

FINAL REPORT

AAIU Synoptic Report No: 2008-012
AAIU File No: 2007/0082
Published: 3/7/2008

In accordance with the provisions of SI 205 of 1997, the Chief Inspector of Air Accidents, on 12 September 2007 appointed Mr. Graham Liddy as the Investigator-in-Charge to carry out a Field Investigation into this Accident and prepare a Synoptic Report.

Aircraft Type and Registration:	Schweizer 300 CBi ¹ , G-CDTK
No. and Type of Engines:	1 x Lycoming HIO-360-G1A
Aircraft Serial Number:	0216
Year of Manufacture:	2005
Date and Time (UTC):	12 September 2007 @ 15.15 hrs
Location:	Clonshanny, Co. Offaly
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 Passengers - 1
Nature of Damage:	Helicopter suffered severe damage
Commander's Licence:	PPL (H) USA
Commander's Details:	Male, aged 38 years
Commander's Flying Experience:	107 hours, of which 25.5 hours were as pilot-in-command
Notification Source:	Tullamore Gardaí
Information Source:	AAIU Field Investigation

SYNOPSIS

While returning to base from a local flight, the engine stopped, at a reported height of 1,000 ft. The helicopter landed heavily from the ensuing auto-rotation. The heavy landing severely damaged the helicopter, and caused serious injury to the passenger. The Pilot was less severely injured. The Investigation concluded that the helicopter had run out of fuel. Three Safety Recommendations are made in this Report.

¹ This helicopter type was originally certified as the Hughes 269. The full designation for this helicopter is Schweizer 300CBi Helicopter Model 269C-1.

FINAL REPORT

1 FACTUAL INFORMATION

1.1 Background

The Pilot operated another helicopter, a turbine powered Hughes 500, on behalf of the owner of this helicopter. The operating base was at the owner's home at Clonshanny, Co. Offaly. The Hughes 500 was used to transport the owner to work locations throughout Ireland. At the time of the accident, this helicopter was undergoing maintenance and awaiting parts, and it was consequently not available to meet the transportation requirements of the owner. The Pilot of the accident helicopter made arrangements to hire-in the accident helicopter, G-CDTK, in order to meet the owner's transportation needs. The Pilot contacted a company based at Enniskillen, in Northern Ireland, to hire G-CDTK for approximately 25 hours flying. On Friday 7 September 2007, he traveled to Enniskillen and picked up G-CDTK. He then flew it to the owner's base at Clonshanny. On the following day, he flew the helicopter from Clonshanny to Cork Airport to deliver a passport. This flight was conducted at a high power setting to combat headwinds. The helicopter was refueled at Cork, taking on 110 Litres of Avgas. The helicopter then returned to Clonshanny. Another local flight, reportedly of approximately 15 minutes duration, was then flown in the local area. No further flying was done in the helicopter until the accident flight on 12 September 2007.

1.2 Accident Flight

At approximately 14.10 hrs. on 12 September 2007, the helicopter took off from Clonshanny for a flight in the local area, with the Pilot and one passenger on board. It was intended to fly to Tullamore, then to Ferbane, and then to return to Clonshanny. Shortly after take-off, at 14.17 hrs, the Pilot contacted Shannon ATC and advised them of his intentions. He was given a transponder code of 7001. However, communications were poor, as would be consistent with a helicopter operating at low altitude at this distance from Shannon. The Pilot had some difficulty in hearing Shannon, and set the transponder to 7000. Shannon ATC subsequently reported that the helicopter did not appear on Shannon Radar, or the composite display, which included data from Dublin Radar. This was not unusual, as the radar rarely detects targets below 1,500 ft in this area, due to terrain masking.

At approximately 15.15 hrs, the helicopter was returning to Clonshanny. The Pilot stated that, at an altitude of 1,000 ft, as he selected the fuel booster pump to "ON", the engine lost power. At this point the helicopter was within one mile of the base at Clonshanny. The Pilot stated that he initiated an auto-rotation and flared at the "height of a two storey house" The helicopter dropped vertically from this flare and struck the ground hard, without any forward speed.

