



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Western Pacific Region

Accident Date: February 21, 2019

AIRFRAME AND ENGINE EXAMINATION

WPR19LA087

This document contains 11 embedded photos.

A. ACCIDENT

Location: Kukuiahaele, Hawaii
Date: February 21, 2019
Aircraft: MD Helicopters 369E / N506PH
NTSB IIC: Fabian Salazar

B. EXAMINATION PARTICIPANTS:

Name: Fabian Salazar
Duty Position: ASI
National Transportation Safety Board
Federal Way, WA 98003

Name: Joan Gregoire
Duty Position: Chief Air Safety Investigator
MD Helicopters
Mesa, AZ

Name: David Riser
Duty Position: Sr. Air Safety Investigator
Organization: Rolls-Royce Corp
Indianapolis, IN

Name: Joel A. Van Brunt
Duty Position: Chief Ops Officer
Paradise Helicopters
Hilo, HI

C. SUMMARY

Examination of the airframe and engine occurred at the accident site in Kukuiahaele, HI, and at the hangar of the operator, on March 5 and 6, 2019. The IIC did not travel for the examinations. No evidence of preimpact mechanical malfunction or failure that would have precluded normal operation was noted during the examination of the airframe. A preliminary examination was accomplished on the engine and revealed the compressor bleed valve was in the incorrect closed position. No other engine anomalies were noted. It was decided that the engine would be transported to Keystone Turbine Services (KTS), Coatesville, PA, for further examination and a possible test run. After the bleed valve was replaced with an exemplar unit, the engine ran normally up to full power.

D. DETAILS OF THE INVESTIGATION

Airframe Examination. The airframe was examined by a party member from MD Helicopters. This report of the airframe was generated by viewing photos of the airframe and communication with the party member from MD Helicopters.

The helicopter had come to rest on its left side, on a generally flat open area. The right windshield and lower chin bubbles were fractured including the composite section between the

two chin bubbles. The left pilot's windshield was not fractured. The cockpit area sustained minor damage to the right side and substantial damage to the lower left side. The cabin area was not compromised and retained its shape. The instrument panel remained secured to the fuselage and the flight instruments remained secured in the panel. The operator removed the radios from the helicopter for recovery. The flight controls remained attached and were not damaged. The Hobbs meter read: 207.7 hours. The right-side pilot's door remained attached to the fuselage and secured. The right-side rear passenger door remained attached to the fuselage and was secure. The right-side skid remained attached to the fuselage at both struts and was removed from the fuselage for recovery. The right side of the fuselage received substantial damage above the engine bay. The right side of the tailboom at the fuselage and under the "doghouse" exhibited wrinkling of the skin. The fuel cap was secure to the port.

The tailboom sustained substantial damage with separation just forward of the empennage. A section of the tailboom bent upward about 20 inches inboard of the separation point. The tail rotor control tube and the tail rotor drive shaft were fractured at the same area as the break in the tailboom.

The empennage separated from the tailboom and was in the wreckage. The right side of the T-tail exhibited crushing and downward bending. The tail rotor and gear box remained attached to the end of the tailboom. One tail rotor blade was bent chordwise toward the tailboom about 12 inches from the root of the blade. The other blade exhibited minor damage. The vertical stabilizer exhibited damage on the leading edge consistent with contact by one or more main rotor blades. The lower vertical stabilizer and the stinger exhibited denting and bending along with dirt staining, consistent with contact with the ground. The tail rotor gearbox chip detector was clean and free of metal shavings. The oil from the gearbox was clear and bright.

The left side of the fuselage and the tailboom exhibited denting and wrinkling of the skin above the engine bay. The left-underside fuselage exhibited substantial damage with crushing and denting of the sheet metal. The left-side rear passenger door and the left-side pilot's door were removed for recovery. The left-side skid separated from the front strut at the upper and lower strut union, and at the upper attachment point of the rear strut. The left-side rear strut separated from the fuselage along with the left skid.

