CIVIL AVIATION AUTHORITY OF NEW ZEALAND

AIRCRAFT ACCIDENT REPORT

OCCURRENCE NUMBER 98/2972

HUGHES HELICOPTERS 269C

ZK-HQZ

MANGATOATOA HUT, UREWERA NATIONAL PARK

2 NOVEMBER 1998

Glossary of abbreviations used in this report:

ATPL(A)	Airline Transport Pilot Licence (Aeroplane)
amsl	above mean sea level
C	Celsius
CA	Civil Aviation
CAA	Civil Aviation Authority
CPL(A *or* H)	Commercial Pilot Licence (Aeroplane *or* Helicopter)
E	east
ELT	emergency locator transmitter
F	Fahrenheit
IGE	in ground effect
IIC	investigator-in-charge
kg	kilogram(s)
km	kilometre(s)
lb	pound(s)
m	metre(s)
NZDT	New Zealand Daylight Time
OGE	out of ground effect
rpm	revolutions per minute
SAR	search and rescue
UTC	Coordinated Universal Time

AIRCRAFT ACCIDENT REPORT

OCCURRENCE No. 98/2972

Aircraft type, serial number and registration:	Hughes Helicopters 269C†, 840338, ZK-HQZ
Number and type of engines:	1 Lycoming HIO-360-D1A
Year of manufacture:	1974
Date and time:	2 November 1998, 1130 hours* (approx)
Location:	Mangatoatoa Hut, Urewera National Park Latitude: S 38° 31.7' Longitude: E 177° 10.0'
Type of flight:	Private
Persons on board:	Crew: 1 Passengers: 2
Injuries:	Crew: 1 fatal Passengers: 2 nil
Nature of damage:	Aircraft destroyed
Pilot-in-command's licence	Commercial Pilot Licence (Helicopter) Airline Transport Pilot Licence (Aeroplane)
Pilot-in-command's age	46 years
Pilot-in-command's total flying experience:	13091 hours, including 173 helicopter
Information sources:	Civil Aviation Authority field investigation
Investigator in Charge:	Mr H R Ritchie

†The Hughes 269 is popularly known as the "300". In mid-1983 production and product support was taken over by Schweizer; examples of the type subsequently produced are known as the Schweizer 269 or 300.

* Times are NZDT (UTC + 13 hours)

Synopsis

The Civil Aviation Authority was notified of this accident by the New Zealand Police, Rotorua, on the afternoon of 2 November 1998. The Transport Accident Investigation Commission was in turn notified by CAA but decided not to investigate. Mr H R Ritchie was appointed Investigator-in-Charge, and a CAA site investigation was commenced next day.

The helicopter was departing from a bush helipad, with three persons and their equipment on board. The take-off attempt was unsuccessful, and the helicopter did not clear the treetops adjacent to the take-off area. The helicopter fell to the ground and impacted a rocky creek bank. Neither passenger was seriously injured but the pilot received fatal injuries.

1. Factual information

1.1 History of the flight

1.1.1 The pilot and the two other men (referred to in the report as Passenger A and Passenger B) were on a hunting trip of several days duration in the Urewera National Park. The pilot was a part owner of the helicopter, and had flown it from its Ardmore base to Opotiki on 28 October. He and passenger A flew into the park next day and stayed overnight at the Te Pua Hut, Passenger B joining the party on 30 October.

1.1.2 The party relocated to the Mangatoatoa Hut after the arrival of Passenger B, the pilot making two flights to transport his companions and their equipment. The party spent the next two days hunting, using the helicopter to reconnoitre the area.

1.1.3 Departure from the Park was planned for the morning of 2 November. Passenger B reported that, the night before departure, the pilot calculated the all-up weight of the helicopter, and was evidently satisfied that with all three persons and their equipment, the helicopter would still be within its maximum weight limit.

1.1.4 Before take-off, the pilot attached a chain sling to the helicopter cargo hook and attached a jerrycan full of fuel, the pilot's pack and a deer carcass. Two empty jerrycans were also tied to the chain. One of the passengers' packs was loaded into the external cargo rack and the other placed in the cabin with three rifles.

1.1.5 After completing a pre-flight inspection, the pilot occupied the left seat, with Passenger B in the centre seat, and Passenger A in the right seat. The pilot and Passenger A had lap and shoulder harnesses at their seat positions, but Passenger B had only a lap belt.

1.1.6 The pilot carried out his normal start, warm-up and rotor engagement, then lifted off and manoeuvred to pick up the sling load. In the hover, after having picked up the load, the pilot remarked to Passenger A that the manifold pressure indication was 25 inches, and Passenger A confirmed that by his own observation.

