



Rolls-Royce

Engine Investigation Report

Rolls-Royce Corporation

**Model 250-C20J
Engine CAE 271024**



**Jack Johnson
Air Safety Investigations**

**Accident Date: 16 August 2019
Engine Exam Date: 5 November 2019**

**Omaha Police Department
Omaha, Nebraska
N106PD**

Background

On 16 August 2019, a Bell 206B-3, registration N106PD, was significantly damaged during a training evolution at the Blair Municipal Airport near Omaha, Nebraska. The pilot and observer received minor injuries.

The FAA examined the aircraft and found no evidence of mechanical failure or malfunction. The NTSB then directed the operator to recover the aircraft to their operations base at Blair Municipal Airport. During the initial examination, the engine's Fuel Control Unit was removed in anticipation of it being tested. The NTSB directed the operator to remove the engine in order to test the engine at a properly-equipped maintenance facility. The Fuel Control Unit was then re-attached to the engine and shipped as-is.

The operator performed a cursory examination prior to engine removal and found crash damage to the axial compressor case which had previously gone unnoticed. The NTSB coordinated with Rolls-Royce and the team agreed to proceed with engine removal and shipment to Keystone Turbine Services in Pennsylvania for examination.

This report presents the observations made during the investigation.

Accident Flight

The helicopter was engaged in an hour long routine police patrol when the pilot began the return flight to Blair Municipal Airport. The pilot elected to perform some impromptu training with a simulated Power Turbine Governor (PTG) failure. As the helicopter approached the airport, the throttle was rolled out of the FLY position and the helicopter proceeded to the runway. Once established over the runway, the pilot returned the throttle to the FLY position and began hover-taxiing to base. While taxiing, the pilot received a LOW ROTOR warning. The pilot lowered collective to restore main rotor RPM and then raised collective to slow his decent rate. The helicopter subsequently landed hard and rolled over.