1.3 Injuries

The Pilot and his passenger suffered injuries, consistent with a heavy vertical impact. The Pilot was discharged from hospital the following day. The passenger suffered spinal injuries that required surgery.

1.4 Helicopter Information

The Schweizer 300CBi is powered by a fuel injected 4-cylinder Lycoming engine. The single fuel tank, as fitted to G-CDTK, is located to the rear of the cabin on the LH side of the helicopter. It has a total capacity of 33.0 US gallons (125 Litres) of fuel of which 0.5 gallons (1.8 Litres) is designated as unusable fuel. The quantity for the unusable fuel is a maximum value and the actual value is usually considerably less.

FINAL REPORT

The fuel tank is fitted with a capacitance type fuel contents gauge. The tank also has a separate low fuel contents warning system. This consists of an independent capacitance probe in the tank and a warning light on the instrument panel. The warning light is set to come on when the remaining fuel will be exhausted within 7 to 10 minutes flying time. This warning light has a press-to-test facility to ensure that the bulb is operational. The electrical supply to the bulb, in either the press-to-test scenario, or when the low warning system is activated, is through a spring-loaded central contact in the bulb-holder. It may be noted that the capacitance type fuel measurement for both the fuel contents and the low fuel warning system is only available on later model Schweizer 300 helicopters such as G-CDTK. Older models used float type systems for both these functions. It is widely known that float type gauges are generally far less reliable and less accurate than the capacitance type.

The G-CDTK was equipped with one standard hourmeter. This hourmeter starts to record time when the transmission oil pressure rises to approximately 2.5 PSI, that is, once the main rotor is turning at a significant speed. The Schweizer Flight Manual states that the reading of this meter can be used for scheduling periodic maintenance, but without any multiplication factor.

For information, the Schweizer 300CB model features a carburetor engine, and has lower fuel consumption as noted in Section 1.12 below.

1.5 Helicopter Fuel Information

Schweizer informed the Investigation that the standard fuel consumption for the 300 CBi was 12 to 14 US gallons/hr (45.5 to 53 Litres/hour).

It may be noted that there was no Avgas available at the Clonshanny base. Only Avtur, for the turbine-powered Hughes 500, was available there, stored in a bowser.

1.6 Damage to the Helicopter

The helicopter suffered extensive damage, consistent with a heavy vertical impact. The skid undercarriage collapsed completely, the bottom of the fuselage suffered ground impact damage, the cabin floor and instrument panel were distorted, the main tail boom supports failed and the main blades suffered kinking damage. The extent of the damage to the helicopter probably rendered it beyond economic repair (**Photo No. 1**).

1.7 Examination of the Helicopter

The Investigation team arrived at the accident site approximately 2½ hours after the accident. Examination of the helicopter showed ground marks consistent with a high rate vertical impact with no forward speed. The single fuel tank of 33 U.S. gallons capacity, (125 Litres) showed only a minuscule amount in the bottom left side of the tank, (the helicopter was erect but leaning to the left). There was no smell of fuel at the site and the fuel gauge (when battery power was applied) indicated zero. The Investigation noted that the exhaust pipe of the helicopter was in contact with the grass in the field, as the undercarriage had collapsed. The following morning, the helicopter was removed by truck to the AAIU facility at Gormanston. The ground underneath the helicopter was examined for signs of fuel scorch, which typically occurs when Avgas is spilt on grass. No evidence of a fuel spill was found. Samples of the grass were taken. Laboratory examination of this grass found no evidence of fuel. A small amount of fuel was recovered from the helicopter fuel filter. This was free of contamination, as was the filter element.

