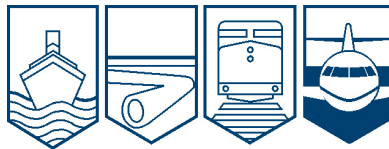


Transportation Safety Board
of Canada



Bureau de la sécurité des transports
du Canada

**AVIATION INVESTIGATION REPORT
A09Q0131**



LOSS OF CONTROL AND COLLISION WITH CABLES

**ESTROM F-28C HELICOPTER C-GVQQ
MONT-LAURIER, QUEBEC
05 AUGUST 2009**

Canada

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

Loss of Control and Collision with Cables

Enstrom F-28C Helicopter C-GVQQ

Mont-Laurier, Quebec

05 August 2009

Report Number A09Q0131

Summary

Around 0855 eastern daylight time, a private Enstrom F-28C helicopter (registration C-GVQQ, serial number 387) took off from Mont-Laurier Airport, Quebec, on a local visual flight rules (VFR) flight over the town of Mont-Laurier, with the pilot and one cameraman on board. About 20 minutes later, as the helicopter was returning to the airport, the engine (Avco Lycoming HIO-360) experienced a power loss and backfiring. During an attempted emergency landing, the aircraft struck cables over highway 117, struck the highway and rolled over in a ditch. The helicopter was completely destroyed in the post-impact fire. Both occupants were fatally injured.

Ce rapport est également disponible en français.

Other Factual Information

Weather Information

No aviation routine weather reports (METARs) are available for Mont-Laurier, Quebec. However, the METARs for Gatineau, Quebec, 62 nautical miles (nm) to the south and for Mirabel, Quebec, 83 nm to the southeast, indicated a light wind from the west, scattered clouds and a temperature of 18°C¹. Video images taken just before the occurrence indicate that similar conditions suitable for visual flight existed at Mont-Laurier at the time of the occurrence. Therefore, weather is not considered to be a factor in this occurrence.

Pilot Information

The pilot was certified and qualified for the flight in accordance with existing regulations. He held a valid commercial pilot – helicopter licence. He also held a commercial pilot – aeroplane licence with floatplane endorsement and multi-engine rating, and an instrument rating valid until 01 September 2010. Examination of the relevant medical records revealed no factors that could have contributed to the accident.

The pilot received a private pilot – aeroplane licence in October 1970, a commercial pilot – aeroplane licence in September 1975, and a multi-engine – aeroplane rating in April 1979. He then completed his training for an instrument flight – aeroplane rating in June 1992. He received a commercial pilot – helicopter licence in May 1985 on a Hughes 300 (H269). The pilot owned several aircraft, including an Enstrom F-28C (EN28), a Bell 206 (BH06), a Cessna 150, a twin-engine Piper Navajo (PA-31), a Magister Super Fouga and an Utva 66.

The pilot had approximately 5500 flying hours on aeroplanes and helicopters. The investigation could not determine the pilot's experience on helicopters, but according to the log book for the Enstrom, he had flown about 300 hours on C-GVQQ since purchasing it in 1986. The pilot had received two hours of training on the EN28 in July 1986 and five hours of training on the BH06 in April 2006 to qualify for endorsement on these helicopter types. The *Canadian Aviation Regulations* (CARs) do not require that training records be kept for pilots in private operation. As a result, the investigation could not determine whether or not the pilot received additional flight training on the EN28 since July 1986.

Recency Requirements

To continue exercising the privileges of his licence, a pilot must comply with the recency requirements set out in CARs. The occurrence pilot was in compliance with these requirements as follows:

1. he acted as pilot-in-command or co-pilot of an aircraft within the five years preceding the flight²;

¹ METAR CYND 051300Z 30007KT 15SM FEW006 SCT240 18/13 A2987 RMK SF1CI1 SLP116 SKY14.

METAR CYMX 051300Z 27005KT 25SM FEW014 FEW120 FEW260 18/15 A2985 RMK CF1AC1CI0 SLP110 SKY13.

² CARs 401.05(1) (a).

2. he successfully completed a recurrent training program within the 24 months preceding the flight³.

Theory training is considered acceptable as a recurrent training program⁴. One such program is the Self-Paced Study Program that can be found in Transport Canada's *Aviation Safety Letter*. This program requires that pilots complete the "Flight Crews Recency Requirements Self-Paced Study Program" questionnaire and correct it themselves.

Another acceptable option is a flight test for renewal of an instrument rating. Since the pilot had passed such a flight test on the Piper Navajo in July 2008, he met the recency requirements up to July 2010 for his aeroplane and helicopter licences. He had also made at least five helicopter take-offs and five helicopter landings in the six months preceding the flight, thereby fulfilling the conditions prescribed by CARs⁵ for carrying passengers.

