CIVIL AVIATION AUTHORITY
OF NEW ZEALAND

AIRCRAFT ACCIDENT REPORT

OCCURRENCE NUMBER 04/1624

HUGHES 269C

ZK-HDL

TE PUKE

16 MAY 2004

Glossary of abbreviations used in this report:

AD	Airworthiness Directive
AGL	Above Ground Level
AMSL	Above Mean Sea Level
ARA	Annual Review of Airworthiness
CAA	Civil Aviation Authority
EASA	European Aviation Safety Agency
ELT	Emergency Locator Transmitter
ft	foot or feet
HIO (engine)	Horizontal Helicopter, Fuel Injected, Opposed Cylinders
km	kilometre(s)
NZST	New Zealand Standard Time
R1	Revision 1
RPM	Revolutions Per Minute
SH2	State Highway 2
TBA	To Be Advised
TBO	Time Between Overhaul
TIS	Time In Service
UK CAA	United Kingdom Civil Aviation Authority
WGS 84	World Geodetic System 1984

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Aircraft type, serial number and registration:	Hughes 269C, S/N 800953, ZK-HDL
Number and type of engines:	One, Lycoming HIO 360 D1A
Year of manufacture:	1980
Date and time:	16 May 2004, 0620 hours NZST
Location:	Rangiuru Sale Yards, Te Puke Latitude[1]: S 37 46 49 Longitude: E 176 22 30
Type of flight:	Private
Persons on board:	Crew: 1 Passengers: 1
Injuries:	Crew: 1 serious Passengers: 1 fatal
Nature of damage:	Aircraft destroyed
Pilot-in-command's licence	Private Pilot Licence (H)
Pilot-in-command's age	35 years
Pilot-in-command's total flying experience:	Total time1302 hours including fixed wing. Total time (helicopters) 200 hours, 45 on type.
Information sources:	Civil Aviation Authority field investigation
Investigator in Charge:	Mr T.P McCready

[1] WGS-84 co-ordinates

Synopsis

The Civil Aviation Authority was notified of the accident at 0900 hours 16 May 2004. The Transport Accident Investigation Commission were in turn notified, but declined to investigate. A CAA site investigation was commenced that day.

The private helicopter with two persons onboard left its home base at dawn to carry out a photographic flight. After a few minutes of flying it crashed on farmland and caught fire. The pilot was seriously injured and the passenger (a professional photographer) was killed.

1. Factual information

1.1 History of the flight

1.1.1 The helicopter departed from its home base with a professional photographer on board in order to obtain photographs of the sunrise over kiwifruit orchards in the local area.

1.1.2 The helicopter circled the "Kiwi 360" company headquarters adjacent to SH2 and then proceeded towards the Rangiuru Sale Yards near Te Puke. The pilot heard a loud bang and noted a loss of power, so carried out an autorotation onto farmland adjacent to the sale yards.

1.1.3 A witness proceeding along SH2 noticed the helicopter emitting 'smoke and flames like a meteorite'. He followed the helicopter and on locating the accident scene assisted the pilot away from the burning wreckage. The passenger remained in the wreckage and died.

1.1.4 The accident occurred in daylight at approximately 0620 hours NZST adjacent to the Rangiruru Sale Yards at an elevation of 500ft AMSL. Latitude S 37 46 49, Longitude E 176 22 30.

1.2 Injuries to persons

Injuries	*Crew*	*Passengers*	*Other*
Fatal	0	1	0
Serious	1	0	0
Minor/None	0	0	

1.3 Damage to aircraft

1.3.1 The helicopter was destroyed by ground impact and fire.

1.4 Other damage

1.4.1 Nil.

1.5 Personnel information

1.5.1 The pilot held a current Part 61 Private Pilot Licence (Helicopter).

1.5.2 He also held the current Class 2 medical certificate appropriate for that licence.

1.5.3 The pilot had 1302 total hours which included fixed wing and helicopter flying.

1.5.4 The pilot had 45 hours on the Hughes 269C helicopter and approximately 200 hours total time on helicopters with R22 and FH1100 experience. At the time of the accident he was preparing to commence commercial helicopter pilot training.

