



Engine Investigation Report

Rolls-Royce Model: 250-C20B
Engine Serial Number: CAE 833577*
Aircraft Model: H369D
Registration Number: N8648F
Operator: Vertol
Accident Date: 4 July 2018
Wreckage Exam Date: 29 Aug 2018
Report Date: 8 Jan 2019



Model 250-C20B/I


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Report Enclosures:

Narrative

Appendix A, Wreckage Exam Photographs

Background Information:

Per the NTSB preliminary report: "On July 4, 2018, about 2114 Universal Coordinated time, a Hughes 369D helicopter, N8648F, impacted international waters in the Pacific Ocean about 20 seconds after takeoff from a Taiwan-registered fishing boat. The commercial pilot and the observer received fatal injuries. The helicopter was destroyed by the impact and salt water immersion. The helicopter was registered to Vertol Systems Company of Hillsboro, Oregon, and operated as a 14 Code of Federal Regulations Part 91 aerial observation flight. Visual meteorological conditions existed about the time of the accident."

Rolls-Royce participated in a wreckage examination under the direction of the NTSB in Majuro, Marshall Islands on 29 August 2018. Investigators from MDHI and Boeing were in attendance as well as the Operations Director from Vertol systems.

Wreckage Examination Observations:

The aircraft was recovered to the local Vertol maintenance facility at MAJ airport and secured in a large metal container (CONEX) until the parties arrived. The aft section of the tailboom to include the tail rotor assembly was not recovered.

The engine was securely mounted to the airframe. The throttle was in the "fly" position and the linkage to the fuel control unit was intact and moved smoothly. The power turbine governor input linkage was connected to the collective and moved smoothly. The N2 rotor could not be turned in the drive direction but freewheeled appropriately. A vacuum check was performed on the fuel system prior to engine removal with no leaks detected.

All of the external air, oil, and fuel line connectors were secure when checked by hand. The aircraft mounted oil system was undamaged and the scavenge oil filter pending bypass button was not extended. The oil tank was over filled with oil, likely due to the aircraft lying on its side after recovery, allowing engine oil to backfill into the reservoir. The oil was normal in appearance. The aircraft mounted scavenge filter was inspected and no debris was noted within the filter element. The aircraft mounted fuel filter element was free of debris and the filter bowl was full of fuel. A fuel sample was retained from the filter bowl.

The engine was removed from the aircraft and installed in a turnover stand to facilitate the field examination. Fuel was present in the fuel line into the engine and the oil in and out lines were unobstructed. A pneumatic system leak check was attempted; however an obstruction in the power turbine governor Pc air input tee prevented the pressurized air from entering the entire system. The engine fuel system components were removed and the lines inspected. No cracks or abnormalities were observed on the lines.

The fuel control unit was partially disassembled and the drive shaft turned freely with no abnormalities noted to the drive or spool bearings. The governor and speed enrichment

springs were intact and no abnormalities were noted within the fuel control unit. The fuel inlet strainer did not contain debris or contamination.

The power turbine governor was also partially disassembled. The drive shaft spun smoothly and the spool bearing was normal in appearance and feel. The governor spring was intact and appeared normal. The fuel pump was partially disassembled and the filter bowl was full of fuel. A sample was retained from the filter bowl. The filter element was inspected and appeared normal. The fuel pump gears and bearings were inspected with no anomalies noted. The fuel nozzle was disassembled and no contamination was noted on the fuel screen surface. The air shroud and both primary and secondary orifices displayed heavy corrosion.

The combustion section was removed and the combustion liner inner surface was corroded while the liner side walls displayed a normal burn pattern. The outer combustion case was normal in appearance.

Once the turbine module was removed from the gearbox both the N1 and N2 rotors spun freely. The turbine module was partially disassembled and all of the turbine wheel blades were observed to be intact with no damage noted. The first stage turbine nozzle and nozzle shield appeared normal with no obvious hot streaks. The third stage turbine nozzle was covered in a purple substance likely due to salt water immersion. The turbine bearings were oil wetted and turned freely while the shafting was intact with no evidence of disconnects.

