



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Western Pacific Region

AIRFRAME AND ENGINE EXAMINATION

WPR19FA091

This document contains 15 embedded photos.

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A. ACCIDENT

Location: Forks, WA.
Date: March 8, 2019
Aircraft: Bell Helicopter UH-1B
NTSB IIC: Fabian Salazar

B. EXAMINATION PARTICIPANTS:

Name: Dennis Hogenson
Deputy Regional Chief
National Transportation Safety Board
Federal Way, WA 98003

Name: Fabian Salazar
IIC
National Transportation Safety Board
Federal Way, WA. 98003

Name: Kevin McKee
Seattle FSDO, FAA
Seattle, WA.

Name: Marlin Kruse
Air Safety Investigator
Honeywell Aerospace
Phoenix, AZ.

C. SUMMARY

Initial examination of the airframe and engine occurred on March 9, 2019 at the accident site. The airframe was further examined on April 25, 2109. at Air Transport, Phoenix, AZ. The engine was further examined at Honeywell Aerospace, Phoenix, AZ, on April 24, 2019. Findings included substantial damage to the internal components of the engine including the fragmentation of the sealing disk, first G.P. The helicopter was found with the 180 ft long line attached to the cargo hook and the hydraulic grapple was found attached to the opposite end of the long line with a log secured in the jaws.

D. DETAILS OF THE INVESTIGATION

1.0 AIRFRAME

Examination of the accident site revealed the helicopter came to rest inverted on a heading of about 100° in an area of recently felled trees. The fuselage sustained extensive damage. The nose of the aircraft had folded over to the top of the fuselage. The top of the fuselage, just forward of

the engine doghouse, had folded up and aft to the point of striking the main rotor mast. There was no post impact fire and the line remained attached to the cargo hook (See photos 1 and 2).



Photo 1. Showing the helicopter at the accident site.



Photo 2. Showing the rear view of the helicopter at the accident site.

The engine nacelle / engine fairings were removed prior to the flight and were absent. The tail boom broke away about 2 ft from the root and came to rest on its right side. A large impact strike appeared near the separation point of the tail boom. The tail boom came to rest onto a tree stump at this impact point. The synchronized elevators displayed impact damage at the tips. The vertical fin sustained impact damage and lateral bending to the left about 1 ft from the base. A repair was observed at the T/R drive shaft cover near the 90° gearbox. The synchronized elevator push-pull tube fractured near the point of tail boom separation. One tail rotor control cable remained attached while the other broke free near the tail boom separation location. The tail rotor drive shaft cover remained latched down along the leading edge of the vertical fin. The tail rotor drive shaft covers remained latched down and intact. The T/R drive shaft was not examined at the accident site.

INSTRUMENTATION. The helicopter instruments displayed the following indications:

The helicopter was utilizing left door instruments. The Left door instruments indicated:

EGT: 0°

N1: 0%

Torque: 53 pounds

Dual Tachometer: Engine: 0 RPM, Rotor: 0 RPM

Hook Armed Light: Off

Master Caution Light: Off

Instrument Panel:

Airspeed Indicator: 0 knots

Attitude Indicator: 80° right roll, 22° nose down

Altitude: 1,520 ft MSL

Vertical Speed Indicator: 100 FPM descent

Dual Tachometer: Engine: 0 RPM, Rotor: 0 RPM

RMI: 280°

Engine Torque: 0 pounds

N1: 0 %

EGT: 30°

Fuel Pressure: 11 pounds

Fuel Quantity: 1,300 pounds

Engine Oil Pressure: 0 Pounds

Engine Oil Temperature: -75 (Bottom of scale)

Transmission Pressure: 0

Transmission Temperature: -75 (Bottom of scale)

Main Gen: 0

DV Volts: 0

AC Volts: 0

An N1/N2 Cycle Counter was found mounted to the instrument panel. The Cycle Counter was sent to AKV Engineering, Camarillo, California and found to be operating normally. Information from the Cycle Counter's three pages was recorded.

2.0 DRIVETRAIN

The transmission separated from the support case but remained attached to the fuselage by the lift link located at the forward bottom of the transmission. The transmission and mast were displaced aft to the point of coming to rest over the engine compartment area. The freewheeling unit was inaccessible for examination due to crushing from the transmission mount area of the fuselage.