1.6 Aircraft information

1.6.1 The Hughes 269C helicopter, commonly referred to as a Hughes 300C, was manufactured in 1980. The helicopter involved in this accident was imported into New Zealand from USA in 1990 with 1890 recorded airframe hours.

1.6.2 Agricultural spray equipment and a cargo hook were fitted in 1991 and it was flown as an agricultural/utility helicopter using this equipment.

1.6.3 The helicopter was damaged in an accident in October 1995 with 3024 recorded airframe hours. The accident is recorded as CAA Occurrence No. 95/3111. A rebuild was carried out over the following year and the helicopter was released to service and flew again in December 1996.

1.6.4 In 1999 the helicopter was sold to an agricultural operator who operated it in that role until it was purchased by the person who was the pilot on 3 July 2003.

1.6.6 The helicopter had a current Certificate of Airworthiness and the Annual Review of Airworthiness was carried out on 26 April 2004.

1.6.7 The last maintenance carried out was a 100 hour inspection, also certified on 26 April 2004.

1.6.8 Three different serial numbered engines had been installed in the helicopter during its time in New Zealand.

1.6.9 The engine installed at the time of this accident had a history of unserviceabilty, a summary of which is set out below:

Event	Description	Date
1	Engine imported into NZ from Australia fitted to helicopter ZK-HNI	Aug 1996
	+ 109.6 hours	
2	Cylinders removed and top overhaul including new pistons and rings carried out	Nov 1996
	+ 66.4 hours	Jan 98
3	Complete overhaul due to metal (copper) in the filter	Apr 1998
	+ nil hours	
4	Refitted to ZK- HNI Accident due to ground resonance during maintenance ground run CAA Occurrence 98/1767	May 1998
	+ nil hours	
5	Bulk strip carried out due to ground resonance accident and overspeed condition Chrome cylinders fitted	Jul 2000
	+ nil hours	
6	Fitted to ZK-HDL after bulk strip	Jul 2000
	+ 193.3 hours	
7	Engine removed due to excessive oil consumption Cylinders re-chromed due excessive wear New piston's and rings	Mar 2001
	+ 333.8 hours	
8	Engine removed – metal in filter	Removed Dec 2001

	Plucked centre main bearing All cylinders top overhauled New con-rod bolts, nuts, bearings	O/H Jul 2002
	+ 93.7 hours	
9	New cylinders fitted due to excessive oil consumption	Oct 2002
	+ 162 hours	
10	Engine removed – metal in filter New con-rod bolts, nuts and No 1 cylinder	Apr 2003
	+ 11.5 hours	
11	Engine removed – metal in filter Plucked centre main bearing All steel components – magnetic particle inspected Crankcase repaired	May 03
	+**40.2 hours**	
12	100 hr inspection Throttle shaft nut retightened	Apr 04

1.7 Meteorological information

1.7.1 Weather was not a factor in this accident. It was a fine morning with light wind.

1.7.2 The accident occurred at 0620 hours and the beginning of morning civil twilight for the area was 0647 hours.

1.8 Aids to navigation

1.8.1 Nil.

1.9 Communications

1.9.1 Nil.

1.10 Aerodrome information

1.10.1 The flight was conducted from the pilot's own helicopter landing area based at his kiwi fruit orchard.

1.11 Flight recorders

1.11.1 Nil.

1.12 Wreckage and impact information

1.12.1 The helicopter had auto rotated as a result of the engine failure into a farm paddock which was a depressed hollow lower than the adjacent public and sale yard roads. The pilot stated that he was attempting to land in the next paddock ahead but couldn't stretch the glide far enough. Low light conditions existed at the time and there was no evidence that sun strike was a factor in this accident.

Fig 1: Red line indicates autorotation approach and impact area (circled). Dashed line is at the base of hollow depression of paddock sloping down from adjacent road. Note proximity of power lines along roadway from left to right.