History of the Flight

The pilot flew over the town of Mont-Laurier on the day before the occurrence with C-GVQQ to survey the damage caused by a tornado. To provide a bird's-eye view of the damaged area, he offered to take cameramen from the two television networks serving Mont-Laurier on a helicopter flight over the area the next day. In preparation for the flight, the right side door of the helicopter was removed in accordance with the flight manual so video footage could be shot without the windows. The flight was operated as a private flight. The aircraft weight and centre of gravity were within the limits prescribed by the manufacturer.

Around 0840⁶ the helicopter took off from the Mont-Laurier Airport for a flight over Mont-Laurier with one of the cameramen. The flight proceeded without incident, and the aircraft landed back at the airport around 0855. The engine was left running, the cameraman got out, and the other cameraman boarded the helicopter for a similar flight over the town.

The flight over the town was conducted at about 250 feet above ground level (agl). CARs 602.14 (2)(a)(iii) states that an aircraft shall not be operated over a built-up area unless the aircraft is operated at an altitude from which, in the event of an emergency necessitating an immediate landing, it would be possible to land the aircraft without creating a hazard to persons or property on the surface. Moreover, the helicopter must be at an altitude of 1000 feet above the highest obstacle located within a horizontal distance of 500 feet from the aircraft. CARs deems that an aircraft is being operated over a built-up area if the built-up area is within a horizontal distance of 500 feet⁷.

³ CARs 401.05(2) (a).

⁴ CARs Standard 421.05(2) (a) to (g).

⁵ CARs 401.05(2) (b) (i) (A).

⁶ All times are eastern daylight time (Coordinated Universal Time minus four hours).

⁷ CARs 602.12 .

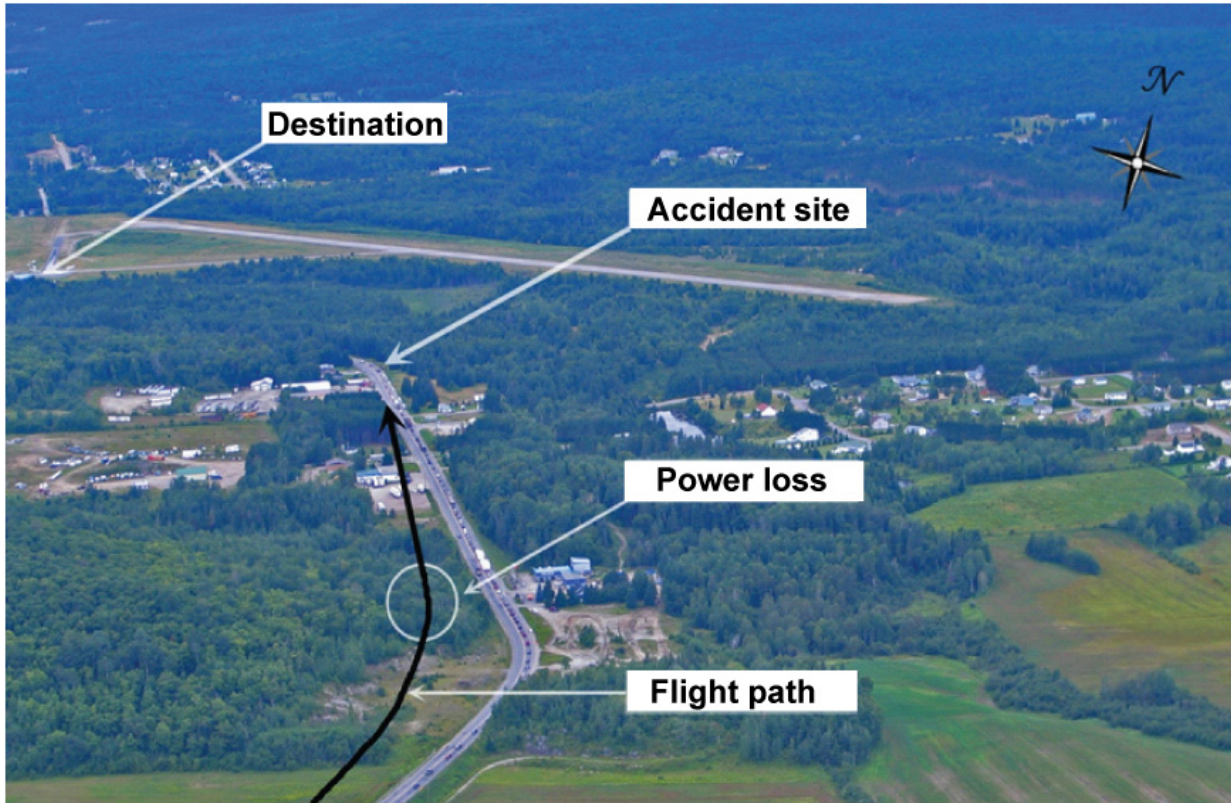


Photo 1. Return path to Mont-Laurier Airport.