3.0 MAIN ROTOR ASSEMBLY

The stabilizer bar remained attached to the main rotor assembly. One main rotor blade control tube was damaged and broke in two but remained attached at both connection points. Both pitch horns were separated from the blade grips. Both drag braces remained attached to the main rotor blades and the blade grips. One scissors drive link had pulled free of the rotating swashplate. The trunnion bearing remained attached to the drive link. The scissors and sleeve assembly remained intact and did not display damage. The collective levers remained attached to the collective sleeve and appeared normal. The swashplate support appeared normal. The collective servo had separated from the collective levers about 6 inches from the trunnion bearing. Both damper link tubes remained attached to the dampers and the stabilizer bar assembly. The mast appeared normal.

The “A” main rotor blade was damaged with indications of trailing edge to leading edge abrasions from the tip of the blade inboard to about 5.5”. Damage from trailing edge to leading edge 15” inboard from the tip, 3” wide by 8” deep. The trim tab, and about 9 inches of the adjacent blade, inboard were damaged and the trim tab was bent up. An object strike on the bottom half of the blade from 109” inboard of the tip and extending about 30” long. A 3.5” diameter hole was located about 181 inches from the blade tip. The A blade was bent upwards about 40° at the blade grip. The A blade, pitch horn separated from the blade grip, allowing the A blade to rotate 180°.

The “B” main rotor blade was damaged with indications of a 90° bend upwards at about 57” from the root. Damage to the leading edge was observed, all the way through to the trailing edge, 109 inches inboard from the blade tip. Damage from the trailing edge to the leading edge 11 inches to 17 inches from the bottom of the blade, going up.

The K-flex drive shaft, connecting the transmission to the engine was found fragmented.

4.0 TAIL ROTOR ASSEMBLY

The “A” blade was damaged with indications of chordwise cracking about 33 inches from the tip. The “B” blade was damaged with indications of a leading-edge strike and chordwise cracking about 35 inches from the tip. Both tail rotor pitch-change links remained connected at both ends (blade grips and cross-head). The 90° gear box was loosely attached to the top of the vertical fin. The tail rotor drive shaft separated at the first hanger bearing which was near the area where the tail boom separated from the fuselage. The remaining five tail rotor driveshaft components remained attached to the number 2,3, and 4 hangar bearings, the 42° gearbox and the 90° gearbox. The drive shaft covers were observed to be secured in place. The tail rotor hydraulic servo remained attached to the airframe and displayed no damage.

Landing gear. The landing gear assembly remained attached to the lower fuselage. The left skid was damaged and displayed a large round impact bend pushing inward towards the helicopter. The left skid appeared normal. The forward and aft cross tubes appeared normal, but with slight

bending on the left side. The skids remained attached to the cross tubes and the four attachment points. The skid shoes remained attached to the skids.

5.0 HYDRAULICS

The three hydraulic servos, lateral, longitudinal, and collective, had separated from the swashplate. The hydraulic pump was attached to the transmission. Pressure and return lines from the hydraulic pump to the servos remained secured.

The cargo hook remained attached to the underside of the helicopter. The cargo hook was examined at the secure facility and operated normally in both electronic release of the hook and manual release of the cargo hook. The cargo hook mount was a military design. It displayed a significant bend towards the left-hand side. The manual release cable was found attached to the cargo hook and continuity was established from the manual cargo release pedal on the right side of the pilot station. The torque tube from the right-side manual cargo release to the left-side cargo release pedal was damaged.

6.0 GRAPPLE LOGGING EQUIPMENT

The helicopter was equipped with a hydraulic pump for the grapple device used in transporting logs. The pump remained attached to the transmission at the rotor brake quill. Additional components for this hydraulic system were located on the left side of the engine deck.

The cargo hook retained the 5000-pound rated strap and the strap retained the 180 ft line. The long line held the grapple hook device at the other end. Two hydraulic hoses were secured to the bottom of the fuselage via a chain and attached to the grapple hook device. Tape was used about every ten feet to bind the two hydraulic lines and the line together. The tape separated from the line and the hydraulic hoses and was distributed throughout the debris field.

The grapple hook device was examined at a recovery site and found to function normally. The 500 pound-rated strap displayed wear and damage. The line appeared normal.