1.1.7 The pilot turned the helicopter in the hover to face approximately south-west, in the general upstream direction of the adjacent Mangatoatoa Stream. He made the initial take-off in the same direction, but commenced a right turn almost immediately after leaving the helipad. At the same time the rotor rpm began decreasing and the helicopter descended towards the treetops ahead. Despite jettisoning the sling load, the pilot was unable to recover the situation before the helicopter struck the trees. The helicopter lost forward speed and fell nose first to the ground, impacting on the rocky bank of the stream. It came to rest semi-inverted, with the rotor head in the water.

1.1.8 Passenger A, who was not seriously injured even though his shoulder harness had broken on impact, released his seat belt and vacated the wreckage. He went around to the other side to extricate the apparently unconscious pilot from the helicopter. The pilot was still restrained by his harness, which Passenger A cut away to release him. Passenger A then moved the pilot away from the wreckage, and returned to assist Passenger B out of the helicopter.

1.1.9 The passengers moved the pilot up the bank, tried to make him comfortable and tended his injuries. Passenger A removed the ELT from the wreckage and made sure it was operating. A short time later, the pilot died without regaining consciousness, and the passengers moved their gear and the ELT back to the hut. They found the underslung load in the stream bed, about 50 metres upstream from the impact site.

1.1.10 Back at the hut, they lit a fire and waited for indications that the ELT signal had been received. About an hour after the accident, the heard the sound of an aeroplane overhead, and a further hour later, the Taupo-based rescue helicopter arrived at the scene.

1.1.13 The accident occurred in daylight, at approximately 1130 hours NZDT, at the Mangatoatoa Hut, Urewera National Park, at an elevation of approximately 2000 feet. Grid reference 260-W17-733888, latitude S 38° 31.8', longitude E 177° 10.0'.

1.2 Injuries to persons

Injuries	*Crew*	*Passengers*	*Other*
Fatal	1	0	0
Serious	0	0	0
Minor/None	0	2	

1.3 Damage to aircraft

1.3.1 The helicopter was destroyed.

1.4 Other damage

1.4.1 Nil.

1.5 Personnel information

1.5.1 The pilot held a CPL(H), first issued in March 1998. He also held an ATPL(A) first issued in 1975, with Instrument and Instructor category C and D ratings, and type ratings on Fokker F27, Boeing 737 and Boeing 767 aircraft. He held a current Class 1 Medical Certificate with no endorsements.

1.5.2 He had a total flying experience of 13 091 hours, of which 173 were on helicopters. All of the helicopter time was on the Hughes 269 type. In the 90 days prior to the accident, the pilot had flown 192 hours on Boeing 767 aircraft and 17 hours on Hughes 269 helicopters.

1.5.3 His last dual helicopter training was a two-hour flight on 21 September 1998. The Chief Helicopter Instructor of the training school that operated HQZ reported that the pilot had made several previous trips into the hills in HQZ and had done some training in heavy weight operations.

1.6 Aircraft information

1.6.1 Hughes 269C helicopter serial number 840338 was imported into New Zealand in 1984, when it was issued with a non-terminating Certificate of Airworthiness in the standard category and registered ZK-HQZ. A syndicate of five, which included the pilot, acquired the helicopter in 1996 and registered it in the name of an Ardmore-based flying school, where it was used mainly for flight training.

1.6.2 At the time of the accident, the helicopter had accrued 5078.5 hours in service. The most recent inspection, a 50-hourly, was carried out on 1 October 1998, at 5044.3 airframe hours.

1.6.3 The engine, Lycoming HIO-360-D1A, serial number RL-20762-51A, had accrued 893.6 hours since overhaul. The overhaul life of the engine was 1500 hours.

1.6.4 The aircraft maintenance records indicated that the required maintenance had been completed, although there appeared to be a discrepancy with the Annual Review of Airworthiness (ARA). The ARA was required by Civil Aviation Rules Part 91 to be completed by 1 April 1998 but was recorded as having been performed on 20 July 1998. The required ARA certification by the holder of an inspection authorisation was not apparent in the maintenance records.