At approximately 0910, on the return flight to the airport, the cameraman stopped shooting video about 2 km from the landing site at the airport. At this point, the helicopter was at a height of about 250 agl and travelling 75 mph (see Photo 1). A few seconds later, the helicopter experienced a loss of power and backfiring when it was 1.6 km from the landing site. Approximately 14 seconds after the power loss, the helicopter flew over a garage parking lot at a height of about 150 feet agl, then over a wooden area, and finally positioned itself above highway 117. The helicopter was fishtailing during the descent⁸. Once the helicopter was over the highway, descent was arrested at about 20 feet agl with a horizontal trajectory along the highway, but the helicopter was yawed to the right. Roughly 32 seconds elapsed from the power loss to the time the helicopter flew above the highway.

8

Fishtailing: repeated pronounced yawing.

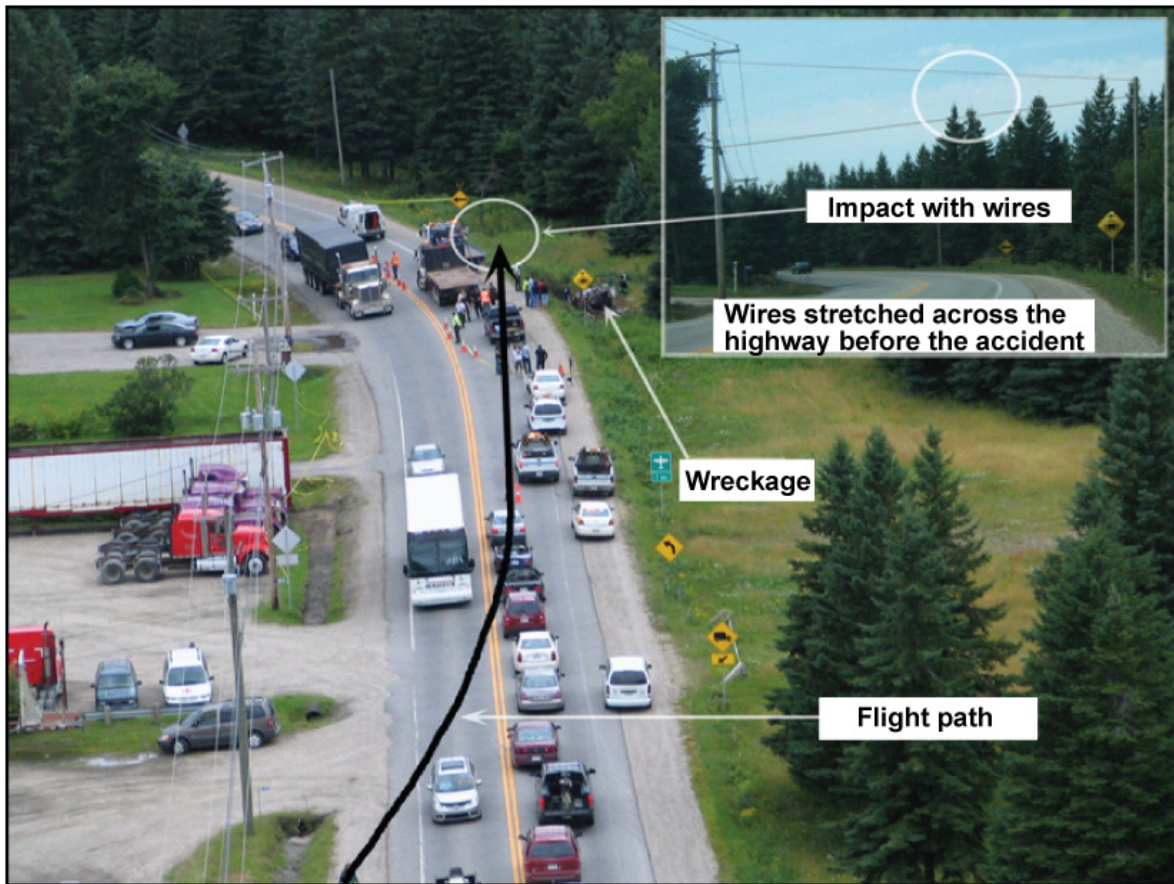


Photo 2. Accident site.