FINAL REPORT

1.8 Further Tests

At the AAIU facility in Gormanston, 10 Litres (2.6 U.S. Gallons) were put into the fuel tank. It was observed that no fuel leak was found. The fuel gauge read approximately 3 U.S. gallons. It was noted that the fuel low contents light did not illuminate when there was no fuel in the tank. This warning system is adjustable but is normally set to illuminate the fuel low contents warning light when the tank's contents reduce to 1.75 to 2.0 US Gallons (6.6 to 7.5 Litres) total capacity, which can include up to 0.5 US gallons of unusable fuel. Thus the light should illuminate when there is between 5 and 10 minutes flying time remaining, depending on the unusable fuel on that particular tank and the helicopter's power setting. Furthermore, it was found that the light would not illuminate when the press-to-test feature was activated, indicating a disruption in the power supply to the bulb. The bulb filaments were examined and found to be intact. When the warning light assembly was manually jiggled about (with the fuel tank empty), the light did come on intermittently. The press-to-test facility also worked when the light assembly was manually jiggled about, but only in an intermittent manner. Examination of the bulb holder found that the central contact was distorted off-centre and made poor contact with the bulb (**Photo No. 2**). This bulb-holder was then replaced by a serviceable unit. The low contents warning system was again checked and then found to work reliably. The calibration of the warning light is set using a 2° nose down datum, set from the main rotor hub. Because of the significant distortion of the helicopter, the Investigation was unable to verify the precise setting of the warning system. However tests showed that the warning light came on when the fuel contents reduced to approximately 1.5 US Gallons (5.6 Litres). The specified value is 1.7 to 2.0 US Gallons. Given the distortion of the helicopter, the system was probably calibrated within the specified settings prior to the accident.

1.9 Engine Tests

The engine could not be run immediately, due to impact damage to the wiring of the fuel booster pump, which made it impossible to prime the fuel system. Furthermore, the starter relay had also suffered damage. The wiring to the booster pumps was repaired but the booster pump still did not run. The booster pump was then removed and replaced. Using this replacement pump to prime the fuel system, the engine was started and ran satisfactorily, at idle, once the air in the fuel system was purged. The engine could not be run at high power settings as the landing impact damage had resulted in the cooling fan rubbing against its shroud. The removed booster pump was strip inspected in an approved workshop. The armature of the pump motor was found to have burned out. No physical or impact damage was found on the pump casing.

1.10 Maintenance of the Helicopter

At the time of the accident the hourmeter had a reading of 923.4 hours. The last Technical Log entry was on 28 August at 917.5 hours. The last log book entry was 14 May 2007 at 683.9 airframe hours. The maintenance statement showed that a 25-hour lubrication was performed at 708.1 airframe hours (date not recorded) and that the next inspection due was a 50-hour inspection required at 733.1 airframe hours or by 13 Nov 2007, whichever occurred first.

The owners of the helicopter (a UK-based company, and the UK agent for Schweizer Helicopters) informed the Investigation that airframe hours were calculated by factoring (multiplying) the hourmeter reading by 80%. By this calculation, the helicopter had 738.7 airframe hours completed at the time of the accident. Thus, by this maintenance system, the 50-hour inspection was overdue at the time of the accident.

FINAL REPORT

The Investigation contacted the UK CAA with regard to the practice of factoring the hourmeter reading by 80%, particularly with reference to the Flight Manual statement that the meter can be used for scheduling periodic maintenance, but without any multiplication factor. The CAA stated that they would not support any factoring of the hourmeter reading in respect of maintenance periods for this helicopter type. Thus, the helicopter had missed checks relating to 215 hours of flying which would have included two 100-hour inspections.

1.11 Pilot Interview

The Investigator met with the Pilot a few days after the accident. The Pilot participated fully in the interview. At the Pilot's request, the owner of the turbine-powered helicopter was also present at this interview. A number of significant points arose. The owner and the Pilot jointly examined G-CDTK for fuel contents prior to the final departure. They both stated that the fuel gauge read about $\frac{1}{2}$ full. They did not have a clean dip-stick but satisfied themselves that the tank was approximately half full by tapping on the outside. The Pilot was questioned about the low fuel warning light. He stated that he did not observe it coming on; in fact he observed no warning lights before the engine stoppage. He stated that he believed there was about 20 minutes duration remaining when the low fuel contents warning light comes on. He also stated that he found the lack of a clock in the cockpit a problem, as he had difficulty in keeping track of the fuel consumption rate without the benefit of a cockpit clock.