The helicopter was equipped with a cargo hook. The cargo hook had an electronic release button located on the cyclic control stick and was normally actuated by the pilot's right ring finger. The helicopter also had a manual cargo release push pedal located on the deck near the tail rotor control pedals. This manual cargo release pedal could be actuated by either foot. According to the operating certificate the pilot was required to test the electronic release and the manual release daily. According to the mechanic, the cargo hook had a maximum weight capacity of 4000-pounds but was limited to 3000 pounds by company policy. The sling load method being used included a 5000-pound capacity nylon strap which was looped through the blue 180' line.

The manual cargo hook release pedal, located on the left-side floor of the pilot's station, was destroyed during the accident and could not be examined. Continuity of the manual cargo hook release cable was established from the cargo hook to the floor of the right-seat pilot's station.

The electronic cargo release button, located on the pilot's cyclic control stick, was examined, and performed normally

The cargo hook was moved to Onboard Systems International Inc. for examination. The cargo hook underwent an acceptance inspection revealing that no anomalies were found that would have precluded normal operation. The acceptance inspection included operating the cargo hook release in the manual and electronic modes up to loads equaling the maximum allowed cargo load.

7.0 ENGINE

The T-53-L13B, Serial number: LE-17761B was overhauled by CAPPSCO International Corp. An FAA Form 8130-3 (02-14) was signed on August 1, 2017. The engine was installed into the helicopter on July 2, 2018. The engine was examined at the accident site. The engine remained attached to the engine deck via the engine mounts. The outer view of the engine appeared normal with no overt damage to the engine. All fuel lines, oil lines, and electrical lines appeared attached and normal. The mounts were damaged yet functioning. The fuel line was attached to the engine fuel control. The throttle lever was attached to the linear actuator and the linear actuator was attached to the fuel control. The fuel control was near the "MIL PWR" position.

On April 24, 2019, the engine was transported to and examined by employees of Honeywell Aerospace, Phoenix, AZ. Members of the FAA, NTSB, and the IIC were present. The engine was placed on a maintenance stand and examined. During this examination it was observed that components of the engine (compressor, power turbine rotor) would not rotate freely.

7.1 Accessory Drive Gearbox Assembly

The accessory drive gearbox assembly was examined and appeared normal, and not disassembled. Oil was present in the oil screen and appeared normal with no visible metal particles present. The drive splines appeared normal. Continuity of rotation from input to output drives was established.

The air inlet appeared normal and did not contain evidence of vegetation or dirt ingestion. The variable inlet guide vanes (VIGV) appeared normal with no evidence of damage. The VIGV rod moved freely and the VIGV's rotated freely.

All axial compressor blades (stages one through five) remained attached at the roots. Some compressor blades, at all stages, displayed evidence of contact with the compressor housing while under rotation. The blade tips displayed heat discoloration with metal at the tips of the blades rolled aft, opposite the direction of rotation. The compressor housing displayed evidence of blade contact, with rotational scarring evident. All the centrifugal compressor blades remained attached to the impellor and displayed evidence of contacting the impellor housing while under rotation. There was evidence of heat discoloration and metal, with the blade tips rolling aft, or opposite the direction of rotation.

7.2 Gas Producer Nozzle and First Stage Turbine

The first stage gas producer (GP) nozzle was damaged and fragmented. The sealing ring (seal disk) separated into multiple pieces. This component was sent to the Honeywell Aerospace metallurgy lab for further examination. The first stage GP turbine rotor displayed damage to all turbine blades at the leading edge and the tips.

7.3 Gas Producer 2nd Stage Nozzle and Turbine Assembly

The second GP nozzle was intact, but damaged, displaying missing portions of the trailing edge of many of the guide vanes. The second GP turbine rotor displayed leading and trailing edge damage to all turbine blades. The gas producer cylinder was damaged and scored internally by contact from the compressor blades.

7.4 Combustor Turbine Assembly

The first stage Power Turbine (PT) nozzle displayed damage along the leading edge, near the tips of the guide vanes and along the trailing edge. The first stage PT rotor displayed damage to all turbine blades. The second stage PT nozzle displayed minor damage along the trailing edge. The second stage PT rotor assembly displayed minor damage to the turbine blades near the leading edge.