1.6.5 After the accident, the IIC requested the Police to weigh the survivors and the equipment recovered. Where appropriate, estimates were made of the weight of other items that were on board the helicopter. The following is a summary of the weight of the helicopter at take-off:

Item	Weight (kg)	How determined
Empty weight ZK-HQZ	529	Flight Manual
Cargo rack	9	Flight Manual
Pilot	84	Post-mortem
Passenger A	68	Weighed
Passenger B	98	Weighed
A's packs (2)	29	Weighed
B's pack	10	Weighed
Rifles (3)	9	Weighed
Fuel (20 US gallons)	55	Estimated
Total	**891**	**(1965 lb)**
Underslung load (jettisonable)		
Pilot's pack	28	Weighed wet
Deer	35	Estimated
Chain sling	5	Estimated
Jerrycans, plastic, (3)	2	Estimated
Fuel (20 litres) in one of above	14	Known quantity
Adjustment for wet pack	-5	Estimated
Total	**79**	**(174 lb)**
TAKE-OFF WEIGHT	**970**	**(2139 lb)**

1.6.6 The normal maximum take-off weight (MTOW) for the Hughes 269C is 2050 lb (Flight Manual, Section II, Limitations). Flight Manual Supplement CSP-C-1G, "Cargo Hook Installation Kit" permits operation to 2150 lb MTOW provided that weight in excess of 2050 lb is external and jettisonable. However, a copy of this supplement was not included in the Flight Manual on board HQZ, nor was there a copy of any of the three other CAA-issued supplements relating to the installation of a cargo hook by local (New Zealand) modification. Section IX (Optional Equipment) of the Flight Manual requires at page 9-2:

"Caution – Flight operation of the aircraft with optional equipment installed is prohibited if the applicable Flight Manual Supplement is not on board the aircraft and readily available to the pilot."

1.6.7 One of the requirements in the ARA process is to ensure that the Flight Manual is the current version for the aircraft (Rule 43.153(a)(9)). This should include checking that the appropriate supplements are incorporated.

1.6.8 An additional requirement of the Flight Manual (Section II, Limitations) was a shoulder harness for the centre seat occupant. HQZ was not fitted with such a harness. CA Rule 91.109 requires that:

"No person shall operate an aircraft unless it is operated in compliance with the operating limitations specified in the aircraft flight manual."

1.6.9 The Chief Helicopter Instructor of the school advised subsequently that the school was now aware of this limitation, and that its two other helicopters of the same type were equipped with a shoulder harness at the centre seat position.

1.7 Meteorological information

1.7.1 The pilots involved in the SAR activity following the accident reported that the conditions at the site were a northerly wind up to five knots, temperature up to18ºC, relative humidity "high" and stratiform overcast cloud at about 3000 feet amsl.

1.7.2 Passenger A recalled that there was no wind apparent at the Mangatoatoa Hut before the departure of the helicopter.

1.8 Aids to navigation

1.8.1 Not applicable.

1.9 Communications

1.9.1 Not applicable.

1.10 Aerodrome information

1.10.1 The helipad at the Mangatoatoa Hut was about five metres square with the ground falling away by differing amounts on all sides. Towards the south-west, the initial take off direction used by the pilot, the ground fell away steeply into the stream, some 50-60 feet below, with terrain on the far side rising above the height of helipad and covered with large trees. To the north-west, there were large trees close by the helipad, the tops of which were approximately 50 feet above helipad level. To the south-east towards the hut, there was a drop of 10-20 feet over the 30-40 metres to the hut, with rising terrain and large trees beyond.

1.11 Flight recorders

1.11.1 Not applicable.

1.12 Wreckage and impact information

1.12.1 The helicopter wreckage was in a partially-inverted attitude on the bank of a shallow, stony stream bed. The cabin area was facing the rock bank with less than a metre between the rock and the back of the cabin. There was light, tree top foliage entangled with the rotor assembly.

1.12.2 The bulk of the transparent acrylic canopy and frames were found to the right hand side of the wreckage. Pieces of broken acrylic and other small pieces of wreckage were also found back along the flight path before the ground impact point.

1.12.3 The external load had been jettisoned and had landed 35-40 m upstream from the main impact point. The hook mechanism on the helicopter was checked and it was confirmed that the release had operated correctly.

1.12.4 The wreckage was lifted from the site and conveyed to Taupo where detailed examination and partial reconstruction were undertaken by the investigators. The main reason for the reconstruction was to try and determine why the pilot had suffered fatal injuries while the two passengers had survived virtually unscathed.

1.12.5 During the examination, it was noted that the only significant pieces of wreckage not recovered were the forward upper half of the pilot's door, door frame and the associated hinges. These had not been located with the main wreckage at the site and were not seen during the site investigation. There was evidence a severe tree-trunk impact on the airframe adjacent to the pilot's left shoulder position, as well as timber splinters and associated damage to components inside the lower part of the cabin area, below and to the right of where the pilot's legs would have been.