The main rotor system remained attached to the transmission and the transmission remained attached to the fuselage. The five-blade main rotor assembly exhibited substantial damage to all rotor blades. All blades exhibited significant chord-wise bending at different locations of each blade. The red, and white, blade dampers separated in two but remained attached at both ends. The blue, yellow, and green blade dampers remained intact and attached at both ends. All blade grips exhibited evidence of contacting the rotor hub at the aft or retreating end. All pitch change links, from the swash plate to the pitch horns remained attached at both ends.

The KA-Flex driveshaft from the engine to the transmission remained attached at both ends and did not exhibit bending. The fan belt remained attached to the pulleys/sheaves. The chip detector to the transmission was clean. The control tubes to the swashplate remained attached at both ends.

ENGINE: Model 250-C20B, serial number: CAE836362.

The engine was examined by a party member from Rolls-Royce. The IIC did not travel for the engine examination at the operator's hangar but did travel for the follow up engine exam and test run.

The engine remained attached to the fuselage by the engine mounts. The engine bay area was not compromised by impact. Upon examination it was observed that the compressor bleed valve was stuck in the closed position and had evidence of corrosion on the valve. The engine was removed from the helicopter to be shipped to a Rolls-Royce authorized service center.

ENGINE RUN

The engine was received by Keystone Turbine Services (KTS), Coatesville, Pennsylvania. The IIC and party members were present when the engine shipping container was opened. The engine was not damaged while in transit. The compressor bleed valve was observed to still be in the closed position. The engine was further examined by employees of KTS and Rolls-Royce where it was determined that a "run as received" test run would be conducted using the accident bleed valve and manually opening it for the test run. The test run occurred on May 15, 2019.

The engine was placed in the engine run test cell and operated by employees of KTS. The engine started normally, and the bleed valve was observed to close on its own but at a rate that was slower than normally observed by the KTS employees. The engine was then shut down and the accident bleed valve was replaced with an exemplar bleed valve that could be operated manually using compressed air.

The engine was started a second time with the bleed valve manually placed in the appropriate position for start. The engine was then brought up to full power and operated normally. Upon reduction of the engine power from a full load condition and with the bleed valve kept in the closed position, the engine began to surge, and the turbine outlet temperature (TOT) began to rise. Any attempt to increase power would increase the severity of the surging. The engine test cell control computer automatically shut down the engine. The engine was started a third time and the event was replicated with the same power surge and rise in TOT.

The accident bleed valve (serial number FF-29669) was examined by members of KTS, Rolls-Royce Engines and the IIC. The bleed valve was discovered to be constructed using Federal Aviation Administration Parts Manufacturing Approval (PMA) components. Before teardown, the bleed valve was visually examined and exhibited corrosion on the outer surfaces of the valve and the bushing. The two hex-head bolts securing the outer cases of the compressor, and nearest the bleed valve exhibited corrosion on the head of the bolts. The bleed valve assembly was then disassembled. The KTS employee had difficulty removing the valve from the bushing and was forced to use a mallet to tap the valve out. The valve exhibited a build up of corrosion on the stem and the inside of the bushing. The bushing and valve were measured using calibrated pins and rings owned by KTS. According to KTS, the bushing was 0.307" and the valve stem was 0.3079." Other internal components, including the spring and bellows, exhibited corrosion on their surfaces. Photos of the bleed valve taken on March 5th show corrosion but there were no

photos of the bleed valve taken at the accident site to provide information on the amount of corrosion at the time of the accident.

The accident valve and bushing were shipped to the NTSB materials laboratory where the corrosion was examined and found to contain a chemical that was consistent with Ardrex 6367, an engine wash compound used by the operator.

According to the director of maintenance, Paradise Helicopters had previously shipped two other bleed valve assemblies to KTS due to pilot complaints of engine anomalies. With permission from Paradise Helicopters, the two bleed valves were disassembled and measured. For bleed valve FF21414, the bushing was 0.308" and the valve stem was 0.3074". For bleed valve FF28091, the bushing was 0.308" and the valve stem was 0.3079".

PHOTO EXHIBIT



Figure 1. Front view of N506PH. Photo courtesy of MD Helicopters.



Figure 2. Right-side view of N506PH. Photo courtesy of MD Helicopters.



Figure 3. Rear view of N506PH. Photo courtesy of MD Helicopters.



Figure 4. Left-side view of N506PH. Photo courtesy of MD Helicopters.