7.5 Combustion Chamber

There was a large amount of fragmented internal components (nuts, bolts, safety wire, metal fragments,) found deposited in the combustion area.

PHOTO ARRAY



Photo 3: T-53-L-13B Engine showing the gas producer turbine rotor assembly and internal engine damage.



Photo 4: First stage gas producer turbine rotor. Photo courtesy of Honeywell Aerospace.



Photo 5: First stage gas producer turbine rotor with sealing disk resting in place. Photo courtesy of Honeywell Aerospace.



Photo 6: First stage GP sealing disk. Photo courtesy of Honeywell Aerospace.

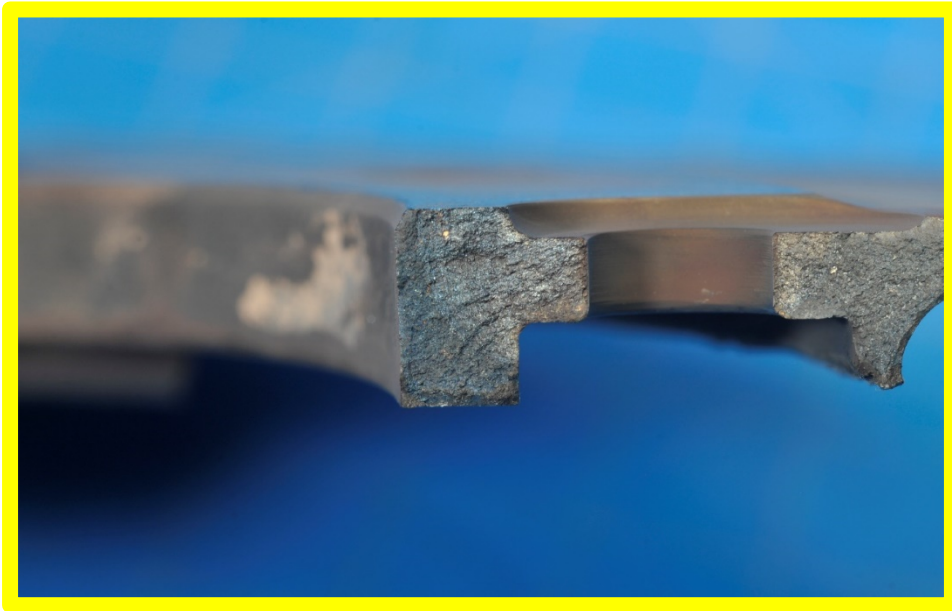


Photo 7: First stage sealing disk, side view. Photo courtesy of Honeywell Aerospace.