1.12.6 The damage to the airframe, and also to the right skid assembly, was consistent with impact marks found on one of the larger tree trunks at the accident site.

1.12.7 The wreckage was later transported to Ardmore where the engine was removed and ground run in a test rig.

1.13 Medical and pathological information

1.13.1 Post-mortem examination determined that the pilot had died of "a violent decelerating injury to the anterior chest, with fracture to the rib cage and internal injuries with haemorrhage". There were fractures to four right-side ribs and six left-side ribs, a ruptured aorta and fractures of both bones in the lower left leg. The pilot's injuries were consistent with the tree trunk impact damage to the airframe, described in 1.12.5.

1.13.2 There was no sign of any pre-existing medical condition that could have impaired the pilot's ability to operate the helicopter.

1.13.3 Routine toxicological screening detected no trace of alcohol or commonly used medicinal or recreational drugs.

1.14 Fire

1.14.1 Fire did not occur.

1.15 Survival aspects

1.15.1 Given that two of the three occupants suffered only minor injury, this accident appeared that it could have been survivable for all. However, it is evident that the difference in injuries was directly related to the airframe damage sustained prior to ground impact, when the left side of the cabin struck the tree trunk. From the extent of damage to the tree trunk and the helicopter from this impact, it was apparent that the initial impact absorbed much kinetic energy, probably resulting in a less severe ground impact than otherwise may have occurred.

1.15.2 The ELT fitted to the helicopter had activated during the impact and was instrumental in the early location of the accident site. Passenger A assisted the recovery by ensuring the ELT was operating and later repositioned it at the hut for best transmission results. He also moved the remains of the pilot's door to an open area of creek bed downstream from the wreckage as a visual indicator and later on lit a fire at the hut.

1.15.3 The first ELT signal detection was by satellite at 1136 hours; the data placed the transmission in the correct area. A subsequent pass placed it in the Rotorua area, but a third resolved the ambiguity. The National Rescue Co-ordination Centre, as soon as the signal was received, tasked an aeroplane from Taupo to conduct an electronic search. This search confirmed that there was an ELT operating, and the local rescue helicopter subsequently homed to the signal.

1.16 Tests and research

1.16.1 The engine was run in a test rig at an overhaul facility. A full-power run under load revealed that the engine maximum speed was down about 100 rpm from the normal maximum of 3200. This equated to a loss of 7-8 horsepower. There was nothing to indicate that this condition was a result of the accident.

1.17 Organisational and management information

1.17.1 Not applicable.

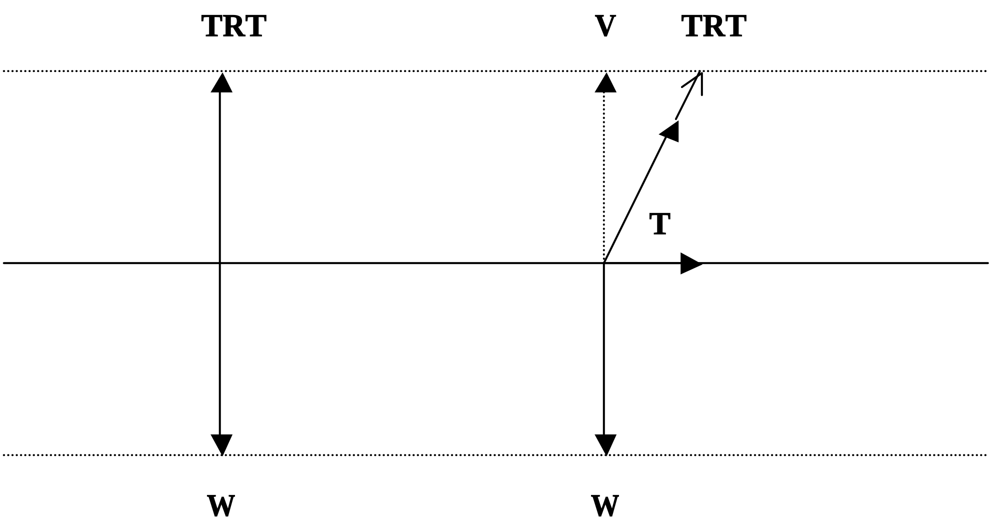
1.18 Additional information

1.18.1 The maximum power produced by a normally-aspirated engine, such as that installed in HQZ, decreases with increasing altitude. This is a function of the decreased air density at altitude, and is reflected in the manifold pressure limit placard on the instrument panel and in the Limitations section of the Flight Manual.

