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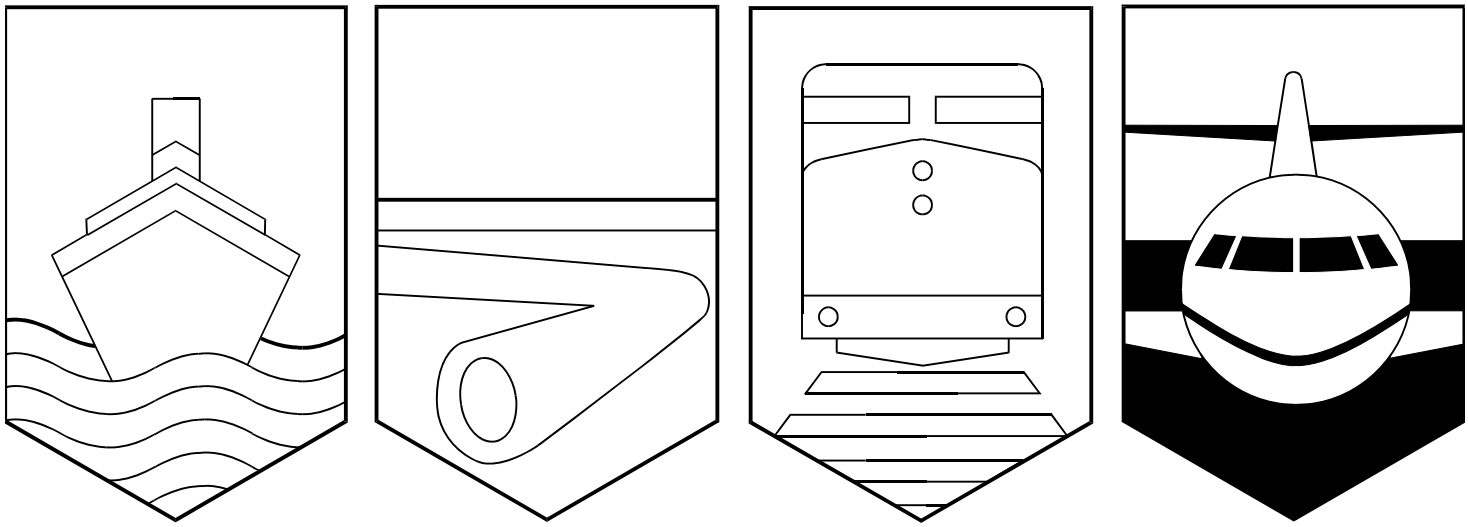
Bureau de la sécurité des transports du Canada



AVIATION OCCURRENCE REPORT

POWER LOSS - FORCED LANDING

UNIVERSAL HELICOPTERS NEWFOUNDLAND LIMITED
BELL HELICOPTER TEXTRON 206L LONG RANGER C-FUHL
PORCUPINE POINT, LABRADOR
15 SEPTEMBER 1994

REPORT NUMBER A94A0180

Canada

MANDATE OF THE TSB

The Canadian Transportation Accident Investigation and Safety Board Act provides the legal framework governing the TSB's activities. Basically, the TSB has a mandate to advance safety in the marine, pipeline, rail, and aviation modes of transportation by:

- conducting independent investigations and, if necessary, public inquiries into transportation occurrences in order to make findings as to their causes and contributing factors;
- reporting publicly on its investigations and public inquiries and on the related findings;
- identifying safety deficiencies as evidenced by transportation occurrences;
- making recommendations designed to eliminate or reduce any such safety deficiencies; and
- conducting special studies and special investigations on transportation safety matters.

It is not the function of the Board to assign fault or determine civil or criminal liability. However, the Board must not refrain from fully reporting on the causes and contributing factors merely because fault or liability might be inferred from the Board's findings.

INDEPENDENCE

To enable the public to have confidence in the transportation accident investigation process, it is essential that the investigating agency be, and be seen to be, independent and free from any conflicts of interest when it investigates accidents, identifies safety deficiencies, and makes safety recommendations. Independence is a key feature of the TSB. The Board reports to Parliament through the President of the Queen's Privy Council for Canada and is separate from other government agencies and departments. Its independence enables it to be fully objective in arriving at its conclusions and recommendations.