1.12.2 The contact with the ground was heavy with some forward movement. The lower vertical fin was severely crushed and ploughed a short furrow along the ground. The cross tube structure and rear cross tube flexed sufficiently on contact to dig a hole in the ground at the contact point, as did the engine. Spinal injuries to the pilot and passenger are also consistent with heavy ground contact.

1.12.3 The helicopter rebounded after the initial ground contact and rotated 180 degrees in an anti clockwise direction shedding numerous parts in the rotation swathe including landing skids and tail boom with the drive shaft, gearbox and tail rotor.

1.12.4 Fire consumed the helicopter cabin and engine area.

1.12.5 Investigators were left with a severely burnt out main cabin structure to examine, however the firewall between the engine and cabin ensured that the engine compartment was reasonably intact and not severely heat damaged like the surrounding components.

1.12.6 Fuel lines were closely examined after the witness report of the helicopter being on fire in flight. However, after rolling the engine over, a large hole was found in the engine crankcase and it was obvious that a piston connecting rod (con-rod) had failed and caused an internal engine failure. The number two piston con-rod had failed around the big end bearing cap.

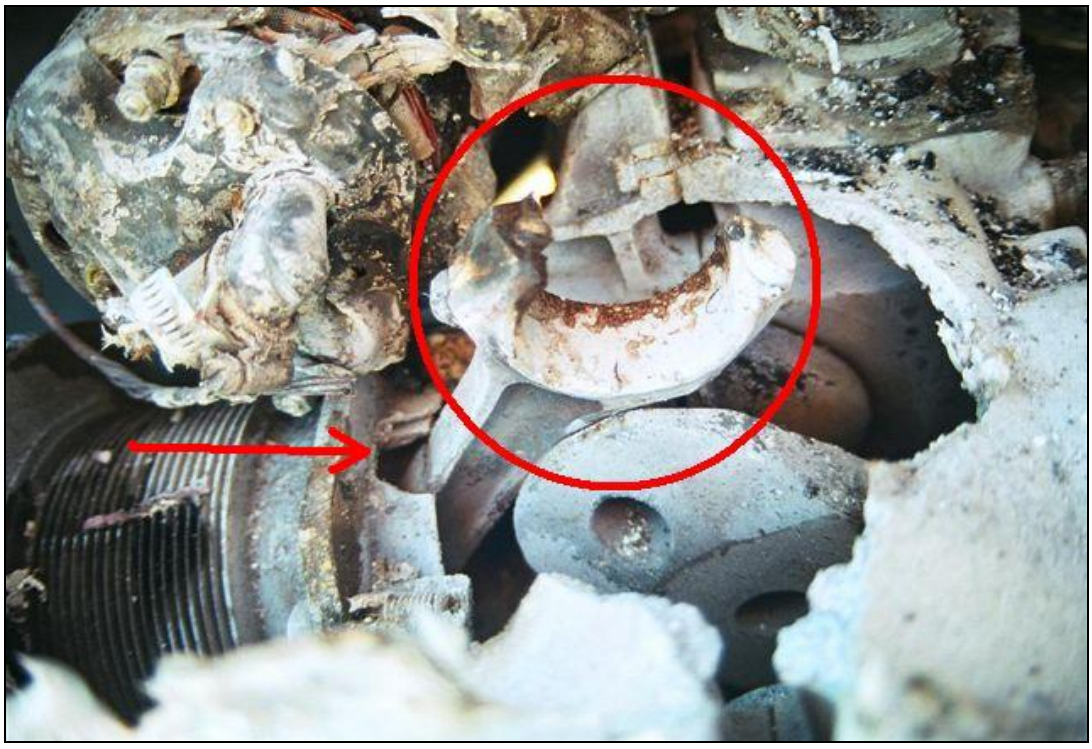

Fig 2: Failed con-rod big end bearing (circled). Arrowed area shows damage resulting from continued engine running in this failed condition.

