TRANSPORT ACCIDENT INVESTIGATION COMMISSION
TE KOMIHANA TIROTIRO AITUA WAKA

AIRCRAFT ACCIDENT REPORT

No. 92-014

Aerospatiale AS 350B

ZK-HWW

Glenfalloch Station,
Upper Rakaia

10 July 1992

Transport Accident Investigation Commission
Wellington · New Zealand

Price $11.10 (including G.S.T.)

ISSN 0112-6962

TRANSPORT ACCIDENT INVESTIGATION COMMISSION

AIRCRAFT ACCIDENT REPORT No. 92-014

Aircraft Type, Serial Number and Registration:	Aerospatiale AS 350B, 1299 ZK-HWW
Number and Type of Engines:	1 Turbomeca Arriel 1B
Year of Manufacture:	1980
Date and Time:	10 July 1992, 1110 hours NZST
Location:	Glenfalloch Station, Upper Rakaia Latitude: 43°18'S Longitude: 171°13'E
Type of Flight:	Air Transport (Heli skiing)
Persons on Board:	Crew: 1 Passengers: 5
Injuries:	Crew: 1 Nil Passengers: 5 Nil
Nature of Damage:	Substantial
Pilot in Command's Licence:	Commercial Pilots Licence (Helicopter)
Pilot in Command's Age:	50
Pilot in Command's Total Flying Experience:	14000 hours 600 on type
Information Sources:	Transport Accident Investigation Commission field investigation
Investigator in Charge:	Mr D G Graham

1. NARRATIVE

1.1 On Friday 10 July 1992 the pilot arrived at Glenfalloch Station at about 0930 hrs to prepare for the day's heli-skiing operations. ZK-HWW had last been flown on Monday 6, July 1992 (for an uneventful 2.2 hours on heli-skiing work) and had since remained parked in the open in its normal location on a prepared area of shingle adjacent to the refuelling facility. The main rotor blades, tail rotor, and engine intake were protected with fitted PVC covers suitably positioned and secured.

1.2 During the week snow had accumulated to a depth of 30 cm on the exposed parts of the parked helicopter. A thick layer covering the main rotor blades had been removed by the station owner as soon as practicable on Thursday following a heavy snowfall during the night.

1.3 The pilot noted on arrival that there was a large accumulation of snow on the rotor head and on the engine cowls and engine intake cover. He had been alerted regarding the amount of snow which had earlier settled on the main rotor blades and took special care to check the rotor head assembly thoroughly. To avoid loose snow falling into the transmission cowl he did not sweep the rotor head cover at this time, believing that the pile of snow would be thrown clear once the rotors were turning.

1.4 After removing the covers from the main rotor blades and the tail rotor, the pilot uncovered the engine air intake, tipping the snow off to one side carefully and checking visually that the intake duct itself was clear. Fuel samples from the main tank and engine fuel filter were tested and found free from water.

1.5 At about 0950 hours the pilot started the engine to carry out a ground run. The start cycle was normal with a maximum TOT of 760°. There was slight initial vibration due to the residue of ice and snow on the rotating blades and the pilot accelerated cautiously through the vibration range to normal ground idle, continuing to governed RPM once the vibration decreased. Governed RPM was maintained for about five minutes before power was reduced again to ground idle. All engine indications were normal and the heater was selected on full to dry out the cabin and warm the cockpit transparencies. After about ten minutes at ground idle the engine was shut down.

1.6 Following the arrival of the heli-ski party some 35 minutes later, the pilot conducted a pre-flight inspection and used a broom to remove remaining snow from the cabin roof. It appeared that the snow had gone from the rotor head cover. He was satisfied that there was no snow lying on the transmission deck or within the engine bay. All oil levels were normal. The subsequent engine start was uneventful, producing a maximum TOT of about 800° and the pilot lifted ZK-HWW from the parking site and hover taxiied the 50 m to the raised passenger loading platform. All indications were normal. After landing the pilot remained in the aircraft with the engine running while the heli-ski guide loaded the equipment, assisted the four passengers to strap into the rear seats and then seated himself in the front left seat.

1.7 ZK-HWW was fitted with a ski-pod on the left side. The 50% fuel load, skis and survival equipment, and the six occupants brought the all-up weight close to the maximum authorised take-off weight of 1950 kg.

1.8 The loading process took approximately five minutes. After completing the standard pre take-off checks, the pilot lifted ZK-HWW to a low hover and confirmed, as anticipated, that 80% power was required to maintain a 2 to 3 foot skid height above the pad.

1.9 There was considerable loose blowing snow so the pilot carried out a towering take-off. Power was increased to 82 — 83% and the helicopter was allowed to gain height before achieving significant forward speed. Once clear of the cloud of blowing snow the pilot lowered the nose to commence translation.

1.10 At about 200 feet above ground level with the airspeed increasing between 35 knots and 40 knots, the aircraft's nose unexpectedly "twitched" right, the audio warning sounded and panel lights flashed.

1.11 Realising that an engine failure had occurred the pilot lowered collective, maintained forward airspeed and set up an autorotative descent straight ahead. The aircraft had been climbing above a large paddock and the unbroken expanse of snow and the flat light conditions made it difficult to judge height above the surface.

1.12 The pilot had not raised collective completely to arrest the descent, when the helicopter contacted the ground heavily and slid for some distance in the soft snow before coming to rest.