1.18.2 "Ground Effect" is a phenomenon encountered by helicopters in a steady hover close to the ground. The effect is greatest over a smooth surface, and is experienced from just above the ground, where it is at a maximum, and tapers off up to a height equal to about two thirds of the main rotor diameter. The modification, due to the proximity of the ground, of the downward airflow through the rotor results in greater lifting efficiency of the rotor. This requires less engine power to produce the same rotor thrust.

1.18.3 In a steady hover, total rotor thrust (TRT) is equal to weight (see Figure 1). To achieve forward flight, the TRT vector must be inclined to give a horizontal component "T" in Figure 1. For the helicopter to maintain height, the vertical component of TRT must remain at the same value as in the hover, and this will require an increase in engine power to maintain.

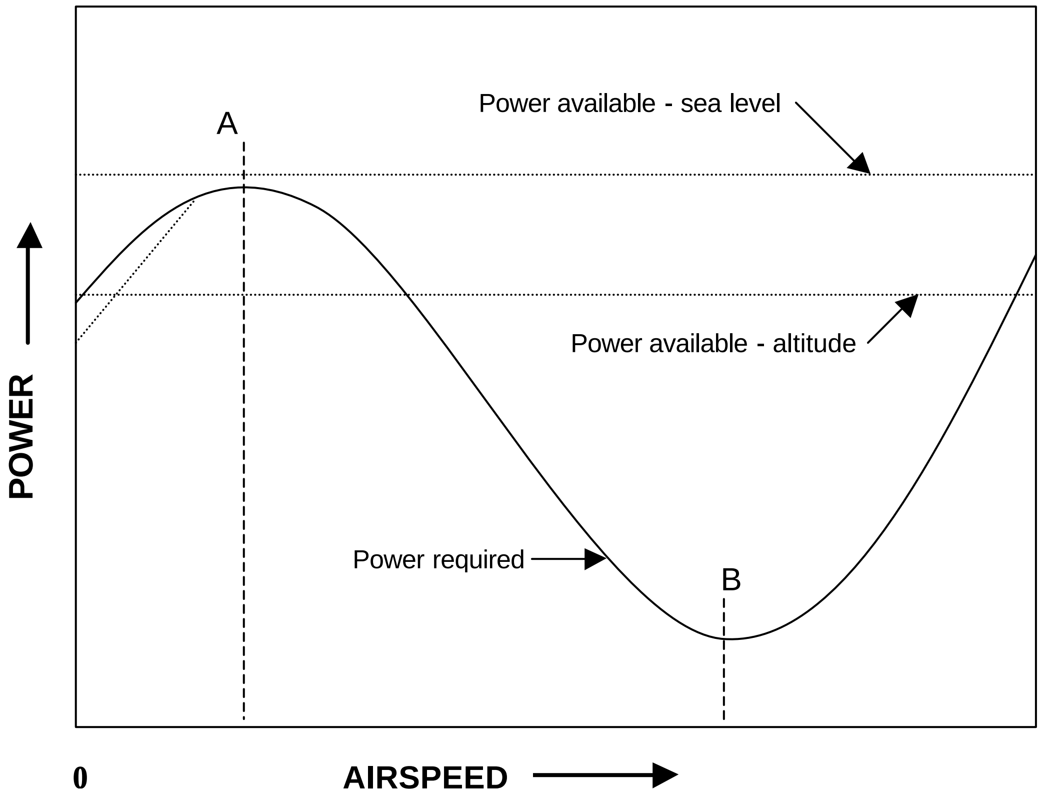
Figure 1



1.18.4 The left-hand element of Figure 1 represents the forces acting in a steady-state hover. The right-hand element depicts the forces acting in forward flight. For level flight, the vertical component "V" of the TRT must equal the weight. To achieve this, the TRT must be increased, by an amount depicted by the second arrow reaching to the upper index line. The length of the second arrow has been exaggerated for clarity.

1.18.5 At an airspeed typically between 12 and 20 knots, the rotor develops "translational lift" as a result of the forward speed, thus requiring less engine power to produce the required TRT. The engine power required decreases with increasing airspeed (and translational lift) up to about 45 knots, above which (mainly) airframe drag will require an increase in engine power. This is depicted in Figure 2, where the zero-airspeed end of the "power required" curve represents the helicopter in a hover, A is the speed of onset of translational lift, and B is the minimum drag speed.