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Aviation Occurrence Report

Power Loss - Forced Landing

Universal Helicopters Newfoundland Limited
Bell Helicopter Textron 206L
Long Ranger C-FUHL
Porcupine Point, Labrador
15 September 1994

Report Number A94A0180

Synopsis

About 12 minutes into the flight, the engine chip light illuminated. The pilot made a precautionary landing and shut down the engine to inspect the chip detector. Finding only a small quantity of metal paste (fuzz) on the forward facing chip detector, the pilot cleaned and reinstalled the chip detector before departing to continue the flight. Two minutes after take-off, a complete engine stoppage occurred. The pilot entered the helicopter into an autorotation. During the forced landing on a coastal flat, the front of the skid landing gear dug into the soft surface, and the main rotor struck and cut the tailboom. There were no injuries to any of the six occupants.

The Board determined that the pilot incorrectly assessed the engine as airworthy and took off to continue the flight. The engine stopped two minutes after take-off when the No. 1 bearing failed as a result of separator and/or roller wear. The reason for the failure of the No. 1 bearing could not be determined. Contributing to this occurrence was the lack of adequate training for pilots on checking chip detectors and the absence of any guidance on inspecting and assessing chip detectors in the flight operations manual.

Ce rapport est également disponible en français.

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5.0 Appendices

1.0 Factual Information

1.1 History of the Flight

On the morning of the occurrence, the engine chip light illuminated during flight. The pilot landed the Bell 206L helicopter and, after having found only a small amount of metal paste (fuzz) on the forward facing chip detector, he continued the flight.

Later that morning, at 1135 Atlantic daylight saving time[1] (ADT)[2], the helicopter departed Makovik, Labrador, on a flight to Rigolet, Labrador, with the pilot and five passengers on board. About 12 minutes into the flight, the engine chip light illuminated. The pilot landed the helicopter, shut down the engine, and removed and inspected the chip detector. Finding only a small quantity of fuzz on the forward facing chip detector, the pilot cleaned and reinstalled the chip detector and took off to continue the flight.

Two minutes after take-off, at an altitude of 1,000 feet above ground level, three loud bangs were heard, followed immediately by a complete engine (Allison 250-C20R) power loss. The pilot entered the helicopter into an autorotation and carried out a forced landing on a coastal flat. During the landing, the front of the skids dug into the soft surface, which resulted in the main rotor striking and severing the tailboom. After the main rotor came to a stop, the pilot activated the emergency locator transmitter (ELT) and all six occupants evacuated the aircraft.

There were no injuries, and the occupants were picked up approximately three hours later and transported to Makovik.

The accident occurred at latitude 54°51'N and longitude 058°56'W[3], at approximately 1200 ADT, during the hours of daylight, at sea level.

1.2 Injuries to Persons

	Crew	Passengers	Others	Total
Fatal	-	-	-	-
Serious	-	-	-	-
Minor/None	1	5	-	6
Total	1	5	-	6

1.3 Damage to Aircraft

The helicopter sustained substantial damage as a result of the main rotor striking and severing the tailboom. Also, prior to being recovered from the coastal flat, the helicopter was partially submerged in salt water when the tide came in.

1.4 Other Damage

There was no damage sustained by property or objects other than the aircraft.

1.5 Personnel Information

	Captain
Age	23
Pilot Licence	CPL Helicopter
Medical Expiry Date	01 Dec 94
Total Flying Hours	2,620
Hours on Type	2,490
Hours Last 90 Days	176.4
Hours on Type Last 90 Days	176.4
Hours on Duty Prior to Occurrence	4.5
Hours off Duty Prior to Work Period	12.5

The pilot was properly licensed and qualified for the flight.

1.6 Aircraft Information

1 All times are ADT (Coordinated Universal Time [UTC] minus three hours) unless otherwise indicated.

2 See Glossary for all abbreviations and acronyms.

3 Units are consistent with official manuals, documents, reports, and instructions used by or issued to the crew.

1.6.1 General

Manufacturer	Bell Helicopter Textron
Type and Model	206L Long Ranger
Year of Manufacture	1981
Serial Number	45040
Certificate of Airworthiness (Flight Permit)	Valid
Total Airframe Time	6,188.7 hr
Engine Type (number of)	Allison 250-C20R (1)
Propeller/Rotor Type (number of)	Bell Helicopter 206-011-001-029 Semi-rigid (1)
Maximum Allowable Take-off Weight	4,000 lb
Recommended Fuel Type(s)	Jet A, Jet A-1, Jet B
Fuel Type Used	Jet B

The helicopter was maintained, certified, and equipped in accordance with existing regulations and approved procedures. The weight and centre of gravity were within prescribed limits.