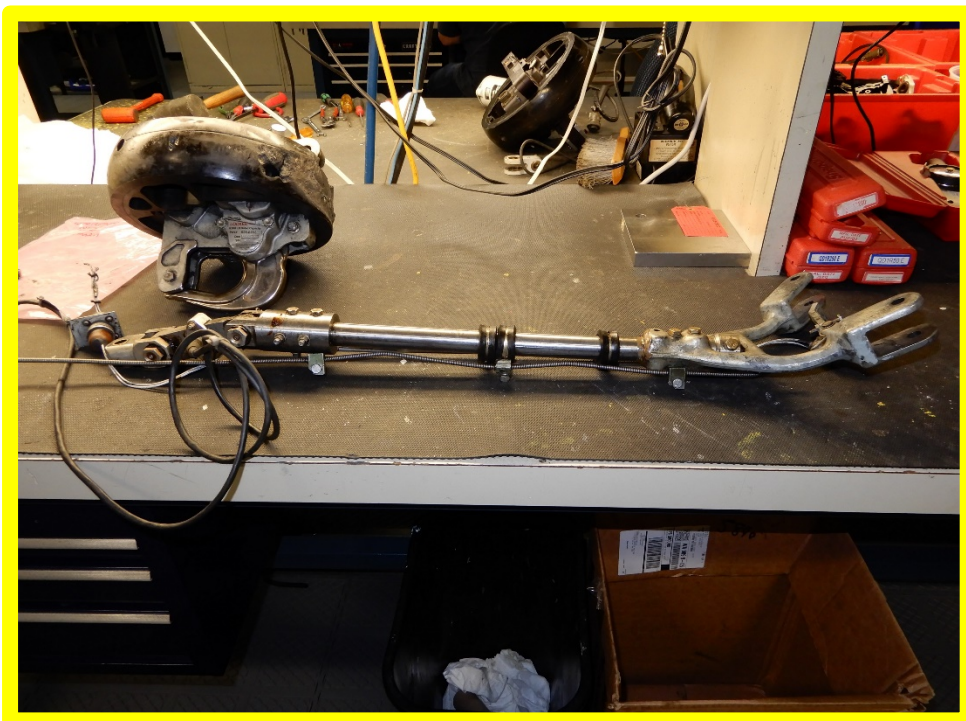


Photo 8. Cargo hook assembly



Photo 9. Cargo hook examination, showing cargo hook on test stand.



Photo 10. Engine cycle counter, Page A



Photo 11. Engine cycle counter, Page B



Photo 12. Engine cycle counter, Page C

MODULE-COMPONENT RECORD CARD

DESCRIPTION SEALING DISC, FIRST G.P. **REMOVED FROM**
PART NUMBER 1-100-135-03 **SERIAL NO.** 3694 **ENGINE S/N:** _____
PART TIME SINCE NEW 1067.3

NOTE: RETURN THIS CARD WITH MODULES OR COMPONENTS

MAINTENANCE PERFORMED	PARTS REPLACED	HOURS/CYCLES	REMARKS	STAMP OR INITIALS
INSPECTED IN ACCORDANCE		1067.3 / 2134.6	REINSTALLED ON LE-17761B	
DMWR 1-2840-113			AT ENG TSN: 4572.3	

The total operating hours and operating cycles on the components based on previous logbook entries and/or customer supplied information, FOIA, time coding, CCAD forms.

Date: 1AUG2017

Organization: Cappsco Intl. Corp.

Signature & title  Q.C.

Photo 13. Maintenance card for first stage sealing disk, Showing historical hours and cycles of the sealing disk, prior to installation into the engine at overhaul.

7/2/2018 65-12854 N64RA ACTT 14859.5 HOBBS 5845

1. REINSTALLED M/R/B PART NUMBER 204-011-250-113 SER# A2025 AT T.S.N. 1108.7
INSTALLED M/R/B PART NUMBER 204-011-250-113 SER# A6184 AT T.S.N. 2372.3
2. REINSTALLED STABILIZER BAR PART NUMBER 204-011-326-007 SER# S19-914
3. REMOVED MAST ASSY PART NUMBER 204-040-366-015 SER# HPI 112372
INSTALLED MAST ASSY PART NUMBER 204-040-366-15 SER# A12-11974 T.S.O. 944.9
TOTAL RIN ON THE MAST POLE 73461
4. REMOVED M/R/H PART NUMBER 204-012-101-139 SER# ABG-3439 T.S.O. 743.9
INSTALLED M/R/H/ PART NUMBER 204-012-101-139 SER# ADA-04952 T.S.O. 547.1
5. INSTALLED SCISSOR AND SLEEVE ASSY PART NUMBER 204-011-401-011 SER # MD19-7244
T.S.O. 0.0
6. INSTALLED COLLECTIVE LEVERS PART NUMBER 212-010-403-005 SER# EAFS-11413 AND
EAFS-11417 AT T.S.N. 1869.0
7. REMOVED TRANSMISSION PART NUMBER 204-040-016-005 SER# ABU-16279
INSTALLED MAIN TRANSMISSION PART NUMBER 204-040-016-005 SER# ABU-15249 T.S.O. 944.9
WITH INPUT QUILL 205-040-263-111 SER# A12-10827 T.S.O. 0.0
8. REMOVED T/R/H PART NUMBER 204-011-801-121 SER# HPI109763 T.S.O. 829.4
INSTALLED T/R/H PART NUMBER 204-011-801-121 AT T.S.O. 344.3
9. REMOVED T/R/B PART NUMBER 2042200-101 SER# A433 AND A430 AT T.S.N. 1278.8
INSTALLED T/R/B/ PART NUMBER 2042200-101 SER# A208 AND A209 AT T.S.N. 482.8
10. REMOVED SLIDER PART NUMBER 204-010-720-003 SER# 33721-173 T.S.N. 829.4
INSTALLED SLIDER PART NUMBER 204-010-720-003 SER# MWFS1027 T.S.N. 944.9
11. INSTALLED ENG LE-17761B AT ENG T.S.O. 0.0
ENG WAS INSTALLED, RIGGED, AND RUN UP, LEAK CHECKED. I.A.W. STC SR00073DE I.C.A. AND
TM55-1520-210-23
TAIL ROTOR BLADES WERE INSTALLED I.A.W. VAN HORN S.T.C. I.C.A. MANUAL VMM-UH1B-312
FOR UH1B
COMPONENTS INSTALLED I.A.W. TM55-1520-210-23, TM55-1520-219-20, TM55-1520-219-34
AND S.T.C. SR00026DE
M/R/B T/B/ TO .2 IPS, AD 83-03-03 C/W, AD 2016-2-09 C/W, A/C REJ [REDACTED]