Figure 2



1.18.6 The effect of altitude on power available described in 1.18.1 is also depicted in Figure 2. Power available is virtually constant with changing speed, hence the straight "power available" lines. Hovering IGE requires less power than hovering OGE, and this is represented by the dotted portion of the "power required" curve. The presence of wind will provide translational lift, and if the wind is strong enough, can considerably reduce the power required to hover.

1.18.7 The relationship between the "power required" curve and the applicable "power available" line will determine what type of take-off technique is required. For example, if the "power required" curve is entirely below the "power available" line, there is no take-off restriction; a vertical climb may be performed if required. The other extreme is where that part of the "power required" curve at A is located above the "power available" line. In that case, only a running take-off could be performed.

1.18.8 In the case of HQZ, the pilot found that he required 25 inches manifold pressure to maintain the hover. Referring to the manifold pressure limit placard on the instrument panel (see Figure 3) would have indicated to him that the manifold pressure (MP) limit applicable at a pressure altitude of 2000 feet and an outside air temperature (OAT) of 60º F was 25.6 inches. This margin of 0.6 inches, assuming that manifold pressure could actually be achieved, would, at best, permit only a very shallow departure profile. To ensure that the expected power was available, the pilot could have performed a full-power check before committing himself to the take-off, but does not appear to have done so.

1.18.9 A full-power check can be made from the hover by applying collective pitch until the rotor rpm just begin to decrease, noting the manifold pressure at this point, then lowering the collective pitch lever to return to the hover. An alternative strategy is to take off at a reduced weight and check the power available once established in the climb. The latter method will also give the pilot the opportunity of assessing the suitability of the intended departure path.

	ALT. \ O.A.T. °F	0	20	40	60	80	100
LIMIT M.P.	S.L.	24.1	24.7	25.4	26.0	26.6	27.2
	2000	23.7	24.3	25.0	25.6	26.2	F.T.
	3000	23.5	24.1	24.8	25.4	F.T.	F.T.
	4000	23.3	24.0	24.6	F.T.	F.T.	F.T.

Figure 3

1.18.10 One of the pilots involved in the SAR activity following the accident told the IIC that he had flown HQZ for about 11 hours in late August 1998, only two months prior to this accident. This pilot had 700-800 hours experience on Hughes 269 helicopters in heavy weight operations, and he described the performance of HQZ as “below average in terms of power”.

1.18.11 Section VIII (Additional Performance and Operations Data) of the Flight Manual contains a performance graph at page 8-2: “Hover Ceiling Out of Ground Effect Versus Gross Weight”. This graph is reproduced at Appendix A, and indicates that, at a normal maximum gross weight of 2050 lb (the upper limit on this graph), the helicopter would be only just capable of an OGE hover at 2000 feet pressure altitude and an OAT of 60º F.

1.18.12 With reference to the graph annotations “no muffler” and “no abrasion tape”, HQZ was fitted with a muffler, which reduces the hover ceiling by about 200 feet. The rotor blades did not have abrasion tape fitted. The effects of a muffler and of abrasion tape on performance are found in Section V (Performance) of the Flight Manual.

1.18.13 Flight Manual Supplement CSP-C-1G (Cargo Hook Installation Kit) contains a hover ceiling graph predicated on a six-foot hover height, which is in ground effect. Given that the majority of sling load operations are conducted out of ground effect, this graph would not have been relevant to the accident flight, even had it been included in the Flight Manual. However, reference to this graph suggests that HQZ would have been capable of maintaining a six-foot hover at a maximum weight of 2100 lb at 2000 feet and 60º F. This graph is reproduced at Appendix B.

1.18.14 Where a pilot attempts to take off with little or no surplus power margin available, a situation known as "overpitching" can occur. Raising the collective pitch lever will, up to a point, increase engine power to maintain rotor rpm. This is achieved by mechanical linkage between the collective pitch lever and the fuel control unit. When no further power is available, an increase in collective pitch will result in a loss of rpm, which, if not corrected immediately, can rapidly become irrecoverable.

1.18.15 The normal recovery technique is to reduce collective pitch, checking at the same time that the twist-grip throttle is wide open. In a situation involving a descent towards trees or other obstacles, this can require a great deal of self-discipline on the part of the pilot. A supplementary action, which requires space in which to manoeuvre, is to apply right yaw pedal. This reduces the power required to drive the tail rotor, thus making more available to the main rotor and this can aid rpm recovery. (Note: this applies to helicopters on which the main rotor turns anticlockwise as viewed from above.)