1.6.2 Engine Information

The Allison 250-C20R engine (serial No. CAE295364) had accumulated 1,718.9 hours of operation since new. A review of the engine technical records revealed that there had been an engine chip light at 1,606.2 engine hours. The log-book entry following this chip light was as follows: "Forward facing chip plug, a few small chips as seen under 5 power glass." No metal was found on the chip detectors during a 200-hours inspection carried out at 1,673.8 engine hours.

1.7 Meteorological Information

The flight was conducted in visual meteorological conditions. The ceiling was overcast and estimated to be about 1,200 to 1,500 feet, the visibility was 15 miles, the temperature was 4 degrees Celsius, and the wind was out of the northwest at about 20 knots.

1.8 Communications

The helicopter was equipped with very high frequency (VHF) and high frequency (HF) radios. The pilot was unable to make contact with anyone on either the VHF or the HF radio before or after the forced landing. The pilot reported that, because of atmospheric conditions, HF radio communications had been very poor throughout the week.

1.9 Wreckage and Impact Information

The helicopter touched down with about 5 to 10 knots forward speed. At touchdown, the front of the bearpaw-equipped, low-skids landing gear dug into the soft surface, bringing the helicopter to a quick stop in a slight nose-low attitude. This caused the main rotor blades to rock fore and aft with sufficient deflection to contact and completely sever the tailboom.

An examination of the engine at the accident site revealed a mechanical lockup of the N1 shafting system. The engine was removed and transported to the operator's facilities in Goose Bay, Labrador, where it was stripped down to three major sub-assemblies: compressor, gearbox, and turbine. The compressor front support was then removed and it was discovered that the No. 1 compressor bearing (part No. 23009609, serial No. MP00948) had failed.

1.10 Engine Gearbox Examination

The No. 1 bearing, the compressor front support, and the engine gearbox were shipped to the engine manufacturer's facilities for examination and testing. All work was carried out in the presence of a TSB investigator.

The gearbox was fitted for a functional scavenge flow check by applying regulated oil pressure at the oil inlet port and observing flow at the oil outlet port while motoring the oil pump with the use of a 400 rpm speed gun at the oil pump drive gear. After approximately 35-40 seconds of motoring, the oil pump gained prime and oil began to flow at a steady rate from the oil outlet port.

The gearbox cover was then separated from the housing and both the N1 and N2 geartrains were visually inspected and rotated. All gear teeth and splines exhibited a normal wear pattern and rotation was noted to be free.

The oil pump was then removed from the gearbox and subjected to a production unit bench test. The bench test was conducted in accordance with Assembly Inspection No. 073 and the oil pump exceeded all minimum test criteria.

Only a visual examination and photographic documentation of the No. 1 bearing and the compressor front support were carried out at the manufacturer's facilities. These components were then shipped to the TSB Engineering Branch Laboratory for detailed examination.

1.11 No. 1 Bearing and Compressor Examination

The conclusions of the laboratory examination on the No. 1 bearing and the compressor front support were as follows:

1. The No. 1 bearing failed as a result of separator and/or roller wear. No cracking of any bearing component was detected. If cracks had been present in the two missing separator rails, they would have been obliterated as the failure progressed.

2. No metallurgical cause for failure could be established. The materials of construction met the chemical composition limits and hardness requirements.

3. The oil flow through the pressure reducer was checked and found satisfactory.

1.12 Required Maintenance Following a Chip Light

The Allison 250-C20R *Operations and Maintenance* (O & M) *Manual* (ref. para 9.F, "Magnetic Plug Inspection," page 338) contains the following warning:

> If a magnetic plug warning light comes on during flight, land and inspect the magnetic plugs as soon as possible. This light is an indication of conditions which could cause engine failure.

The O & M manual, para 9.F.(2), pages 339-340, includes the following information on magnetic particles:

A. Magnetic particles and debris, chips, flakes and slivers are possible indications of bearing or gear failure and/or abnormal wear within the engine.