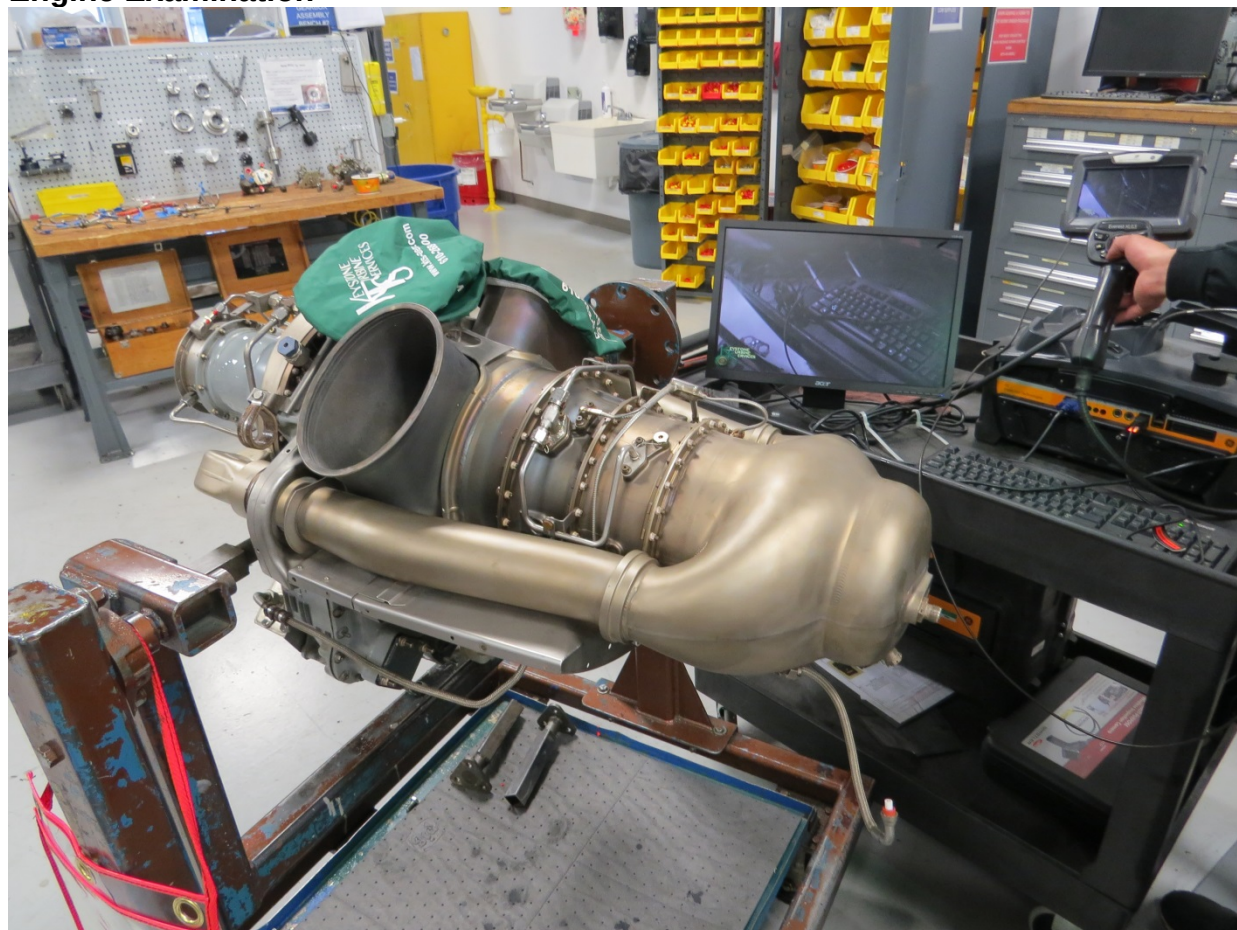
Aircraft Information

Model	Bell 206B-3
Serial Number	4649
Registration Number	N106PD
Airframe Total Time	UNK

Engine Information

Engine Model	Allison 250-C20J
Rating:	420 HP
Serial Number	CAE-271024
Engine Total Hours	4190.0 Hours

Engine Examination



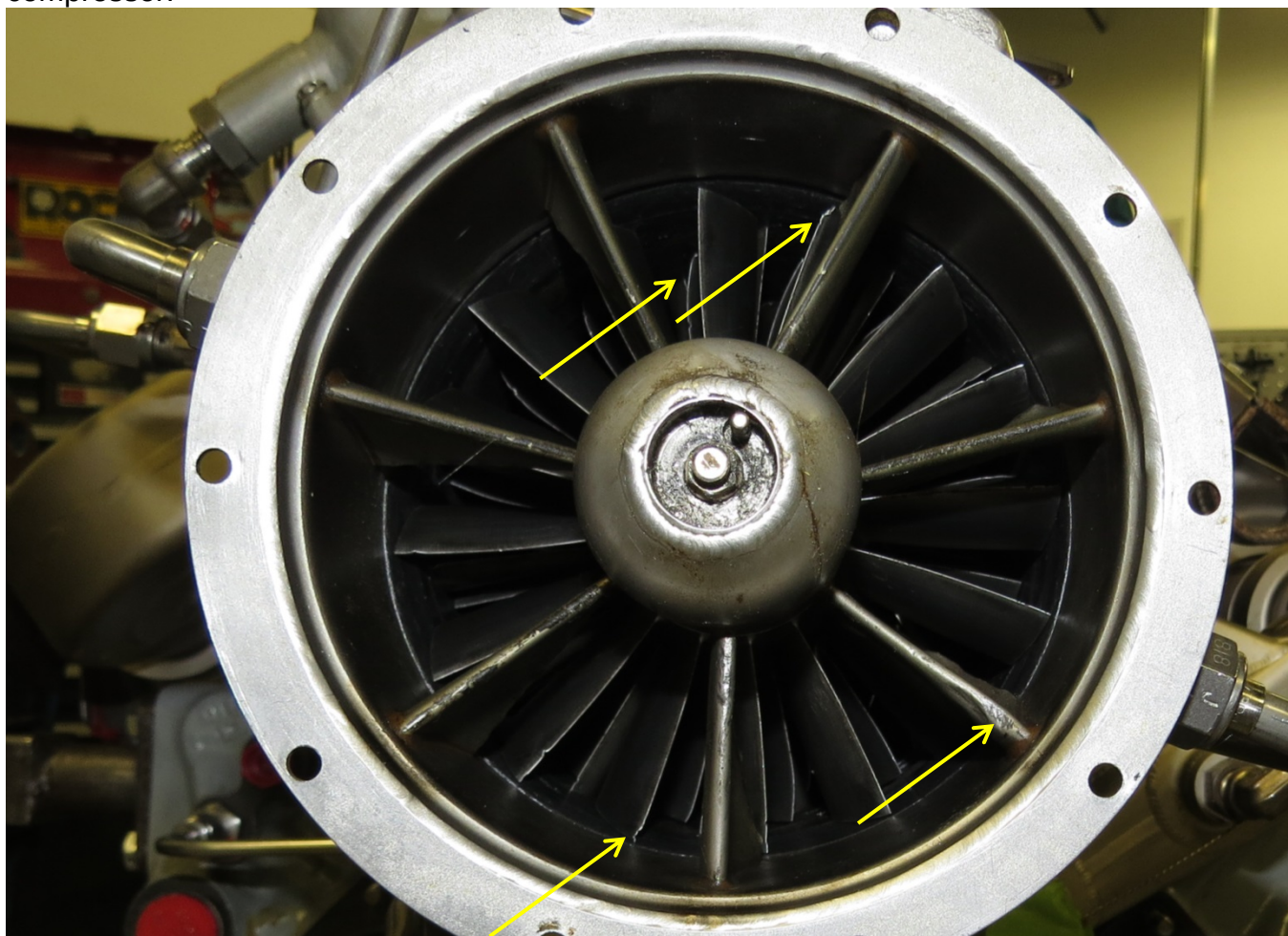
On 5 November 2019, the engine was examined at Keystone Turbine Services under the auspices of the FAA. The engine's sealed shipping container was opened and the engine transferred to a rolover stand for examination.