Before the pilot was able to arrest the sideways motion of the helicopter along the road, it struck the cables spanning the road at a height between 21 and 26 feet agl. The cables wound around the main rotor mast. The helicopter crashed on the pavement and rolled over on its right side into the ditch (see Photo 2).

When the helicopter rolled over, gasoline spilled onto the engine hot parts and ignited immediately. The persons who arrived at the site a few seconds after the accident were unable to control the flames that engulfed the helicopter, and therefore could not rescue the occupants.

Many studies have shown that the occupants have only 6 to 15 seconds to exit a burning helicopter before the temperature exceeds the limit of breathing capacity ⁹.

Since the cabin was completely destroyed by the fire, no analysis could be done on the flight instruments and flight controls.

The airframe wreckage was examined to the extent possible, but the level of mechanical and thermal destruction prevented any determination of flight control continuity.

⁹ *Cause Factor: Human, A Treatise on Rotary Wing Human Factors*, Minister of National Health and Welfare, Medical Services Branch, 1981, p. 184.

Emergency Locator Transmitter

The aircraft was equipped with a Narco 10 emergency locator transmitter (ELT), serial number A17809. The selector was found on ARM; however, the ELT was found separated from its mount and antenna (see Photo 3). The Rescue Coordination Centre was not advised of any ELT signals being received at the time of the accident.

Use of Flight Controls for Autorotation

The flight controls on a helicopter consist of a cyclic, a collective and pedals. Moving the cyclic control in a given direction causes the helicopter to move in that direction. The collective pitch control, to the left of the pilot, controls the vertical movement of the helicopter, and includes the twist-grip throttle for direct control of engine power.



Photo 3. Helicopter wreckage and ELT.

The three-blade main rotor generates lift for the helicopter but also generates torque acting on the helicopter airframe, causing rotational effect in the opposite direction, i.e., to the right. The tail rotor, or antitorque rotor, counteracts this torque effect by applying thrust in the opposite direction, and is controlled by the pilot using the pedals mounted on the floor in front of the seat. In steady-state flight, generating this antitorque force consumes over 10 per cent of the power output of the engine. Also, for every change in power there is a corresponding change in the torque effect, which in turn produces a change in heading which must be counteracted with the tail rotor by means of the pedals.

The transmission reduces the ratio between the engine and the main rotor, and includes a free wheel unit that allows the main rotor and tail rotor to rotate freely in the event of an engine failure. This allows the pilot to make an autorotation landing in an emergency. Since this aircraft does not have a speed governor to maintain constant engine speed (rpm), the pilot must manually increase or decrease engine power by throttle inputs to maintain constant power when a change in pitch (collective) is made, which adds to the complexity of flight control operation.

Normally, the engine produces enough power to drive both rotors. However, when an engine failure occurs, the collective is lowered, the helicopter is established in a steep descent, and the flow of air through the rotor keeps it rotating. This rotation of the rotor induced by air flow is known as "autorotation." The autorotation manoeuvre allows the pilot to make a descent without losing control and to make a safe emergency landing. However, turning during an autorotation descent causes the rotor to tilt, and as a result the rate of descent must be increased in order to maintain rotor rpm.

In the case of a total engine failure at 250 feet agl at a cruising speed of 75 mph, the pilot has about 15 seconds to execute an emergency autorotation landing. If the engine is producing

partial power, the rate of descent will be reduced, with a proportional increase in the time available to execute the emergency landing. In this occurrence, about 36 seconds elapsed between the power loss and the impact with the cables.

Engine Failure Procedures

The procedure for engine failure ¹⁰ on the Enstrom F-28C is as follows :

1. Enter normal autorotation and stabilize at 58 mph.
2. Maximum recommended ground contact speed on prepared surfaces is 35 mph.
3. After ground contact the helicopter must have zero forward motion before collective pitch is fully lowered.

The flight manual does not specify a procedure for a partial power loss. However, the training guide published by Enstrom contains the following recommendations for an engine failure:

1. Enter autorotation (collective full down).
2. Stabilize at 58 mph glide.
3. Select landing site.
4. Check engine rpm. If engine rpm is still showing, add collective pitch slowly to see if blade rpm can be maintained.
Note: Continued flight might be possible at reduced manifold pressure settings. Be prepared for a complete loss of power.
5. At approximately 50 feet agl, flare the helicopter to reduce speed.
6. Level the helicopter and cushion the landing by using up collective. The maximum recommended ground contact speed is 35 mph.