Once the compressor was removed from the gearbox the rotor spun freely. The compressor inlet was undamaged and a piece of debris was lying in the rotor. The compressor was disassembled and the rotor was undamaged. The compressor case halves were inspected and some corrosion was noted on the vane airfoils. The corrosion was consistent with exposure to salt water and likely occurred after the event during storage. The spur adapter gearshaft was intact with some corrosion noted.

The gearbox was opened and the magnesium case had begun to disintegrate into a sludge like material. The N1 and N2 gears were undamaged with no missing teeth or broken shafts. After some manipulation, both the N1 and N2 gear trains turned. Neither the upper nor lower magnetic chip detectors retained ferromagnetic debris (although some sludge was present on the detectors from the deteriorating gearbox). The oil pressure filter was inspected and some sludge and a black plastic-like material was observed. The contamination was not significant enough to obscure the filter element.

Engine Information:

A Rolls-Royce M250-C20B gas turbine engine, S/N CAE 833577, powered the helicopter.

Component	Serial Number	Part Number
Engine	CAE 833577 ¹	6887190
Gearbox	N/A ²	6894171
Compressor	CAC 33401	6890550
Turbine	CAT22819	23069745
FCU	330125	23070606
PTG	BR41575	23065123
Fuel Pump	T108697	6899253
Fuel Nozzle	0129	23077068
Bleed Valve	FF37707	23053176

Summary of Findings:

No evidence of pre-impact mechanical damage was noted within the engine. Based on the fuel system inspection and bench testing, the engine was capable of making power prior to the event.

¹ There was no engine data plate installed. This information obtained from maintenance records.

² There was no gearbox data plate installed. This information obtained from maintenance records.