Impact damage was noted on the bottom side of the compressor housing. The damage was consistent with damage typically seen when the engine drive shaft fails while the engine is still running. As the shaft continues to rotate, the liberated end of the drive shaft will flail and strike the underside of the engine's compressor, causing impact damage like that noted on the subject engine.

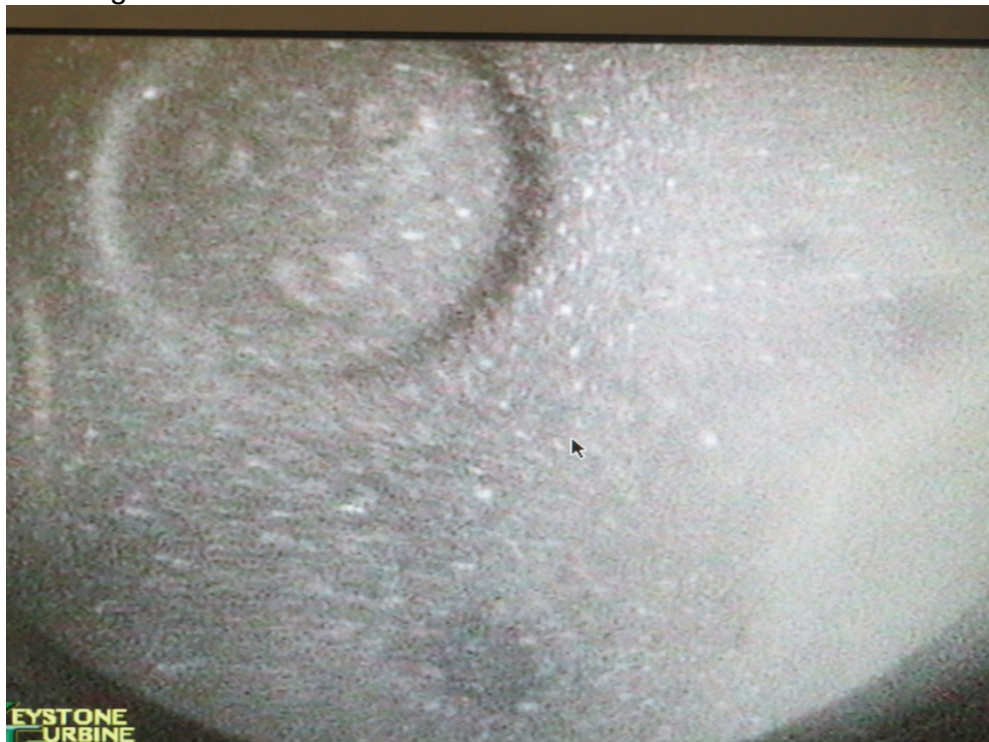


The compressor damage was deemed too severe to attempt to run the engine as-is. The investigation team conferred with Keystone engineers, and decided that the extensive repairs that would be required to make the engine runnable would make the results of such a test effectively meaningless. As such, the team decided to document the engine's condition in-detail, and to examine and test critical engine components to determine functionality.

The compressor could be rotated easily by hand. Rotation of the compressor resulted in corresponding rotation of N1 drive pads and the gas-generator turbine. A small hard-body impact mark was noted on a single inlet guide vane. Numerous compressor blades and vanes exhibited hard-body impact and bending in the direction opposite of normal rotation. This damage is typical of that seen when the main drive shaft fails, as noted above. The compressor inlet is exposed to liberated debris from the failed shaft. If the engine continues to run, debris is ingested by the compressor.