B. Chips or flakes exceeding 1/32 inch diameter or more than 4 slivers per event are not acceptable. In this case the engine is to be removed from service and sent to an approved Allison repair facility.

C. Chips or flakes less than 1/32 inch diameter or less than four slivers per event are acceptable.

Fuzz falls under this last category and, as further described in the O & M manual, para 9.I, would require the following maintenance action to be performed after reinstallation of the magnetic plug:

> 1) Carry out a 30 minute ground run at power and observe engine operation and chip light prior to releasing the aircraft for flight. If the chip light illuminates during 30 minute ground run, remove engine from service.
>
> 2) If warning light does not illuminate during 30 minute ground run, inspect magnetic plugs for further accumulation of magnetic particles, debris, chips, flakes, and slivers. Clean and reinstall magnetic plugs.
>
> 3) If a warning light illuminates within the next eight operating hours following a 30 minute ground run and the cause is determined to be an accumulation of magnetic particles and debris (chips, flakes, or slivers) remove the engine from service.

1.13 Pilot Authority to Check Chip Plugs

In accordance with the *Airworthiness Manual* (AWM) chapter 575, appendix B, pilots of commercial aircraft can be authorized to perform certain elementary maintenance tasks without a maintenance release certification. Prior to being authorized to perform any of the tasks, such persons must have performed the tasks under the direct supervision of an aircraft maintenance engineer (AME). Included in these tasks is the "checking and continuity checking of self sealing chip detectors." Accordingly, the operator's maintenance control manual (MCM) states that, coincident with the pilot's annual training, pilots will receive instruction from a company AME on the performance of these tasks.

Pilots employed by the company had a good understanding as to what are and what are not considered acceptable amounts of magnetic particles found on chip detectors. However, this knowledge appears to have been acquired through informal discussions with maintenance personnel. The pilot of the occurrence helicopter had not been briefed on the significance of recurring chip lights or of the requirement for 30-minute ground runs following inspection of chip detectors. The company flight operations manual (FOM), issued to all employees involved in aircraft operations, including flight crews, does not contain any guidance on checking chip detectors, nor is it required to by regulation.

A search of the TSB occurrence data base identified four other helicopter accidents where the incorrect assessment of airworthiness, after recurring engine chip lights, resulted in engine failure.

1.14 Flight Manual

The 206L flight manual (FM) indicates a lesser degree of urgency for response to engine chip lights than do the manuals for other models of the Bell 206 series helicopter. The 206L FM indicates that a pilot should "land as soon as practical" if an engine chip light illuminates in flight. The manual describes "land as soon as practical" to mean: "The landing site and duration of flight are at the discretion of the pilot. Extended flight beyond the nearest approved landing area is not recommended." All other models of the 206 series helicopter assign a more urgent level of response, i.e., "land as soon as possible," which the manual interprets as: "Land without delay at the nearest suitable area (i.e., open field) at which a safe approach and landing is reasonably assured."

1.15 Survival Aspects

The ELT (Pointer Inc., model Centrum C4000) signal was picked up by a Search and Rescue satellite and the Search and Rescue Coordination Centre alerted aircraft operating in the area of the signal's origin. The pilot of a commercial helicopter proceeded to that location and picked up the occupants and transported them to Makovik.

The helicopter was equipped with the prescribed survival equipment, listed in schedule II of Air Navigation Order Series V, No. 12, for operations in sparsely settled areas. After the forced landing, this equipment was taken out of the helicopter and transported to the shore, where a shelter was set up.

2.0 Analysis

2.1 The Engine

The No. 1 bearing failed as a result of separator and/or roller wear. However, the reason for the failure could not be established because of the extensive mechanical damage.

2.2 Manuals and Pilot Training

The engine manufacturer's O & M manual contains specific instructions on the maintenance actions required following the illumination of an engine chip light. It also contains information that allows personnel to make a correct assessment of the engine's continued airworthiness.

The above information is available to maintenance personnel but is not readily available to flight crew. The company's FOM, issued to flight crew, did not contain any information on the required maintenance procedure for inspecting chip detectors that would assist flight crew in correctly assessing engine airworthiness.