Appendix A, Wreckage Exam Photographs



Figure 1 Aircraft General

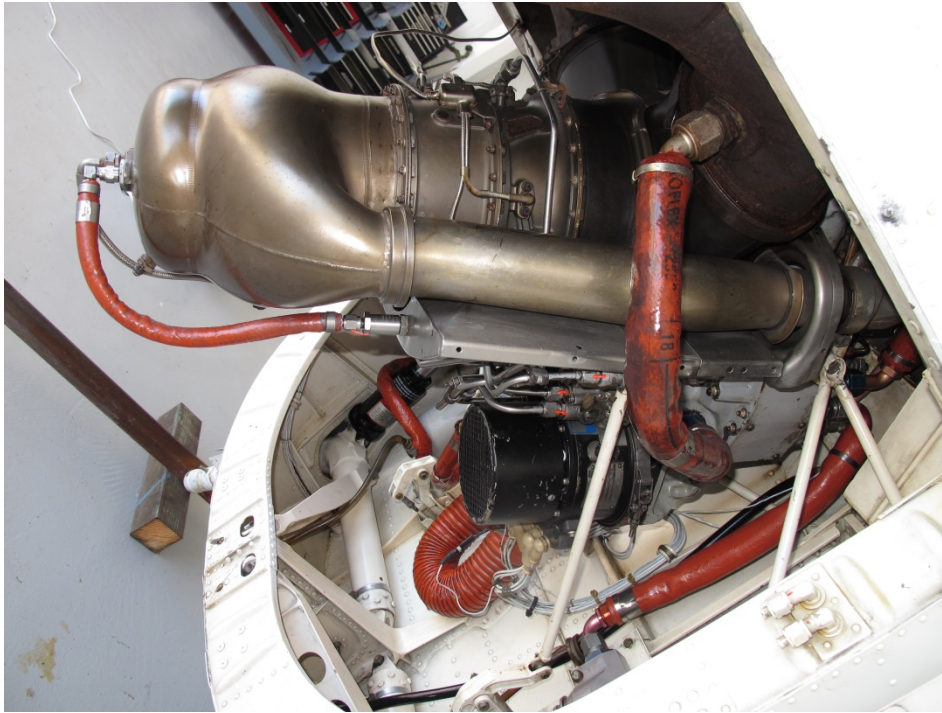


Figure 2 Engine Right Side

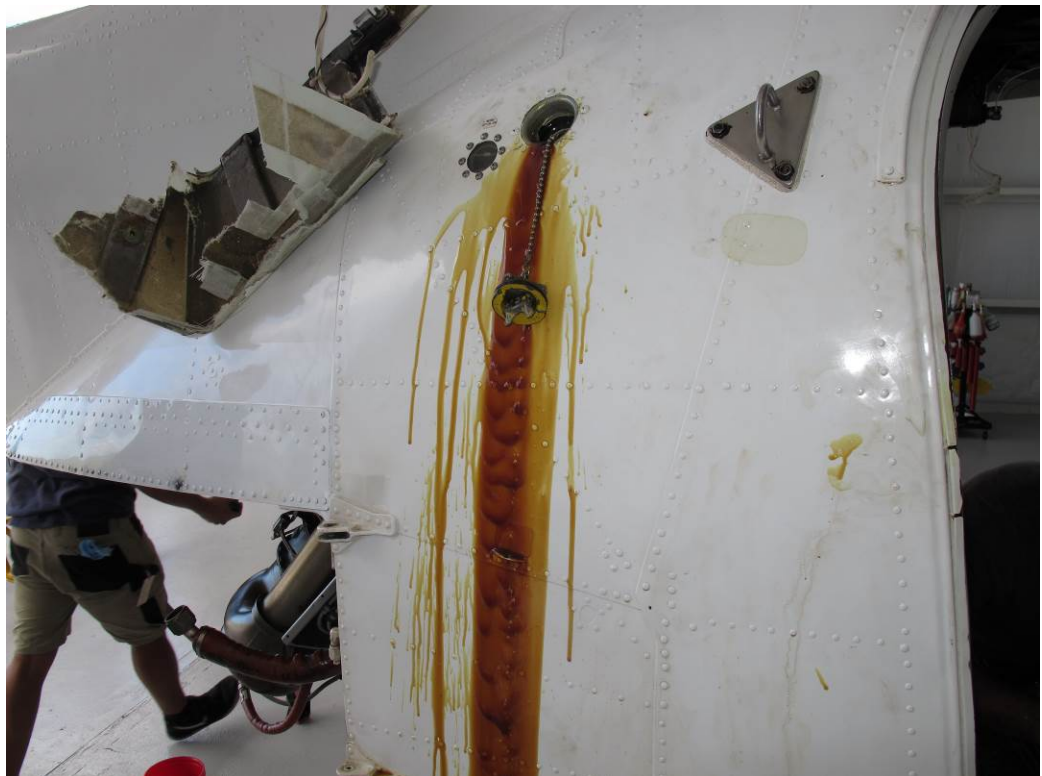


Figure 3 Oil Spilling from Reservoir



Figure 4 Scavenge Oil Filter Element



Figure 5 Airframe Fuel Filter Element



Figure 6 Engine after Removal from Aircraft