The gas-generator turbine was inspected via a borescope inserted into the fuel spray nozzle port. Inspection revealed no evidence of operational failure or thermal degradation. Bright silver metal splatter was noted throughout the combustion chamber and on the nozzle shield. This splatter is typical of an engine suffering compressor damage while the engine is operating. Small pieces of compressor lining are liberated and carried along the gas path to the combustion chamber, where the heat of combustion melts the metal, which is then deposited throughout the combustion chamber and on the nozzle shield. Several small hard-body impact marks were also noted on the first stage turbine blades.



Metal Splatter on Nozzle Shield.



Turbine Blade FOD

The power turbine could be rotated by hand. Rotation was smooth and resulted in the corresponding rotation of the N2 drive pads and the power output shaft drive. Small metallic debris was found in the exhaust collector, as well as metal splatter similar to that seen in the combustion chamber.



The fuel spray nozzle was removed and bench tested with satisfactory results.

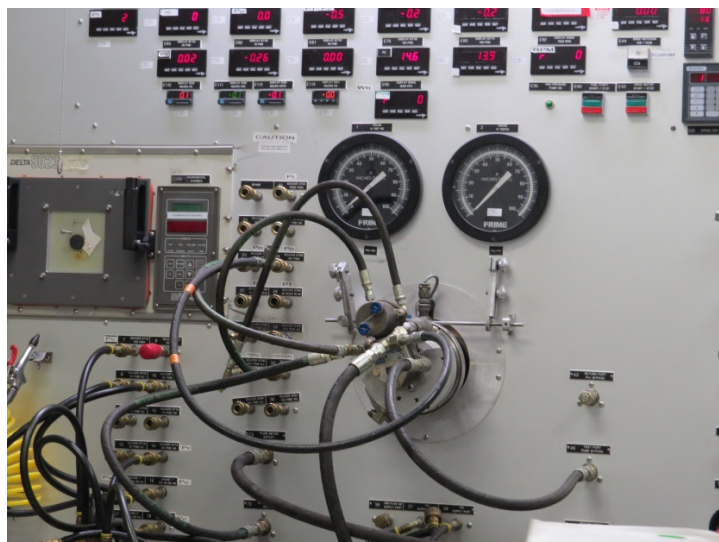
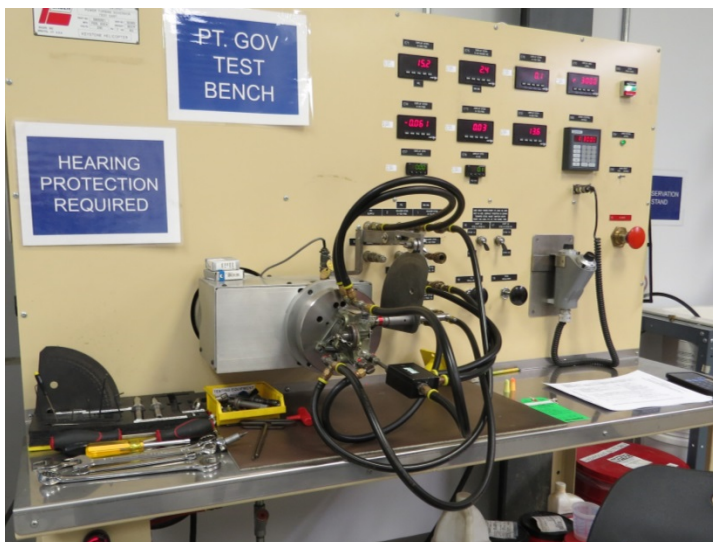


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The bleed valve was operationally checked with compressed air. The valve operated smoothly with no lateral play of the poppet valve.

Both the upper and lower Magnetic Chip Detectors were found free of debris.

The engine accessories, including the Power Turbine Governor, Fuel Control Unit and Engine-Driven Fuel Pump were bench tested and found to meet operational specifications. The Fuel Pump was disassembled to check for evidence of cavitation or filter blockage; none was found.



Engine Maintenance and Records

Component	Serial Number	Part Number	TSO	Total Time
Engine	CAE 271024		684.1	4190.0
Gearbox	CAG 28228	23001923	N/A	4190.0
Compressor	CAC 43531	6890550	684.1	4190.0
Turbine	CAT 27197	23069745	684.1	4190.0
PTG	HR47307	M250-10817	684.1	2040.2
FCU	HR59596	23070606	2156.3	UNK
Fuel Pump	T108278	6899253	684.1	UNK
Bleed Valve	FF27241	23053176	684.1	UNK
Fuel Nozzle	AGW146	23077068	1689.4	7096.4

Summary of Findings

There was no evidence of engine fire, failure or malfunction. Due to crash damage, the engine could not be run on the test cell. All available evidence is consistent with the engine operating at an unknown power level at the time of the accident. No evidence was found of any pre-impact condition which would preclude the engine from producing normal power.