Figure 5. View of the empennage, and tail rotor assembly. Photo courtesy of MD Helicopters.



Figure 6. Main rotor blades. Photo courtesy of MD Helicopters.



Figure 7. Right-side view of the engine. Photo courtesy of Rolls-Royce.



Figure 8. Left-side view of the engine. Photo courtesy of Rolls-Royce.

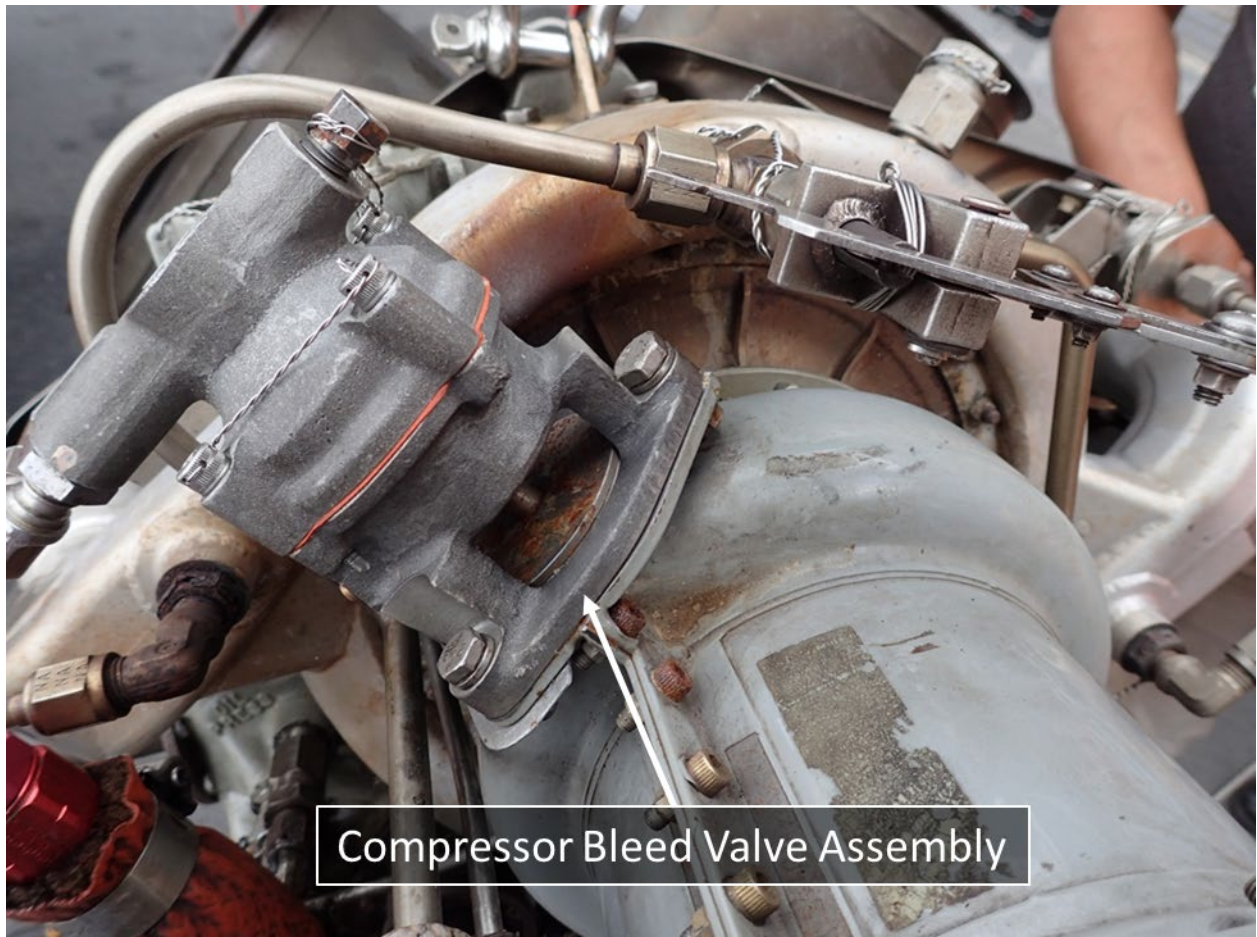


Figure 9. Top of engine view, showing the compressor bleed valve assembly. Photo courtesy of Rolls-Royce.