He also stated that he understood that the fuel consumption was 10 gallons per hour. He was unsure, when asked, if these were Imperial or U.S. Gallons². He said that when he had undergone his helicopter training in the USA, a planning figure of 10 U.S Gallons per hour was used. However, much of this flying was done on the Schweizer 300 CB, for which the manufacturer quotes a lower fuel consumption of 10 to 12 U.S. Gallons per hour. The Pilot was also unsure of the conversion of Litres to U.S. Gallons, and was consequently unaware that the 110 Litres taken on in Cork was 88% of the helicopter capacity and that he was flying on the last 12% when he landed in Cork.

The Investigation examined the Technical Log that was found in the helicopter. It was noted that there were no recent defects reported in this log. In particular, no report of any defect with the fuel low contents warning bulb were found in this log, which covered a period of three months prior to the accident. It was further noted that no entry had been made in the helicopter's Technical Log since the helicopter left Enniskillen. A piece of paper was found in the helicopter after the accident, with phone numbers and other items entered on it. One entry was "917.5" which corresponded to the hourmeter reading prior to departing from Enniskillen. This paper did not appear to contain any other information with regard to the operation of the helicopter. The Investigation noted that the Pilot's recall of the duration of the flight to and from Cork was significantly shorter duration compared to the owner's recall. Also the Pilot's recollection of the duration of the final flight was also significantly shorter than that indicated by the time period from the call to Shannon ATC until the accident time.

Subsequent to this interview. The Pilot stated that he had tested all the warning lights prior to departure from Enniskillen and also before the final flight, and found that they all illuminated as required.

² For information, 1 Imperial gallon = 1.20 US Gallons = 4.55 Litres

FINAL REPORT

1.12 Passenger Interview

The passenger was interviewed several months after the accident, in consideration of his injuries. He stated that he knew very little about helicopter flying and consequently was not aware of the fuel tanks gauge indication, the fuel contents warning light and other cockpit indications. He stated that just before the accident, the helicopter had passed over a scrap yard. About this time he noted an unusual smell and he stated that he remarked on this to the pilot. Shortly afterwards, he heard a loud bang and the helicopter then started to descend rapidly. He could not confirm if the engine was running during this descent. As the helicopter neared the ground, the nose pitched up, the descent stopped and the helicopter then climbed and finally fell vertically to the ground. The passenger stated that he smelt fuel when he was lying on the ground beside the helicopter, after the accident.

1.13 Licensing information

The Pilot had a valid Private Pilot's Licence - Rotorcraft Helicopter with no restrictions, issued by the USA Federal Aviation Administration (FAA), in March 2007. He possessed a valid Second Class medical issued by an FAA-approved medical facility in Ireland.

1.14 Pilot's Log Book

The Pilot was unable to furnish the Investigation with his logbook. He stated that this document had gone missing at some point. However he was able to supply a photocopy of a portion of his logbook. This showed that up to August 2007 (a few weeks before the accident) he had flown a total of 132.9 hours, of which 25.5 hours were as pilot-in-command. Up to the time of the accident, he had completed 77 hours on the Schweizer 300 model, mostly during training in the USA. His flying in the USA was fairly evenly divided between the CB and the CBi model.

2. ANALYSIS

The helicopter's fuel tank was reportedly filled completely prior to departure from Enniskillen. A further 110 Litres were taken on at Cork. The hourmeter reading prior to departure from Enniskillen was 917.5 hours. The reading after the accident was 923.4 hours, giving a total of 5.9 hours flying from leaving Enniskillen until the accident. Assuming a full tank at Enniskillen, and that the tank was totally depleted when the engine stopped, a total of $125 + 110 = 235$ Litres were used in this period. This equated to a consumption of 39.5 Litres/hr, which is only 88% of the minimum consumption rate quoted by Schweizer for the 300 CBi model. Therefore, using the manufacturer's minimum rate consumption data, the fuel in the helicopter would have been exhausted after the 5.9 hours of flying.

