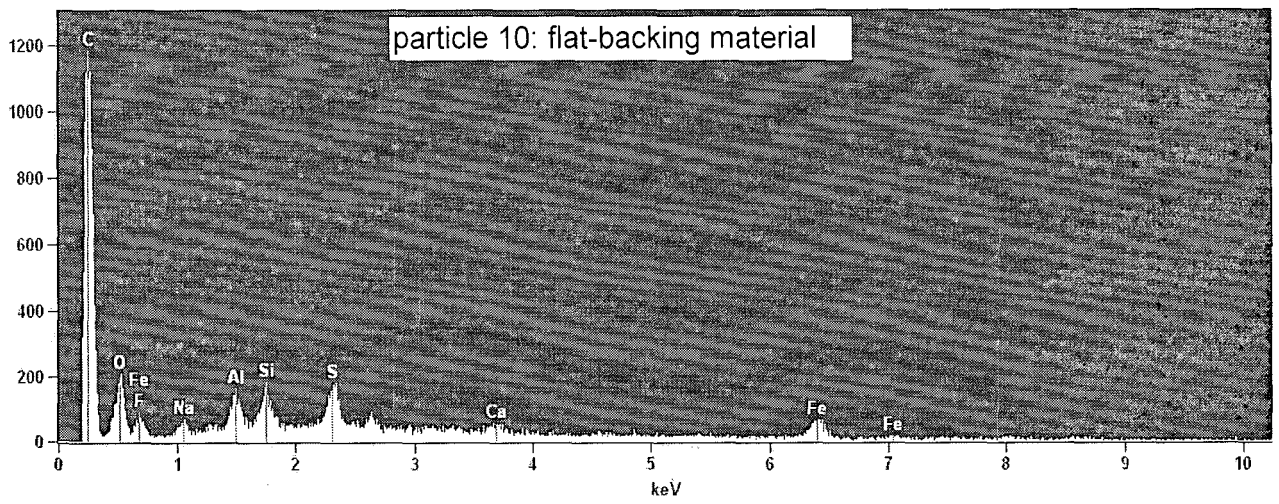


EDS spectrum of particle 9 in figure 7 contained a major elemental peak of fluoride and minor peak of carbon.



EDS spectrum of particle 10 in figure 7 in the area that contained hair-like fibers showed a major elemental peak of silicon and minor peaks of carbon, oxygen, aluminum, sulfur, calcium and iron.

APPENDIX 1



EDS spectrum of particle 10 in figure 7 in the area that contained a flat wall showed a major elemental peak of carbon and minor peaks of oxygen, fluoride, sodium, aluminum, silicon, sulfur, calcium. and iron.