Pilots employed by the company have the authority to check chip detectors. Although they had apparently acquired, through informal discussions with maintenance personnel, a good understanding as to what are and what are not considered acceptable amounts of magnetic particles found on chip detectors, pilots do not receive the training that would allow them to correctly assess engine airworthiness when inspecting chip detectors.

In this occurrence, the pilot carried out a precautionary landing following an engine chip light indication. This was the second engine chip light indication in less than eight flight hours and, according to the manufacturer's O & M manual, the engine was not airworthy and should have been removed from service. However, because the pilot was not aware of the significance of recurring chip light indications and the required maintenance actions, the pilot did not perform a 30-minute ground run and incorrectly assessed the engine as airworthy. As a result, the No. 1 bearing failed and the engine stopped two minutes after the pilot took off to continue the flight.

2.3 Flight Manual - Chip Light Emergencies

There is a discrepancy between the flight manual for the 206L and the flight manuals for other Bell 206 series helicopters in that a lower level of urgency for response to chip light indications is assigned for the 206L. Since the 206L shares similar components with other Bell 206 series helicopters and the consequences of an in-flight failure are the same, the less urgent response of landing "as soon as practical" seems inappropriate for 206L chip light indications.

3.0 Conclusions

3.1 Findings

1. An in-flight engine stoppage occurred as a result of the failure of the compressor No. 1 bearing.

2. The No. 1 bearing failed as a result of separator and/or roller wear. However, no metallurgical cause for the failure could be established because of the extensive mechanical damage.

3. The pilot incorrectly assessed the engine as airworthy following a second engine chip light in less than eight operating hours, and took off to continue his flight.

4. The pilot had not been briefed on the significance of recurring chip light indications or of the requirement to perform a 30-minute ground run following inspection of a chip detector.

5. The company flight operations manual did not contain any guidance for pilots on checking chip detectors and making an assessment as to the engine's airworthiness.

6. The pilot had not received any formal training on the checking of chip detectors as per the requirement in the company's maintenance control manual.

7. The 206L flight manual indicates a lesser degree of urgency for response to chip light indications than do the manuals for other models of the Bell 206 series helicopter.

3.2 Causes

The pilot incorrectly assessed the engine as airworthy and took off to continue the flight.

The engine stopped two minutes after take-off when the No. 1 bearing failed as a result of separator and/or roller wear. The reason for the failure of the No. 1 bearing could not be determined. Contributing to this occurrence was the lack of adequate training for pilots on checking chip detectors and the absence of any guidance on inspecting and assessing chip detectors in the flight operations manual.

4.0 Safety Action

4.1 Action Taken

4.1.1 Operator Action

Subsequent to the occurrence, the operator expanded its ground training syllabus to include more detailed instructions on the checking of chip detectors. The operator has also indicated that the company flight operations manual will be amended to provide guidance and a field reference for pilots on the checking of chip detectors.

4.1.2 Manufacturer Action

The manufacturer is in the process of revising the 206L flight manual; the manual's procedural action for chip light emergencies will be amended from "land as soon as practical" to "land as soon as possible." This revision is expected to be completed and distributed to 206L operators in the summer of 1995.

4.1.3 Regulatory Action

In response to a TSB Advisory letter, Transport Canada indicated that regional inspectors have been advised to evaluate the training procedures in operators' maintenance control manuals and, during audits, to ensure that procedures are being followed. Transport Canada has also indicated that *Airworthiness Manual* Chapter 575 will be amended to the effect that personnel will be trained to check chip detectors and, where applicable, assess the airworthiness of the aircraft upon completion of the task.

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 Hugh MacNeil, authorized the release of this report on 05 June 1995.

Appendix A - List of Supporting Reports

The following TSB Engineering Branch Laboratory report was completed:

LP 164/94 - Compressor Front Support.

This report is available upon request from the Transportation Safety Board of Canada.

Appendix B - Glossary

ADT	Atlantic daylight saving time
AME	aircraft maintenance engineer
AWM	Airworthiness Manual
CPL	Commercial Pilot Licence
ELT	emergency locator transmitter
FM	flight manual
FOM	flight operations manual
HF	high frequency
hr	hour(s)
lb	pound(s)
MCM	maintenance control manual
N1	Gas Producer
N2	Power Turbine
O & M	Operations and Maintenance
TSB	Transportation Safety Board of Canada
UTC	Coordinated Universal Time
VHF	very high frequency
°	degrees
'	minutes

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