Figure 7 Fuel Control Unit Drive Body



Figure 8 Fuel Control Unit



Figure 9 Power Turbine Governor



Figure 10 Power Turbine Governor Drive Body



Figure 11 Disassembled Fuel Pump



Figure 12 Fuel Pump Fuel Filter Element

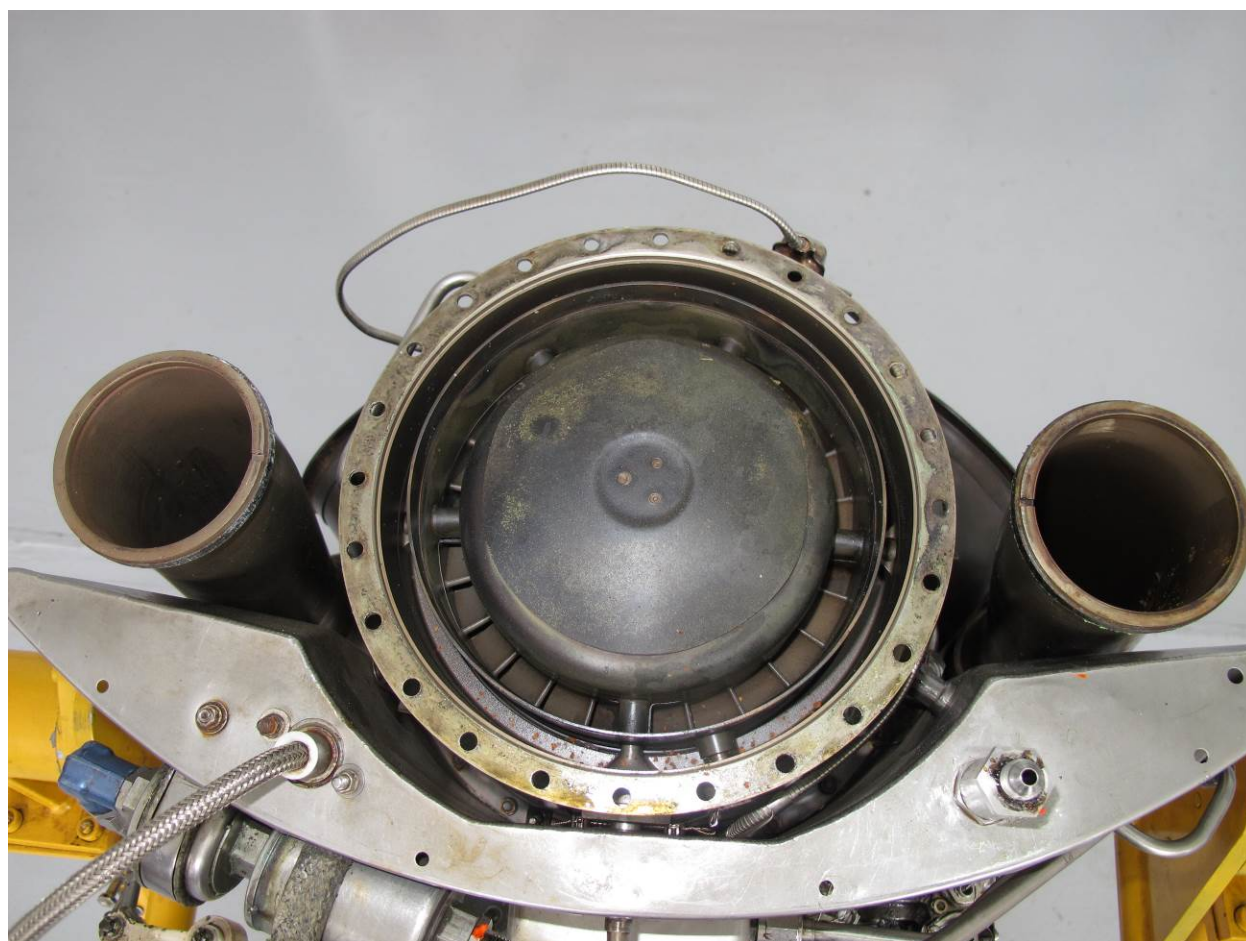


Figure 13 First Stage Turbine Nozzle

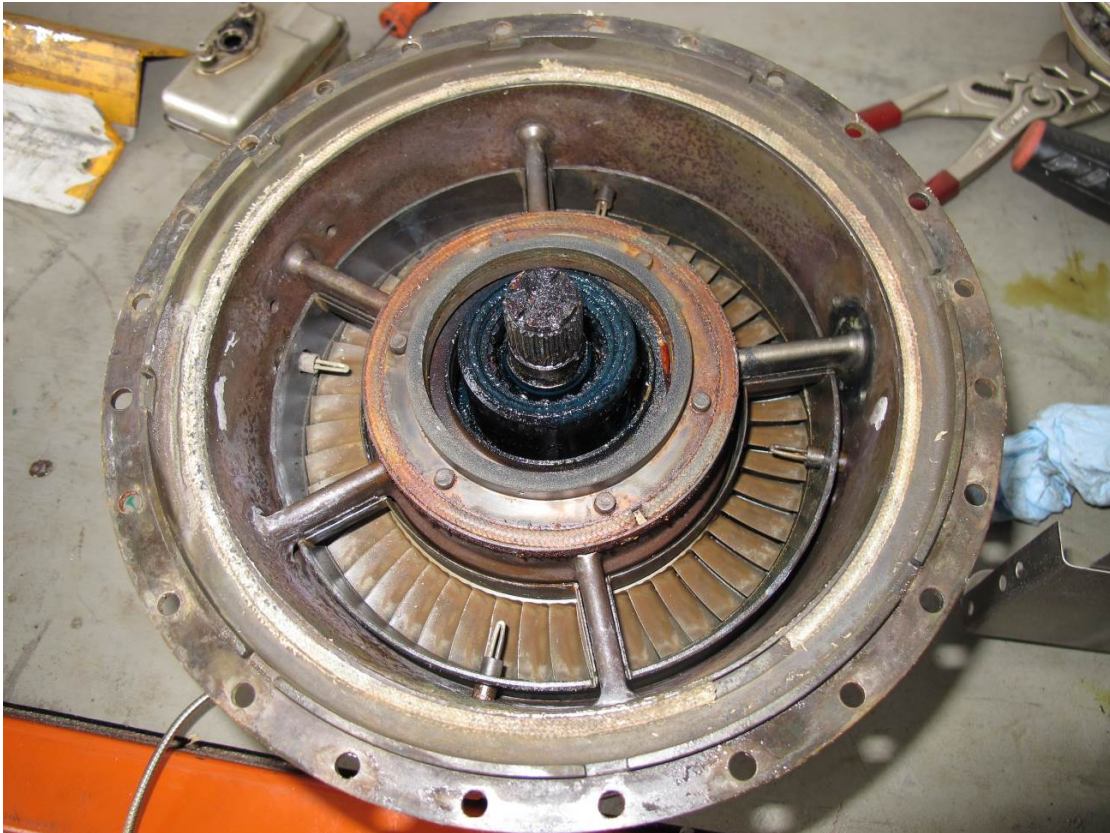