1.18.16 On the other hand, a reduction in rotor rpm can cause an involuntary right yaw. The tail rotor turns at a fixed ratio of main rotor rpm, and when rpm reduce, the tail rotor effectiveness also reduces. This can result in insufficient tail rotor authority to overcome the tendency of the fuselage to rotate in the opposite direction to the main rotor blades.

1.18.17 In this accident, it was not possible to determine whether the right turn after take-off was voluntary or involuntary.

1.19 Useful or effective investigation techniques

1.19.1 Nil.

2. Analysis

2.1 The pilot-in-command was appropriately licensed and qualified to fly the helicopter. He had a reasonable level of total and recent experience on helicopters. However, in comparison with his nearly 13 000 hours on large transport aircraft (turboprop and turbojet), his helicopter experience of 173 hours was relatively small.

2.2 Operations in large transport aircraft are conducted in accordance with scheduled performance requirements and limitations, which allow safety margins for variations in aircraft performance, pilot ability and environmental factors. Operations in light helicopters are not always conducted in the same way. In many cases, very little performance information is available to the pilot.

2.3 In the case of this accident, it is not known if the pilot made reference to such performance graphs as were available to him. Had he done so, the fact that take – off performance was likely to have been at best marginal should have been apparent before he attempted the flight. Immediately prior to take-off, he had the opportunity to perform a full-power check but does not appear to have done so.

This would have given him an unequivocal measure of the power margin available and may have caused him to reconsider the take-off attempt.

2.4 Additionally, had the pilot complied with the Flight Manual limitation requiring that the centre-seat passenger wear a shoulder harness, two trips would have been necessary to carry the two passengers, with a consequent reduction in load.

2.5 In the event, the pilot took off from an OGE hover, with an attempted climb combined with a right turn immediately after take-off. Clearly, the available power margin was insufficient to support this course of action, and the attempt failed. However, there were other options available which may have avoided the accident, as explained in the following paragraphs.

2.6 To achieve any climb performance at all in the circumstances, translational lift would have been required. In the hover, the helicopter was facing in the general upstream direction of the adjacent stream, with relatively clear space ahead. A more prudent course would have been to maintain this direction while accelerating carefully, maintaining height until translational lift was encountered, and then establishing a climb when it was evident that sufficient performance was available.

2.7 Even discounting the reference to the shoulder harness limitation in 2.4, the marginal take-off could have been avoided by splitting the load into two, and flying to a less confined area from where a shallower-profile take-off could be made.

2.8 Additionally, as the helipad elevation was above the level of the stream, there may have been some scope for the pilot to utilise a slight descent to assist the acceleration. Referring back to Figure 1, it will be evident that the more the nose of the helicopter is lowered, the more the inclination of the TRT vector, with a consequent larger increase required to maintain the vertical component. If there is insufficient power margin available to maintain the vertical component and thus balance the weight, then the helicopter must descend.

2.9 Attempting to turn before encountering translational lift will exacerbate the situation, as the TRT vector will be tilted sideways as well as forwards, requiring an additional increase in TRT just to maintain height. Again, with no power margin available, the helicopter will descend.

2.10 By attempting to climb away immediately, the pilot probably also induced an overpitching situation. This, combined with an attempted turn towards an area with no space in which to recover the situation, would lead inevitably to the collision with the trees.

2.11 The reason for the right turn, that is, whether it was a causal factor or an effect of the reduced rpm, could not be determined, so it is not possible to recreate the exact sequence of events.

3. Conclusions

3.1 The pilot was appropriately licensed and experienced for the series of flights being undertaken.

3.2 The helicopter had been operating normally up to the time of the accident.

3.3 The pilot attempted to take off at a weight that left little or no performance margin.

3.4 A full-power check would have given the pilot a precise indication of the performance margin available, but there was nothing to suggest such a check was made.

3.5 The attempted take-off profile would have eroded any available performance margin to the point where overpitching probably occurred, leading to the loss of rotor rpm.

3.6 It was not possible to determine whether the pilot deliberately turned right or was compelled to after the loss of rpm.

3.7 A descent was then inevitable, with no space in which to recover.

3.8 The accident could have been avoided had the pilot divided the load in two, combining it again at a more suitable landing and take-off area.

3.9 Compliance with the Flight Manual limitation requiring a shoulder harness for the centre seat occupant would have resulted in the division of the load.

