AVIATION OCCURRENCE REPORT

LOSS OF POWER

AIR ALMA INC.
BELL 206L-1 LONGRANGER (HELICOPTER) C-GLBA
FONTANGE, QUEBEC 1 mi W
04 JULY 1995

REPORT NUMBER A95Q0118

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

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Summary

The pilot-company maintenance director was at the controls of the Bell 206L helicopter and was conducting a sling load operation near maximum gross weight. All engine parameters were normal during the lift-off. Shortly after take-off, the pilot noticed a high engine temperature followed by a significant power loss.

The sling load was released and the pilot conducted an autorotation into a swamp. The helicopter touched down hard with the engine running, and sustained substantial damage. The two crew members were not injured.

Ce rapport est également disponible en français.

Other Factual Information

An examination of the maintenance records revealed that the engine (Allison 250-C20B, S/N CAE 832271) was removed 96 flight hours prior to the occurrence for a compressor replacement. A 300-hour inspection was also completed approximately 54 flight hours prior, while the fuel control unit was replaced 5 flight hours prior to the accident.

Some of the operations to be carried out at the 300-hour inspection are as follows:

- measure the oil flow from the scavenge passage of the external sump;
- inspect scavenge oil strut in the power turbine support;
- clean carbon deposits from the strut;
- inspect No. 6 and No. 7 bearing pressure oil nozzles; and,
- clean internal carbon deposits from the nozzle.

An examination of the engine was performed at the TSB Engineering Branch. The external visual and mechanical inspection of the engine, controls, and related lines did not identify any faults. The controls were removed and all drives were confirmed to be intact. All external air, fuel, and lubrication lines were in good condition and free of contamination.

The N1 and N2 rotors were initially reported to be seized together. However, both rotated independently with a slight rubbing noise. There was continuity in both gear train systems.

The turbine assembly was removed and it was noted that the O-ring packing, which provides a seal between the spur gear adapter shaft and the turbine-to-compressor coupling, was damaged. Two separate pieces were recovered and one small section was unaccounted for.

The oil filter element contained a moderate collection of carbon particles and several small metal particles. The amount of contaminant would not have significantly affected the oil flow.

The turbine-to-compressor coupling required excessive force to be removed. The shaft was heavily carboned, internally and externally, and was deformed due to torsional stress. The shaft had areas of blueing, indicating apparent heat distress. Necking down of the shaft was located axially in line with the fourth stage turbine wheel.

The gas producer and power turbine rotors were taken to a local repair facility and disassembled. It was determined that the No. 6 and No. 7 bearings were blackened and felt gritty. Their cages had some silver plating "melt out"; however, the bearings showed no reported distress. The No. 8 bearing outer race was capable of turning, and the stationary lab seal was cracked axially and circumferentially. The seal contained a significant amount of carbon, and a bearing failure was imminent.

The *Allison Gas Turbine 250-C20B Series Operation and Maintenance Manual*, as well as related Information Bulletins and Letters, cover a large number of points to be followed in order to prevent carbon build-up, and include lists of symptoms to help recognize the presence of carbon build-up. The main point is that the manufacturer, in effect, acknowledges that carbon accumulation is a known situation, and that he has gone to significant lengths to warn of the problem, to describe potential effects, and to state methods of avoiding and/or correcting the problem.

Analysis

The disassembly revealed that interference between the turbine-to-compressor coupling and the power inner shaft had occurred during operation, most probably because of an accumulation of carbon and oil sludge on the outer surface of the coupling and/or on the inner surface of the shaft. During operation, the coupling rotates at the N1 speed of approximately 50,000 revolutions per minute (rpm), while the N2 shaft speed is in the order of 33,000 rpm. Even very light contact will result in rapid frictional heating, which allows the normal torsional loads on the coupling to impart a twisting deformation. This results in further interference and an imbalance condition. The contact between parts tends to reduce the speed differential, sending conflicting information to the controls.

Ordinarily, the extent of the carbon build-up throughout the engine would be indicative of a long term problem. However, maintenance records indicate that the work to avoid this kind of problem had been performed shortly before the accident. The accumulation of carbon and sludge in the power turbine support assembly, in both the supply and scavenge struts and the bearing cavity, and also in the No. 8 bearing location, suggests a number of possibilities relating to both operation and maintenance.

The following laboratory report was completed:

LP 101/95 - Engine Examination, Bell 206L-1, C-GLBA.

Findings

1. The packing was damaged between the turbine-to-compressor coupling and the spur adapter gearshaft.

2. The oil filter element contained a moderate collection of carbon particles and several small metal particles.

3. The turbine-to-compressor coupling shaft was heavily carboned, both internally and externally, and was deformed due to torsional stress.

4. The No. 6 and No. 7 oil supply screen contained a significant amount of carbon.

5. The No. 6 and No. 7 bearings were blackened and gritty, with some silver plating "melt-out".
6. The No. 8 bearing lab seal was cracked axially and

circumferentially, and contained a significant amount of carbon.

7. The No. 8 bearing showed signs that bearing failure was imminent.

Causes and Contributing Factors

The engine lost power as a result of interference between the turbine-to-compressor coupling and the turbine inner shaft, caused by a carbon accumulation between these components. The build-up of carbon in the turbine assembly is attributed primarily to operation and maintenance procedures, which did not obviate the formation of carbon or apply adequate corrective measures.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson John W. Stants, and members Zita Brunet and Maurice Harquail, authorized the release of this report on 28 February 1996.