The analysis of the hourmeter readings and the available fuel indicated that the helicopter was due to run out of fuel at or about the time of the engine stoppage. The absence of any post-accident leaks and the presence of zero usable fuel in the tank after the accident are consistent with a zero fuel situation.

The gaps in the Pilot's knowledge with regard to the fuel consumption rate, the conversion of U.S. Gallons to Litres, the remaining duration available when the fuel low contents warning light is activated, the absence of a clock in the cockpit and of a dipstick to confirm fuel gauge readings, and the lack of any record of time flown in the helicopter since leaving Enniskillen, combined to produce a situation where there was a significant possibility of the helicopter fuel contents becoming totally depleted.

FINAL REPORT

Due to the faulty bulb holder, the fuel low contents warning light probably did not illuminate as the helicopter was running low on fuel. This is consistent with the Pilot's recollection.

It is probable that the Pilot's training on Schweizer 300 helicopters was done on older models of this helicopter that used float type fuel gauges. These gauges are widely known to be unreliable and prone to erroneous indications. The Pilot's experience of such gauges, allied with the non-illumination of the fuel low contents warning light, and his mistaken belief that some 20 minutes of flying were available after this warning comes on, may have caused the Pilot to dismiss the low reading of the fuel gauge and press on to the nearby base of the helicopter, which was only a mile away when the engine stopped.

The Investigation was unable to determine when the central contact in the bulb holder of the fuel low contents warning system was damaged. This damage resulted in the warning system becoming defective, and the press-to-test feature being intermittent/inoperative. No record of such a problem was recorded prior to the departure of the helicopter from Enniskillen; nor did the Pilot report such a defect. The Investigation is aware that the spring contact in such bulb-holders is prone to damage by excessively robust use of the press-to-test facility.

The subsequent successful running of the engine at the AAIU facility in Gormanston demonstrated that the engine was serviceable at the time of the accident.

The smell prior to the engine stoppage, noted by the passenger, was not mentioned by the Pilot in his interview. The Investigation considers that this smell may well have come from the scrap yard, over which the helicopter had just flown. The bang reported by the passenger is consistent with a backfire, which can occur as the engine runs out of fuel. The fact that the engine ran satisfactorily in subsequent tests and that no pre impact damage was found, indicated that this bang was not mechanical in origin. The Investigation considers that the smell noted by the passenger, as he lay on the ground on the left side of the helicopter, after the accident was probably caused either by the hot exhaust pipe which was in contact with the grass in the field, or by the remnants of fuel vaporizing in the booster pump as the pump's armature overheated.

The Investigation believes that the pump was probably operating at the time of the accident and was left running for a period after the accident, while no fuel was running through it. In this condition, the pump probably overheated and the armature burned out. In normal operation, fuel flowing through the pump has a cooling effect on the pump motor. In any case, a failed pump would not result in an engine stoppage in normal operation. For these reasons, the Investigation does not believe that the burned-out pump armature was a factor in this accident.

The maintenance program that was applied to this helicopter did not conform to the stipulations of the helicopter manufacturer, in that the hourmeter hours were factored by 80% to calculated flying hours. This maintenance program was also contrary to the policy of the UK CAA, the State of Registration. Consequently a number of due inspections on this helicopter had not been completed. Furthermore, under this maintenance program a 50-hour inspection was overdue at the time of the accident. The Investigation does not consider that this defective maintenance program was causal to the accident.

However, it may be noted that continued validity of a helicopter's Certificate of Airworthiness is dependent upon the helicopter being maintained in accordance with the laid down requirements. The UK CAA have stated that, based on the information supplied by this Investigation, they considered the Certificate of Airworthiness of G-CDTK to have been invalid at the time of this accident.

FINAL REPORT

The Investigation noted that the Pilot had only 24 hours experience as pilot-in-command when he started flying the Hughes 500 helicopter, effectively operating as the personal pilot to the owner of that helicopter. While the nature of the relationship between the Pilot and the owner is beyond the scope of this Report, the Investigation is concerned that a pilot of such low experience would be subject to the operational pressures of what is, effectively, corporate aviation. The Investigation believes that the owner was not familiar with aviation regulations, requirements and norms. The Investigation noted that, as this was a USA-registered helicopter, operated by a pilot holding a USA FAA Private Pilot's license, the operation had not sought the approval of the Irish Aviation Authority (IAA), nor had the operation come to the attention of that organisation, until that helicopter was involved in an incident in Athlone on 7 July 2007.

