

AVIATION INVESTIGATION REPORT

A00P0026

ENGINE POWER LOSS - MECHANICAL MALFUNCTION

SCHWEIZER 269C (HELICOPTER) C-GFJO

PRINCE GEORGE, BRITISH COLUMBIA 20 NM S

21 FEBRUARY 2000

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.

## Aviation Investigation Report

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#### *Summary*

The Schweizer 269C helicopter, serial number S1792, powered by a Lycoming HIO-360-D1A reciprocating engine, serial number L 28448-51A, departed Williams Lake, British Columbia, for Prince George, in daylight, visual meteorological conditions, with the helicopter's owner-pilot and a flight instructor on board. At about 1700 Pacific standard time, when the helicopter was 20 nautical miles south of Prince George, the instructor had the pilot perform a simulated engine-out approach and landing into a logging cut-block, with the mutual understanding that a powered recovery would be carried out at a low height above the terrain. After autorotating the helicopter nearly to the ground, the pilot applied collective pitch and engine power, and the helicopter climbed at 50 knots to about 300 feet above ground level. Then, the engine lost power, and the helicopter yawed to the left and began to shudder and shake. The instructor took control of the helicopter and performed an autorotation into the trees. During the flare, as the main rotor blades began to strike the trees, engine power returned and the helicopter yawed again. The instructor flew the helicopter to a nearby clearing and landed without further damage to the aircraft. The pilots were not injured but the helicopter was substantially damaged.

*Ce rapport est également disponible en français.*

## *Other Factual Information*

The helicopter, manufactured by Schweizer Aircraft Corporation in September 1999, had been purchased new by the current owner. A flight instructor and the owner, who was the holder of a student pilot permit, flew the helicopter from the Schweizer factory in Elmira, New York, to Prince George. The helicopter was flown locally for 68 hours, bringing the helicopter's total time since new at the time of the accident to about 108 hours.

A post-accident inspection revealed damage to the three main rotor blades, the chin bubble, and the landing gear cross strut. During this inspection, work described in Lycoming's Mandatory Service Bulletin (MSB) No. 388B was performed under TSB supervision to determine exhaust valve and guide conditions. The results of this work indicated that all four exhaust valves had approximately 0.025 inches of side-to-side movement in their respective guides, which is within limits set out in the table included in the service bulletin (SB).

The Schweizer 269C's engine is equipped with a Precision Airmotive Corporation fuel servo, model RSA-7AA1. This unit and associated fuel lines and injectors were inspected and tested. The fuel servo was flow-checked and found to perform within manufacturer's limits on all test parameters except one: the power enrichment valve opened late. Following the flow check, the servo was disassembled and inspected. No defects were found. The servo was then reassembled and calibrated to its pre-disassembly settings. The number two cylinder fuel injector nozzle was found to have a partial restriction and was found to exhibit hazing of the fuel spray pattern which is not an acceptable pattern for a new nozzle.

The engine was later run at a test facility, using the original fuel lines, fuel injectors, and fuel servo. During the run, the fuel/air mixture was determined to be leaner than normal and the number 4 cylinder was observed to emit smoke and flame from the exhaust as the engine was run at a steady power setting. At that time, the engine also appeared to lose partial power. Following the run, the cylinders were removed and the exhaust valves and guides were inspected. All four valve-to-guide clearances were measured using a 0.5000- or 0.5010-inch plug gauge and all four clearances were found to be below the lower allowable limit (that is, too tight). The exhaust valve-to-guide clearance was lowest on the number 4 cylinder.

Three service bulletins that refer to lean mixture and sticking valve problems with the engine installed in the Schweizer 269C had been issued prior to this accident:

- On 28 February 1989, Precision Airmotive issued Service Bulletin No. PRS-91, pertaining to model RSA-7AA1 fuel servos, which states that, "an enrichment valve that opens late, or not at all, can result in an engine operating on lean limit flow curve at power levels in excess of 72 percent rated power".
- On 07 November 1991, Schweizer issued MSB B-248, pertaining to compliance with the Precision Airmotive Service Bulletin No. PRS-94 issued 21 September 1989, and states that, "there are persistent reports of low power and high engine temperatures (cylinder head, oil, and EGT<sup>1</sup>) on new aircraft, and on overhauled engine/servo combinations". It also states that, "failure to comply with this Service Bulletin could result in engine failure, which may lead to loss of control of the helicopter and subsequent injury or death".
- On 13 May 1992, Lycoming issued MSB 388B, pertaining to exhaust valve-to-guide clearance, which states that "Failure to comply with the provisions of this publication could result in engine failure due to excessive carbon build up between the valve guide and valve

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<sup>1</sup> exhaust gas temperature.

stem resulting in sticking exhaust valves...” The service bulletin details the use of a fixture to determine exhaust valve and guide condition, stating that helicopter engines should be inspected every 300 hours.

Engine power loss on helicopters using the engine/fuel servo combination found on the accident helicopter is a known problem. The TSB is aware of more than 20 service difficulty reports since 07 May 1983 with respect to sticking exhaust valves involving this combination of helicopter and engine.

Samples of fuel from the helicopter and the supplier were sent to a commercial laboratory for analysis. The composition of the fuel samples taken from the helicopter were virtually identical to the reference fuel, and there were no unusual organic components found in the samples.

The flight crew were certified and qualified for the flight in accordance with existing Transport Canada regulations, and the helicopter was being operated within the limitations set out in the Transport Canada-approved rotorcraft flight manual.

## *Analysis*

During the test run of the occurrence engine, a poor fuel spray pattern and a late-opening enrichment valve resulted in an overly lean fuel/air mixture, which caused the engine to operate excessively hot during high power demand. When the exhaust valves overheated, they began to stick and the engine lost power. During the occurrence flight, the engine was at a low power setting during the autorotation. When the pilot accelerated the engine, it is likely that the exhaust valves overheated, causing them to stick, resulting in a loss of power.

Shortly after the accident, the exhaust valve clearance was checked in accordance with the Lycoming MSB 388B; however, it did not reveal the sticking valves later found during the engine test-run. Therefore, the procedures outlined in the MSB were not adequate for conclusively determining if exhaust valves are sticking.

The fuel servo installed on this engine had not been adjusted internally since manufacture. The fuel servo, as found after the occurrence, was not adjusted to the specifications required by Service Bulletin PRS-91. Accordingly, either the service bulletin instructions were not adequate, or they were not complied with during the initial fuel servo configuration.

## *Findings as to Causes and Contributing Factors*

1. Lean engine fuel mixture and a distorted fuel spray pattern likely caused the engine exhaust valves to overheat and stick.
2. Sticking exhaust valves caused engine power loss.
3. Service bulletins issued prior to the accident did not mitigate identified problems related to the power loss.

## *Other Findings*

1. The helicopter was being operated within the limitations set out in the flight manual.
2. Engine power loss using the engine/fuel servo combination found on this model of helicopter is a known problem.

## *Safety Action*

Transport Canada is aware of the circumstances of occurrences related to valve guide clearance and valve sticking in the Lycoming HIO-360-D1A engine installed in the Schweizer 269C helicopter. Transport Canada has initiated research with the US Federal Aviation Administration, the certification authority for the engine, to determine if there is a quality control issue regarding the valve guide clearances.

*This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 27 March 2001.*