4. Safety recommendations

4.1 Nil.

Richard White
(Acting) Assistant Director Safety Investigation and Analysis
4 April 2000

APPENDIX A

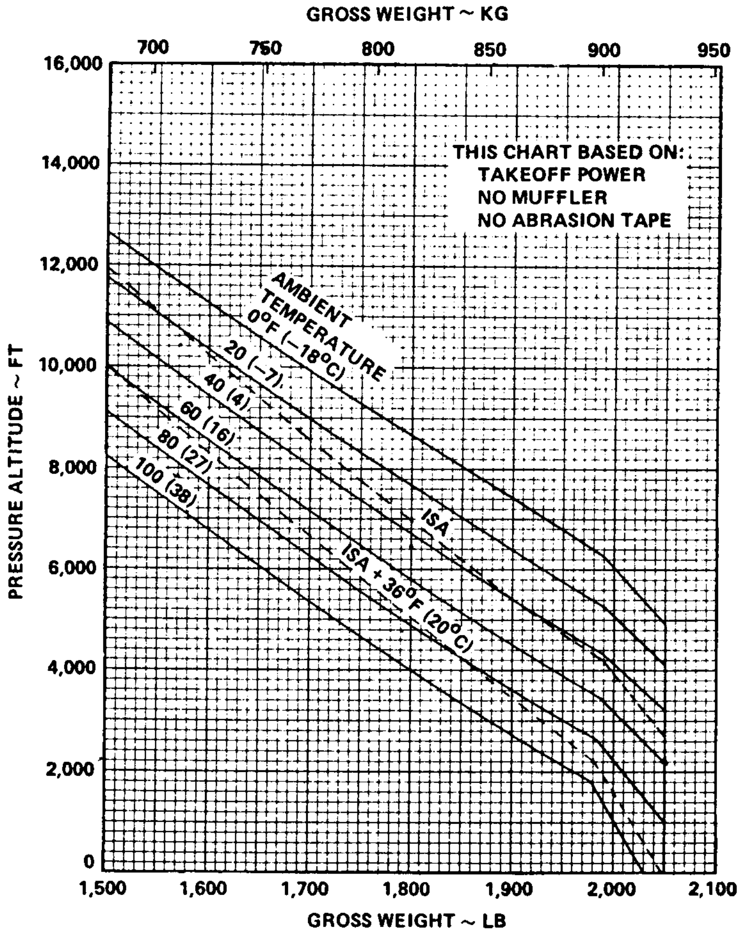


Figure 8-1. Hover Ceiling Out of Ground Effect Versus Gross Weight
(3200 rpm)

APPENDIX B

SCHWEIZER MODEL 269C SERIES HELICOPTERS
CSP-C-1G

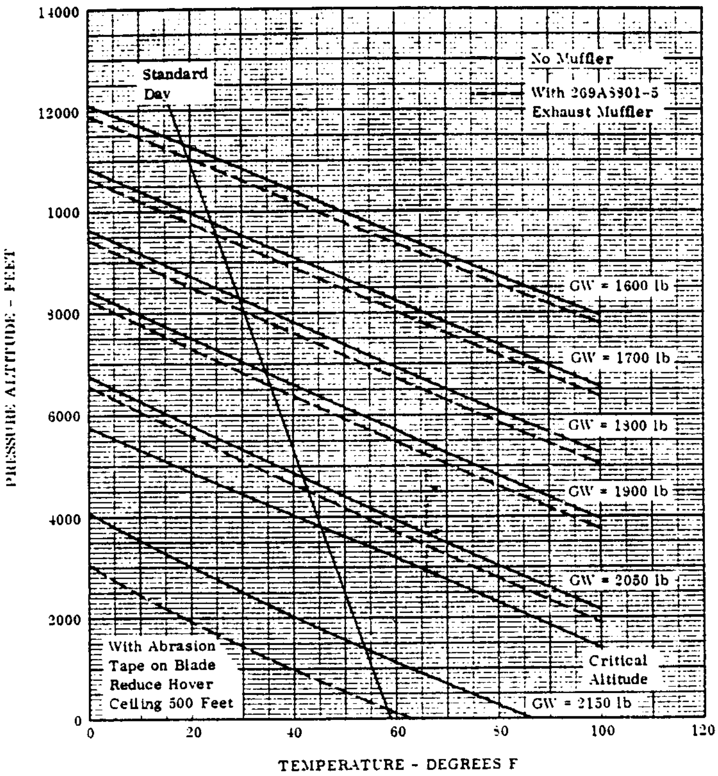


Figure 3-1. In Ground Effect Hover Ceiling Versus Temperature
(6-foot skid height, 3200 rpm)