However, if the engine fails between 10 and 375 feet agl, the procedure is adapted to suit the compressed time frame, and the following recommendations apply:

1. Adjust collective to maintain rotor rpm.
2. Adjust cyclic for autorotative glide.
3. At approximately 50 feet agl use aft cyclic to reduce forward speed.
4. Level helicopter and apply up collective to cushion landing. The maximum recommended ground contact speed is 35 mph.

The maximum recommended speed on ground contact assumes that the aircraft longitudinal centre line is aligned with its direction of motion. Landing with the aircraft yawed in relation to its direction of motion entails a risk of rollover.

Aircraft Information

C-GVQQ was built in the United States in 1977. The helicopter had about 2810 hours in service, including 612 hours since it was purchased by the current owners in 1986. The front seat is designed for three persons.

Since 01 January 1990, C-GVQQ was maintained in accordance with Appendix A to Chapter 571 of the Airworthiness Manual in effect at the time ¹¹. That maintenance program allowed the owners to use the general maintenance schedule published in CARs in lieu of the manufacturer's check-lists. The CARs general maintenance schedule is less specific than the manufacturer's check-list. However, CARs requires that "the method of inspection for each item in the maintenance schedule be in accordance with the manufacturer's recommendations or standard industry practice " ¹². The scope of the inspection for each item in the schedule is determined by the person doing the inspection.

The aircraft was equipped with an Avco Lycoming engine (HIO-360-E1AD, serial number L-17129-51). It is a four-stroke engine with four cylinders mounted independently in a horizontally opposed configuration. Each cylinder has one inlet valve and one exhaust valve. The valves are opened and closed by the rotation of the camshaft, which actuates the rocker arm via a hydraulic tappet and a plunger.

On 13 April 1982, the engine was overhauled by T.W. Smith Engine Co. Inc. in Cincinnati, Ohio, USA, and imported to Canada under export airworthiness certificate E195258. Four years later, on 13 July 1986, the engine was installed in C-GVQQ after it was purchased by the pilot/owner. The standard certificate of airworthiness in effect was issued on 18 March 1993. It remains in effect as long as the aircraft is maintained and certified in accordance with the Airworthiness Manual ¹³. The last engine log-book entry, dated 29 October 2008, indicates that the engine had a total of 542.2 hours airtime since being overhauled in 1982. The aircraft journey log-book indicates that, as of 20 March 2009, the engine had a total time in service of 611 hours over the 27 years since the 1982 overhaul. After being installed in 1986, the engine was inactive for several periods exceeding 30 days, and some lasted several months and even years.

The last entry in the aircraft journey log is dated 20 March 2009. The investigation determined that the aircraft made several flights after that date and that some entries were made in a personal notebook. The CARs ¹⁴ require that the details of each flight be recorded in the journey log daily, on completing each flight or series of flights.

¹¹ Since CARs came into effect, maintenance schedules have been prescribed in Appendix B of Standard 625.

¹² CARs Part VI, Standard 625, Appendix B, section (4).

¹³ Terms and conditions of standard airworthiness certificate.

¹⁴ CARs 605.94(1), Schedule I.

The engine manufacturer, Avco Lycoming, issued a service letter ¹⁵ recommending that an engine preservative be applied to engines that are inactive for over 30 days to reduce the risk of corrosion. There is no indication in the technical records of C-GVQQ that this recommendation was followed.

Avco Lycoming also issued a service letter ¹⁶ recommending that engines of this model be overhauled at 1500-hour intervals or after 12 years since overhaul, whichever is lower.

Overhaul after 12 years is recommended due to the fact that engines are subject to constant deterioration caused by corrosion, drying and hardening of materials such as seals, hoses and fuel pump diaphragms, particularly when not in use for an extended period. Abnormal bearing wear can occur on start-up after a long period of inactivity due to the loss of the protective film of oil. According to CARs, these recommendations are optional for engines in aircraft in private operation but mandatory for aircraft in commercial operation. Since C-GVQQ was in private operation, CARs did not require that the owner follow these engine manufacturer recommendations ¹⁷.

In 2003, all four cylinders were replaced with new ones (part number 05K21274) ¹⁸ obtained from a Transport Canada approved maintenance organization. New valve key assemblies were installed, and according to the journey log they had accumulated about 100 hours in service at the time of the accident. These in-service hours do not include the hours recorded in the personal notebook. The investigation could not determine the reason for the cylinder replacement. The camshaft, the hydraulic valve tappets and the plungers were not replaced, as they are integral components of the engine. Avco Lycoming issued a service bulletin ¹⁹ recommending a specific inspection of the valves in this engine every 300 hours in helicopter service. However, service bulletins are optional for aircraft in private operation.