Figure 10. View of the compressor bleed valve, showing corrosion on the valve. Photo courtesy of Rolls-Royce.

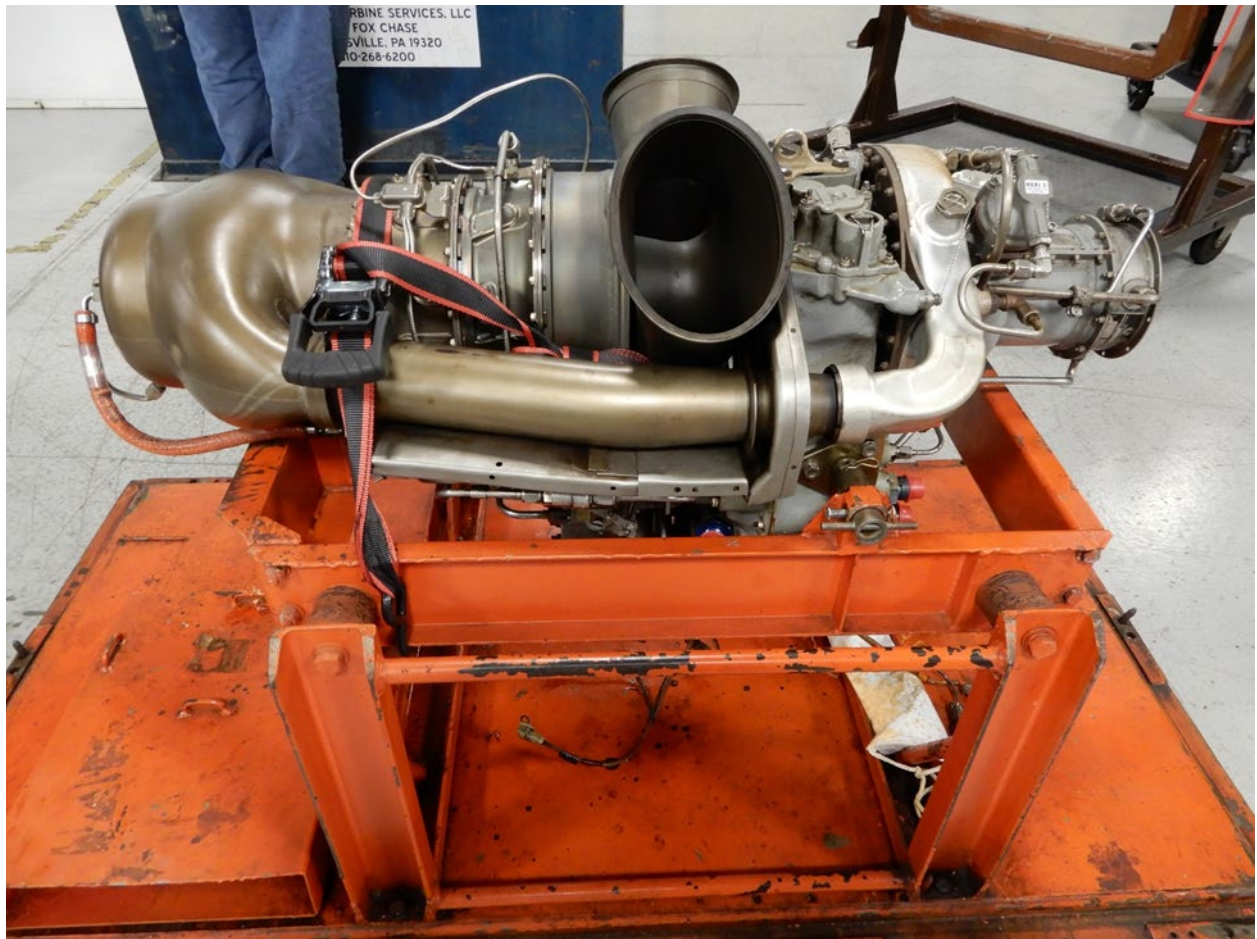


Figure 11. The engine as it was received at the service center. Photo NTSB