1.12.7 Examination of the tail boom revealed a coating of clean engine oil along the entire length of the tail boom.

1.12.8 The low light condition at the time of the accident was considered to be a possible factor so the overnight scene guard was asked to comment on the light conditions at 0620 hours the following morning. He noted that the light conditions were OK at the road level, but that the hollow area below the road, which was the impact point, was still quite dark.

1.13 Medical and pathological information

1.13.1 Post-mortem examination showed that the passenger died due to the fire. The lack of soot in the bronchi and the low carbon monoxide level suggests an almost instantaneous death due to the fire.

1.13.2 The examination also revealed that the passenger received rib fractures, clavicle fractures and compression fractures of the thoracic spine caused by the accident impact. However, these alone would not have killed the passenger.

1.13.3 The pilot also received spinal injuries.

1.14 Fire

1.14.1 Fire occurred at impact.

1.14.2 The fuel tank located behind the cabin had been punctured and allowed fuel to make contact with the hot engine area which provided the fire ignition source. The helicopter remained in a near upright, horizontal position throughout the accident sequence.

1.15 Survival aspects

1.15.1 This accident was survivable, but the heavy contact with the ground following auto rotation meant that spinal injuries to the occupants occurred. Such injuries are common in helicopter accidents where the helicopter is not fitted with crashworthy seats or collapsing seats designed to reduce the vertical forces transmitted to the occupant’s spine in the event of a crash.

Fig 3: Severity of Impact: Black rectangle outlines rear cross tube ground scar, and red circle indicates engine contact. Both landing gear skids impressions are clearly visible next to red dashed lines.

1.15.2 This helicopter has no crashworthy design incorporated into the fuel system. The failure of that fuel system to withstand impact forces contributed to the fatal accident outcome.

1.15.3 The ELT did not transmit because the unit was consumed by fire.

1.16 Tests and research

1.16.1 The helicopter and its components were not subject to detailed metallurgical testing; however a detailed examination of the helicopter and the engine was carried out by the accident investigator who is a licensed aircraft maintenance engineer (LAME).

1.17 Organisational and management information

1.17.1 Nil.

1.18 Additional information

1.18.1 The Hughes 300 helicopter has been operated in New Zealand for many years in a variety of roles and the technology is of 1950's/1960's era design. The TBO is just 1,500 hours and many operators never reach the full life cycle of the engine when it

is used on agricultural and lifting operations. The engine in this helicopter type operates at a high RPM of 3,200 and has little tolerance for engine overspeeds which may be accidental or deliberate in the agricultural role. As a training helicopter, the 300 is also susceptible to overspeeding at start up.

1.18.2 A later version of this helicopter is now available. The new type certificate holder Schweizer introduced the fuel-injected 300CBi in 2002. The new engine is the 180hp Lycoming HIO-360-G1A which provides substantial engine overspeed margin. Schweizer also introduced the STAR system, consisting of a start-up over speed limiter, a low rotor RPM warning system and an automatic clutch engagement system. Helicopter airframe crashworthiness has also been improved with the introduction of a tri-level energy absorption system.

1.19 Useful or effective investigation techniques

1.19.1 Nil.

2. Analysis

2.1 The loud bang and loss of power as described by the pilot is consistent with the failure of the number 2 con-rod. The subsequent autorotation from 500 feet resulted in a very hard landing which was survivable although both occupants suffered spinal injuries common in hard landings of this type and in particular, in helicopters not fitted with energy absorption systems.

2.2 In conducting the autorotation from 500 feet AGL the pilot took the only option available to him. He successfully avoided the saleyards, a house, trees and powerlines and a kiwifruit orchard, and put the helicopter into a paddock between the saleyards and a maize paddock.

2.3 Ground scars and main rotor blade positions indicate that the helicopter was flared nose high with pitch applied to the rotors consistent with the pilot flaring the helicopter onto the ground at the end of an autorotation. Such a manoeuvre requires good visual references in order to be able to judge the correct height to commence the flare to 'cushion' the helicopter onto the ground.