The aircraft was transported to the TSB laboratory in Ottawa, Ontario. Rivets had been installed on the trailing edge of one of the tail rotor blades. According to Enstrom, installing rivets to repair or prevent separation of the trailing edge of the tail rotor is not approved. The approved repair procedure ²⁰ specifies that epoxy resin adhesive be used. Examination also revealed that the materials used to balance the tail rotor blades are not in compliance with aviation standards. However, these deviations did not affect the operation of the aircraft or the outcome of this occurrence.

¹⁵ Service Letter No. 180B, Engine Preservation for Active and Stored Aircraft, last amendment November 13, 2001.

¹⁶ Service Instruction No. 1009AT, Recommended Time Between Overhaul Periods, last amendment May 9, 2008.

¹⁷ CARs Part VI, Standard 625, Appendix C, section (3) 7: "No hard time, including calendar time, between overhauls need be observed in the case of small aircraft reciprocating engines in non-commercial private operation."

¹⁸ Authorized Release Certificate (formerly Form 24-0078).

¹⁹ Service Bulletin No. 388C - Procedure to determine exhaust valve and guide condition, last amendment November 22, 2004.

²⁰ Service Information Letter No. 0127, revision A - Preventive Maintenance of Main and Tail Rotor Blades for Corrosion Control in the Field, dated December 15, 1987.

No entries were found in the aircraft technical records indicating the installation of the tail rotor blade ²¹ with rivets or of the repair or installation of material to balance the blades. CARs ²² require that all repairs be recorded in the aircraft technical records.

Each tail rotor blade is a limited-life part itemized on the type certificate data sheet for the Enstrom F-28C. These itemized parts must be replaced after the number of airtime hours specified by the manufacturer.

Teardown of the engine revealed no external anomalies. The four cylinders were in good condition and no carbon fowling was found on the valves that could have caused them to seize. However, a detailed examination of the No. 4 cylinder revealed that the exhaust valve key assembly²³ and the check ball retainer in the exhaust valve hydraulic tappet²⁴ were broken.

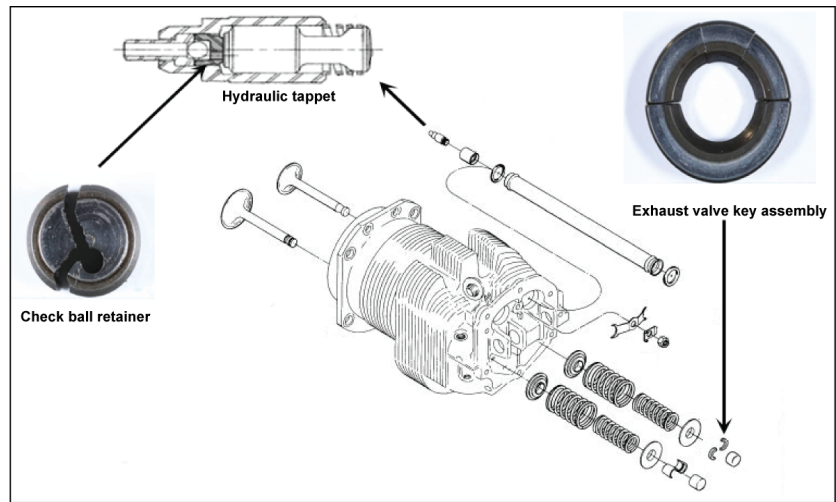


Figure 1. Engine cylinder and parts.

The exhaust valve key assembly consists of two symmetrical, semi-circular halves, one of which had failed in two places. A scanning electron microscope examination showed that these fractures were present before the occurrence. It was not possible to determine the initial cause of these fractures, but the key assembly had remained in its installed position. The exhaust valve key assembly is an integral part of the cylinder that was replaced in 2003.

The check ball retainer in the exhaust valve hydraulic tappet had a pre-existing defect in the form of cracks on the exterior surface which acted as a precursor for the eventual fracture of the retainer. The fracture advanced intergranularly, consistent with material embrittlement, most likely due to impurities in the material used to make the part. The check ball retainer is an integral part of the engine, and there was no indication in the technical records that it was replaced since the 1982 overhaul.

Examination of the turbocharger revealed wear and erosion on the turbine vanes that occurred prior to the power loss and ground impact. The degree of wear observed would have reduced the effectiveness of the turbocharger and affected engine output at high temperature or high

²¹ Serial number 0711.

²² CARs 571.03 – Recording of Maintenance and Elementary Work.

²³ Part number MS13997-3.

²⁴ Part number 78290.

altitude. As a result, aircraft performance would have been limited under such conditions. However, the power available on the last flight was sufficient for take-off and cruising flight.