START	STOP	TOTAL	HIT CHECK	N1	COAST DOWN

AIRCRAFT TIME			INSPECTIONS	
HOBBS START	HOBBS STOP	TIME	HOUR	
58450	58450	0	HOUR	
			HOUR	
			HOUR	
			HOUR	

AIRFRAME		ENGINE
TIME TO DATE		
TIME TODAY		
TOTAL TIME	14859.5	0.0

1628.3

DATE	TIME	LOCATION	PILOT (PRINT)
7/3/18	0545	CONVERT	

DATA RECORDER		
ST		
T/O		
URNS		
WT LB.		

TON/HR	LB/TURNS	TURNS/HR

Photo 14. Maintenance log showing engine installation.

1. Approving Civil Aviation Authority/Country: FAA/United States		2. AUTHORIZED RELEASE CERTIFICATE FAA Form 8130-3, AIRWORTHINESS APPROVAL TAG			3. Form Tracking Number: 06531	
4. Organization Name and Address: CAPPSC INTERNATIONAL CORP. A MIDWEST AEROSPACE COMPANY FAA CERTIFIED TSO REPAIR STATION # 835R048D		5. Work Order/Contract/Invoice Number: M2043				
6. Item:	7. Description:	8. Part Number:	9. Quantity:	10. Serial Number:	11. Status/Work:	
1.	Gas Turbine Engine	1-000-060-22	1ea.	LE-17761B	Overhauled	
12. Remarks: Engine has been disassembled, cleaned, inspected, overhauled, reassembled, and functionally tested in accordance with DMWR 1-2840-113(vol. 1-4). Applicable AD's and extensive SB's complied with at this time. Engine is found to be in airworthy condition and is approved for return to service. All pertinent details of this repair are on file at FAA-CRS# 835R048D under W.O.# M2043. TSN: 4572.3 TSO: 0.0						
13a. Certifies the items identified above were manufactured in conformity to: ☐ Approved design data and are in a condition for safe operation. ☐ Non-approved design data specified in Block 12.			14a. ☒ 14 CFR 43.9 Return to Service ☐ Other regulation specified in Block 12 Certifies that unless otherwise specified in Block 12, the work identified in Block 11 and described in Block 12 was accomplished in accordance with Title 14, Code of Federal Regulations, part 43 and in respect to that work, the items are approved for return to service.			
13b. Authorized Signature:		13c. Approval/Authorization No.:		14b. Authorized Signature:		
13d. Name (Typed or Printed):		13e. Date (dd/mm/yyyy):		14c. Approval/Certificate No.:		
				14d. Name (Typed or Printed): MARC AVILA		
				14e. Date (dd/mm/yyyy): 01 Aug. 2017		
User/Installer Responsibilities						
It is important to understand that the existence of this document alone does not automatically constitute authority to install the aircraft engine/propeller/article. Where the user/installer performs work in accordance with the national regulations of an airworthiness authority different than the airworthiness authority of the country specified in Block 1, it is essential that the user/installer ensures that his/her airworthiness authority accepts aircraft engine(s)/propeller(s)/article(s) from the airworthiness authority of the country specified in Block 1. Statements in Blocks 13a and 14a do not constitute installation certification. In all cases, aircraft maintenance records must contain an installation certification issued in accordance with the national regulations by the user/installer before the aircraft may be flown.						

Photo 15. FAA Form 8139-3 Identifying the overhaul of the engine.