2.4 The resulting hard landing was due to the helicopter being flared too high and subsequent loss of main rotor RPM. This was probably due to the pilot's visual references being the relatively well lighted adjacent roads, trees and sale yards, but the actual landing ground surface was much lower in a hollow. With the low light conditions at the time the pilot was probably flaring into a darkened area with very limited visual cues while the surrounding countryside would have been clearly visible. The photo taken in daylight at Figure 1 shows the difficulty of detecting the depression in the selected paddock.

2.5 No evidence of the helicopter being on fire in the air prior to ground impact was found. Although reported as such, the witness probably observed a lot of smoke trailing the helicopter after the flailing con-rod made a hole in the engine crankcase allowing a considerable amount of oil to be released. Visually this smoke would have been combined with the red flashing anti collision light and hot exhaust glow

in the half light of the morning. The tail boom area showed no signs of any sooting expected if fire had occurred in the air.

2.6 The tail boom and stabiliser which were separated from the helicopter during impact were examined. Considerable clean, unburnt oil was found across the surfaces indicating that the oil streamed from the damaged engine in flight during the autorotation. Comparison with a previous fixed wing accident from a failed con-rod and subsequent hole in the crankcase showed similar oil coverage over the tail plane. Refer www.caa.govt.nz ZK- FGF accident report 99/3689 paragraph 1.12.4.

Fig 4 Considerable amounts of engine oil covered the tail boom and stabilizer.

2.7 Con-rod failures in aircraft and helicopters have occurred before in New Zealand. While the total numbers are not available a sample of such occurrences is provided below:

Reg	Date	Airframe Type	Engine Type	Occurrence
ZK-HIS	Nov 1991	Hughes 269	Lycoming HIO-360-D1A	91/845
ZK-EGW	May 2003	Fletcher FU24-950	Lycoming IO-720-A1B	03/366
ZK-HON	2001	Hughes 269	Lycoming HIO-360-D1A	01/3552
ZK-HZA	Mar 2000	Hughes 269C	Lycoming HIO-360-D1A	00/630
ZK-DXD	Aug 1998	Cessna 206	Continental IO-520-F	98/2102
ZK-HGD	May 1987	Hughes 269A1	Lycoming HIO-360	87/56
ZK-HFI	Aug 1983	Hiller UH 12E		83/76
ZK-HDY	Jan 1983			83/10
ZK-HEP	Jun 1980			80/77
ZK-HIJ	Jun 1979			78/89
ZK-HDB	Apr 1979	Bell 47	Lycoming	79/65

2.8 The Hughes 300 helicopter engine is a high revving installation when compared to other piston powered aircraft and helicopters. In New Zealand, when used in an agricultural role, it is noted for its ability to work hard and carry loads, but the downside is that when used this way the engine seldom reaches its TBO without an engine bulk strip or overhaul being required.

2.9 This accident was survivable, but the fuel tank construction and unprotected position in being mounted behind the cabin and above the engine allows fuel to cover these areas if the tank is ruptured or punctured.

2.10 A sample list of previous Hughes 300 accidents in New Zealand in which fire occurred is provided below:

Reg	Type	Details	Occupants	Occurence
ZK-HYE	Hughes 269C	Helicopter hit power lines and caught fire.	3 fatal	Occurrence 99/3649 TAIC Accident report 99-006
ZK-HHS	Hughes 269C	Helicopter hit power lines and caught fire.	1 fatal	Occurrence 98/8 CAA Accident report
ZK-HYU	Hughes 269A	Helicopter caught fire after impact lying on its side		89/26
ZK-HQY	Hughes 269	Helicopter caught fire after impact	1 fatal	89/101
ZK-HJM	Hughes 269	Helicopter caught fire after impact		80/40
ZK-HIM	Hughes 269	Helicopter caught fire after impact		76/110
ZK-HGF	Hughes 269	Helicopter caught fire after impact		75/109

2.11 Helicopters certified to higher crashworthiness requirements will specify breakaway fuel couplings, protected fuel tanks and roll over vent valves to increase survivability. This investigation revealed that factory kits are available to be fitted to improve this area for this and other types of helicopters.