Analysis

The accident occurred following a partial loss of engine power at about 250 feet agl over an area that provided no suitable site for a safe emergency landing. As a result, the analysis will focus on the failure which caused the partial power loss, maintenance of the aircraft, the choice of flight altitude, and execution of the emergency landing.

The fractures in the exhaust valve key assembly did not affect valve operation, since the key assembly remained in its installed position. The fracture of the check ball retainer in the exhaust valve hydraulic tappet, however, allowed the tappet to become spongy or collapse and allow the clearances to increase in the valve operating assembly. These increased clearances caused the valve to open late and close early, creating conditions conducive to backfiring and reduced power.

Deviation from the maintenance standards as noted in the investigation could raise issues concerning the terms and conditions of the aircraft's standard airworthiness certificate. In some cases, deviation from the standards could reduce the level of safety established by the manufacturer and, consequently, the safety of persons on board the aircraft and on the ground. However, the deviations observed had no effect on the outcome of the occurrence flight.

Failure to record all flying hours in the aircraft journey log does not itself constitute a flight safety risk. However, the manufacturer prescribes periodic inspections for certain parts at specified intervals. It also prescribes mandatory replacement of limited-life parts at specified in-service intervals. According to CARs, recording airtime hours in the aircraft journey log on a daily basis is one way to guard against exceeding the airtime hours specified for inspections and the replacement of certain parts.

The Transport Canada maintenance schedule requires that inspections be done according to CARs instructions²⁵. The scope of the inspection for each scheduled item is determined by the person doing the inspection. Also, the decision as to whether or not to replace parts that fail to meet airworthiness standards is then made according to the person's experience, judgment and knowledge of general aviation standards.

Since no hard time interval overhauls are required on small piston-engine aircraft in private operation, the engine is maintained according to condition. The engine can therefore be used as long as the aircraft maintenance engineer feels it is airworthy and its performance is up to standard. It is therefore not subject to overhaul intervals in terms of service time or years elapsed, either for parts replacement or a complete engine overhaul. In addition, all the other manufacturer recommendations are optional.

An annual inspection would not have detected the cracks, since this inspection does not include inspecting these parts. The specific inspections and engine overhauls at set intervals as recommended by the manufacturer are the principal means of detecting cracks in these parts. Since the aircraft was in private operation, CARs allowed the owner to not overhaul the engine at 1500 hour-intervals or after 12 years since overhaul as the engine manufacturer

²⁵

CARs Part VI, Standard 625, Appendix B.

recommended. As a result, although the engine had less than 50 per cent of the airtime hours specified by the engine manufacturer, just over 27 years had elapsed since its last overhaul.

When the engine backfired, the pilot was probably surprised by the noise and the fishtailing caused by fluctuations in engine power. Since the aircraft is not equipped with a speed governor, the pilot had to continually make corrections by modulating the throttle to maintain constant rotor rpm as the engine power fluctuated. In addition, these changes in power also caused the torque effect induced by the main rotor to fluctuate, which then had to be counteracted with the tail rotor through pedal input to control the direction of flight. The resulting difficulty in maintaining directional control due to the fluctuations in power increases a pilot's workload at a critical time when analyzing the situation, identifying the problem, choosing the correct procedure and taking appropriate action. After the partial loss of engine power, the pilot could not maintain rotor speed if he continued in level flight. The only option available that allowed him to maintain rotor speed was to descend.

A critical aspect of autorotation is the entry manoeuvre required immediately following the loss of engine power, because the pilot must react quickly to conserve rotor rpm by lowering the collective, which initiates the descent. A delay of only two or three seconds after a total power loss would result in a significant decay of rotor speed and could affect control of the aircraft. Accordingly, the first action recommended in the engine failure procedures is to enter autorotation immediately.

Aircraft altitude at the time of the power loss is an important factor in the success of an autorotation and emergency landing. The greater the altitude above ground level, the more time the pilot has to find a suitable landing site. Flying at low altitude reduces that time to the point where it might be impossible to autorotate and set the helicopter down on a safe surface.

The power loss occurred when the helicopter was overflying a wooded area, and the choices for a suitable landing site were limited. If the engine ceases operating completely, the pilot has no choice and must make an emergency landing, irrespective of the condition of the surface below his flight path. However, if the engine is still producing power, it is possible to prolong the descent in order to find a suitable landing site.