Arising from a fatal accident³, the AAIU made a recommendation in 1997 to the Joint Aviation Authority (JAA) regarding the absence of regulations covering corporate aviation in Europe. No response to this Safety Recommendation has been received from the JAA. However on 9 January 2002, the UK CAA informed the AAIU that they were members of a JAA working group that is expected to finalise a relevant revision of JAR OPS 2 before the end of 2002. Following another fatal accident⁴ in 2002, the AAIU reiterated this Safety Recommendation to the JAA. The European Aviation Safety Agency (EASA) which is the successor to the JAA, responded in a letter dated 26 November 2007 that stated: "The EASA has not yet got competence in the field of operations. As soon as the relevant regulation is promulgated, the EASA will publish its opinion for the corresponding implementing rule." To date, EASA has not published regulations in regard to this matter.

3. **CONCLUSIONS**

(a) Findings

1. The helicopter engine stopped due to the fuel tank contents being reduced to zero.
2. The helicopter flared too high at the end of the subsequent auto-rotation, which in turn resulted in heavy impact landing, and caused the injuries to the occupants and the extensive damage to the helicopter.
3. The helicopter's low fuel contents warning light failed to illuminate as the fuel contents reached a critical level.
4. The failure of the low fuel contents warning light was caused by a damaged contact in the bulb-holder. This contact was probably damaged due to excessively robust use of the press-to-test facility.
5. The Pilot probably dismissed the low readings of the fuel gauge as erroneous, and relied on an expected illumination of the low fuel contents warning light to warn him of a critical fuel situation.
6. The Investigation found no defect in the engine that could have accounted for the engine stoppage.

³ The report of this accident can be found at <http://www.aaiu.ie/upload/general/4719-0.pdf>

⁴ The report on this accident can be found at <http://www.aaiu.ie/upload/general/5855-0.pdf>

FINAL REPORT

7. The maintenance program of the helicopter did not meet with the criteria laid down in the approved helicopter manufacturer's Flight Manual and an inspection due under this program was overdue..
8. The maintenance program did not meet the requirements of the U.K. CAA.
9. The shortcomings in the maintenance program were not a factor in this accident.
10. Due to the defects in the maintenance programs, the helicopter was not being operated within the requirements of its Certificate of Airworthiness at the time of the accident. Thus the Certificate of Airworthiness was probably not valid at the time of the accident.
11. The Pilot lacked detailed knowledge of the helicopter's fuel consumption rate and of the point where the low fuel contents warning system should illuminate.
12. The Pilot had very limited experience for the type of flying operations he was engaging in.

(b) Cause

The engine stopped as a result of no fuel remaining in the helicopter's fuel tank.

(c) Contributory Cause

1. The fuel contents of the helicopter were not managed appropriately.
2. The defective bulb holder on the fuel low contents warning system, as a result of which the system failed to warn the pilot of the critical fuel situation.

4. SAFETY RECOMMENDATIONS

1. The IAA should consider a program aimed at educating helicopter owners, and potential owners, of the risks and hazards associated with the use of general aviation helicopters for business purposes. [\(SR 11 of 2008\)](#)
2. The UK CAA should ensure that helicopter maintenance organisations are aware that it is not appropriate to factor the readings of the hourmeter of the Schweizer 300 helicopter when calculating maintenance periods. [\(SR 12 of 2008\)](#)
3. EASA should review the situation with regard to the regulation of corporate aviation activity in Europe as a matter of urgency. [\(SR 13 of 2008\)](#)

FINAL REPORT



Photo No. 1

This photograph shows the helicopter at the accident site, prior to removal to the AAIU facility at Gormanston



Photo No. 2

This photograph shows the bent central contact of the fuel contents low warning light bulb holder. The contact can be seen to be significantly off-centre

- END -