Figure 14 Second Stage Turbine Blades



Figure 15 Third Stage Turbine Wheel



Figure 16 Fourth Stage Turbine Blades



Figure 17 Compressor Case Half



Figure 18 Compressor Rotor



Figure 19 Gearbox

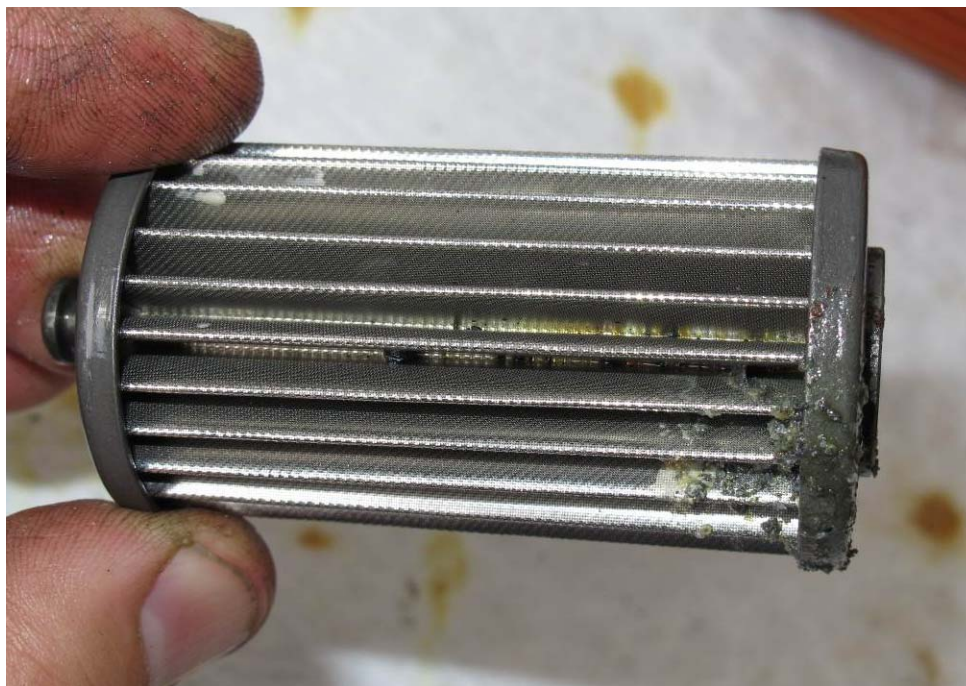


Figure 20 Pressure Oil Filter Element



Figure 21 Top Magnetic Chip Detector



Figure 22 Bottom Magnetic Chip Detector