Since the helicopter was flying at an altitude of less than 375 feet agl, the training guide recommends, in the event of a power loss, that the pilot lower the collective to conserve rotor rpm, establish the aircraft in autorotative glide, flare the helicopter to reduce forward speed, level the helicopter, and use the collective to cushion the landing. At an altitude of 250 feet agl, the pilot had about 15 seconds to execute an emergency landing. He had little time to select a suitable landing site. In addition, the pilot was faced with a dilemma: making an emergency landing on an unsuitable surface or continuing the flight until he found a suitable landing surface while rotor rpm continued to decay. The pilot continued the flight to find a section of the road that would be suitable for landing. Consequently, when the pilot finally arrested the descent about 20 feet above the road, the tail rotor effectiveness had diminished to a point where the helicopter was considerably yawed to the right of its horizontal track along the road.

To land with horizontal velocity, the aircraft must be aligned with the direction of travel, otherwise it could roll over. Consequently, the pilot had to correct to align the aircraft with the direction of horizontal travel before setting down on the road. The complex task of simultaneously arresting horizontal travel along the road with the helicopter yawed, controlling

the descent until touchdown, and counteracting engine power fluctuations without a speed governor was particularly difficult.

When the loss of directional control to the right occurred, the already high workload associated with an emergency landing increased further, most probably creating work overload for the pilot. In a work overload situation, pilots often concentrate on a particular task and ignore the overall situation. As a result, the pilot probably focused his attention on the execution of the manoeuvre and did not see the cables spanning the road.

In the initial training for a pilot licence, the student pilot practises manoeuvres and emergencies on an aircraft type in order to develop a level of skill acceptable to pass a flight test. To continue exercising the privileges of his licence, the pilot must comply with the recency requirements prescribed in CARs²⁶. It is possible to make only one flight every five years and complete a self-paced study program in the Transport Canada *Aviation Safety Letter* within the 24 months preceding the flight to satisfy CARs requirements. To carry passengers, a pilot needs only complete five take-offs and landings in the six months preceding the flight. There was no evidence that the pilot had flown with an instructor to practise emergency manoeuvres on the EN28 after receiving his type rating in September 1986, nor was he required to do so under CARs.

Emergency manoeuvres, particularly helicopter autorotation, are demanding and require a high degree of skill, precision and judgment. Moreover, a helicopter pilot often has less than one minute to execute an emergency landing after a complete engine failure. These skills can only be acquired with training and retained with practice²⁷.

Although the level of experience among pilots engaged in commercial operations is generally high, these pilots are required to make at least one recurrent training session in flight or on a simulator every year to practise these emergency procedures. Pilots engaged in private operations, however, are not subject to this flight training requirement as long as they conduct at least one flight every five years.

The following TSB laboratory reports were prepared:

LP111/2009 - Wreckage and Engine Examination
LP112/2009 - Video Recovery

These reports are available from the Transportation Safety Board of Canada upon request.

Findings as to Causes and Contributing Factors

1. Fracture of the check ball retainer in the hydraulic tappet caused the malfunction of the No. 4 cylinder exhaust valve.
2. The malfunction of the No. 4 cylinder exhaust valve caused backfiring and partial loss of engine power. As a result, the aircraft could not maintain cruise altitude.

²⁶ CARs 401.05.

²⁷ *Cause Factor: Human, A Treatise on Rotary Wing Human Factors*, Minister of National Health and Welfare, Medical Services Branch, 1981, p. 29-31.

3. After the loss of engine power and during the following emergency landing, main rotor rpm decreased and caused a loss of directional control during the flare, followed by an impact with cables over the road.
4. At an altitude of 250 feet above ground level, the pilot had very little time to react to the loss of engine power, complete the autorotation manoeuvre and the emergency landing.

Findings as to Risk

1. It is possible for a pilot to be in compliance with the *Canadian Aviation Regulations'* recency requirements without making a single flight with an instructor. Consequently, pilots in private operation could be inadequately prepared to deal with emergencies.
2. Owners of aircraft in private operation are not required to follow the recommendations of engine manufacturers. As a result, some aircraft parts can go without inspection or replacement for several years beyond the overhaul intervals prescribed by the engine manufacturer.
3. Some aircraft maintenance aspects were not in compliance with standards and requirements. Although these instances of non-compliance had no effect on the outcome of the occurrence flight, this practice could decrease the safety margin provided by the manufacturer.
4. Not all airtime was recorded in the aircraft journey log, which increased the risk that the limits prescribed by the manufacturer would be exceeded.

Other Findings

1. The wear and erosion in the turbocharger was sufficient to prevent the engine from producing its full rated power under certain atmospheric conditions and, consequently, to limit the performance of the helicopter.
2. The intensity of the post-crash fire prevented rescuers from extracting the occupants from the wreckage.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 10 November 2010.

Visit the Transportation Safety Board's website (www.bst-tsb.gc.ca) for information about the Transportation Safety Board and its products and services. There you will also find links to other safety organizations and related sites.