Fuel Vent Modifications

This kit contains a fitting with a check ball which closes the vent in the event that the helicopter is rolled onto its side or inverted. Applicable to all 269A,B,C and C-1 aircraft.

Part No	**For use on:**
SA-269K-101-01	Single 25 gal tank with angled vent
SA-269K-101-03	For single 25/30/35 Gal tank with vertical vent
SA-269K-101-05	For dual 49 gal system
SA-269K-101-07	For dual 65 gal system

2.12 Various attempts have also been made to improve the Hughes 300 fuel tanks susceptibility to rupturing or puncturing. These include giving the thin aluminium skinned tank a covering of fibreglass or Kevlar.

2.13 The helicopter was being flown in a private capacity by the owner pilot who held a private pilot licence. He is a kiwi fruit orchardist who arranged the flight at no cost as his contribution to a kiwi fruit co-operative that he is involved in.

2.14 It could not be established if the professional photographer was aware of the flight's private nature. The pilot and photographer did not know each other and the flight had only been arranged the day before.

2.15 Informal discussions with various police officers, media personnel and photographers since this accident reveal that few seem to be aware of the difference between private and commercial operations or the safety benefits offered by choosing various helicopter types or stipulating pilot experience levels when hiring helicopters. CAA produce a booklet available on the website and as a hard copy titled "How to Charter an Aircraft" which details the certification requirements.

3. Conclusions

3.1 The pilot was appropriately licensed and rated for the private flight.

3.2 The helicopter had a valid airworthiness certificate and had been maintained in accordance with CAA rules.

3.3 The initiating accident cause was an engine failure due to a failed con-rod, possibly as a result of an unrecorded engine overspeed.

3.4 The outcome of the subsequent autorotation to an unsuccessful emergency landing was influenced by low light conditions and terrain. They resulted in low rotor RPM leading to a heavy landing.

3.5 The severity of the heavy landing caused spinal injuries to the occupants and resulted in an immediate fire resulting in a passenger fatality and serious injuries to the pilot.

3.6 In terms of crashworthiness, this model helicopter uses old technology and is susceptible to post impact fires for which some modification kits are available to improve the crashworthiness of the fuel system. These modifications are optional, not mandatory.

3.7 The engine installed in this helicopter is noted for its high RPM operation and low tolerance to overspeed conditions. This particular engine had a history of unreliability.

3.8 Police officers, media personnel and photographers who often hire helicopters in reaction to urgent situations seem largely unaware of the benefits of various helicopter types. In addition, the legal requirements of operators to be certificated are not always understood although information detailing those requirements is readily available.

4. Safety actions

4.1 CAA conducted a presentation at the Agricultural Aviation Association conference held at Masterton in 2004 on the availability of fuel system modifications for helicopters.

4.2 CAA conducted a presentation at the Agricultural Aviation Association conference held at Rotorua in October 2006 outlining the dangers of overstressing helicopters.

4.3 CAA will, via a press release, remind the media, police and other interested parties of the requirements of certificated operators when hiring aircraft and the availability of that information via a booklet and CAA website.

4.4 As a product improvement, Lycoming engines now have up rated bearings from 8,000 pound to 12,000 pound load carrying specification to reduce bearing distress. This improvement was not as a direct result of this accident.

4.5 CAA has published an Airworthiness Directive mandating the installation of a roll over vent valve to the Schweizer 269 series helicopter. This is in line with European Airworthiness Authorities.

DCA/HU269/108 Fuel Vent System - Modification

Applicability: All models 269A, 269A-1, 269B aircraft.

Model 269C aircraft, S/Ns 1 through 1812.

Model 269C-1 aircraft, S/Ns 1 through 105.

Requirement: To prevent release of fuel from the fuel tank vent in the event of a roll-over on landing and the subsequent risk of fire, embody the applicable Schweizer Aircraft Corporation modification kit per Schweizer Service Letter L-169.

(EASA AD 2006-0171 R1 and UK CAA 002-02-2000 R1 refers)

Compliance: Before 31 December 2007.

Effective Date: 21 December 2006

Authorised by:

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