1.13 After checking that no one was injured the pilot switched off the electrics, stopped the main rotors with the rotor brake and told the passengers to vacate the aircraft. During the shutdown checks the pilot confirmed that although the engine appeared to have stopped, the fuel lever was still in the normal governed position. The emergency locator transmitter had activated and was turned off manually shortly after the event.

1.14 The engine failure occurred approximately 250 m north west of the take-off pad which was located at an elevation of about 2000 feet amsl. There was little wind at the time. The local weather was clear with some cloud cover at about 6000 feet on the surrounding hills. At Glenfalloch the sun was just beginning to break through. Estimated ground temperature was +1°C to +2°C.

1.15 Ground impact occurred in a level attitude. Both skids collapsed but the helicopter remained upright, rebounding and sliding for 60 m. Damage was confined to the skid assembly, the lower fuselage panels and frames and the tailboom. The tail rotor was damaged severely due to ground contact and the drive shaft distorted.

1.16 ZK-HWW was examined in situ on the morning following the accident. No damage was evident to the compressor assembly. Fuel samples were free from contamination and the main fuel filter was clean. After appropriate engineering inspection and disconnection of the damaged tail rotor drive shaft an engine test run was carried out. All indications were normal during the start cycle and the engine ran satisfactorily at ground idle. Three successive runs were carried out, the engine lighting off successfully and sustaining ignition in each case. All instrument indications were in accordance with normal running.

1.17 Subsequently the engine was removed from ZK-HWW for strip examination and overhaul by the manufacturer's approved agent in Australia. Some turbine wheel rub had resulted from the heavy landing but no evidence

was found to suggest any engine abnormality or malfunction. Fuel system components exhibited some minor performance variations consistent with the hours run but no defects were disclosed which might have contributed to a sudden loss of engine power or to cause a flame out.

1.18 Total airframe hours at the time of the accident were 6008 with 2239 hours since last overhaul. 24.8 hours had been flown since the last routine inspection on the airframe and engine.

1.19 The Bureau Enquetes Accidents (Office of Air Accident Investigation — France) reported that during the 1985/1986 winter in Europe, four AS350B helicopters had experienced engine flame-out under similar circumstances to the accident involving ZK-HWW. Each of these helicopters had been parked in conditions of falling or blowing snow, generally with proper covers installed. Each of the take-offs were conducted in good weather. The investigations revealed two different types of ingestion leading to flame-out:

(i) Ingestion of snow which had not been completely removed from the cowlings or other parts of the airframe.

(ii) Ingestion of ice from the air inlet duct. In certain conditions the snow can begin to melt then re-freeze in the duct.

In the case of ice ingestion one or more compressor blades sustained damage. Such damage was not generally evident where snow had caused the flame-out.

1.20 Service Letter No. 622-30-84, entitled "Ice and Rain Protection — Operating helicopters subsequent to unsheltered Parking in Snowy Conditions" had been issued by Aerospatiale in February 1985 to remind operators of basic precautions to be observed in such circumstances. Two further Service Letters applicable to the AS350 series were issued during 1986 re-emphasising the recommended precautions and suggesting further procedures to minimise the likelihood of engine flame-out due to snow or ice ingestion. These were Service Letters Nos. 743-05-86 and 784-05-86 "Preparation for Flight After Parking in Falling Snow".

1.21 During 1991, an accident in France resulted when ice within the air inlet duct, which had not been cleared before flight, was ingested into the engine. To again draw the attention of operators to the matter, Aerospatiale re-issued Service Letter 784-05-86 in December 1991. This contained the following information:

"Preparation for Flight After Parking in Falling Snow.

We still have uppermost in our memories the accidents which occurred during the winter 1985/1986 and were due primarily to insufficient snow clearance after parking in falling snow.

In the hope of preventing further accidents of this type we would like to take this opportunity of reminding you of the recommendations which have been added to the Maintenance Manual, Card 05-21-00-605, ie.

— Remove the air intake and the tail pipe covers, once the aircraft is free from snow.

— Remove the snow or ice accumulated close the air intakes, on either side of the screen and inside the engine air intakes.

— Remove the engine cowl.

— Clean the air intake (mandatory)

case of ice build up:

- Use a wooden or plastic scraper to remove it.
- Wipe clean using a cloth soaked in Isopropanol.

— Using a hand-mirror check that no snow or ice remains in the air intake up to the compressor 1st stage.

— Check free rotation of the generator.

These operations are facilitated by compliance with Service-Bulletin no. 30.04 (AMS 07-1537), which enables the engine cowling to be left in place.

It should be possible to ensure safe operation of AS350B aircraft in wintry conditions by fully informing the maintenance staff and the crews, who often operate alone."

1.22 The Bureau Enquetes Accidents also provided information concerning an accident involving an AS350B helicopter in Japan which experienced flame-out while filming for a TV programme in severe snow storm conditions. The evidence from this accident, and protracted testing by the helicopter manufacturer of the operation of the Arriel engine in loose blowing snow, suggested that problems were likely to occur only under extreme conditions. Limitations to cover such conditions are currently the subject of discussions between the manufacturer and the French Airworthiness Authority.

1.23 Service Letter No. 1094-00-91 issued by Aerospatiale in January 1992 summarised this aspect of AS350B operations as follows:

"Flight In Falling Snow.

We would like you to call your special attention to two cases of engine flame-out which occurred due to the accretion of snow while the aircraft were flying in heavy snowfall and in limited visibility conditions.

We have not succeeded in reproducing the phenomenon encountered in service during the flight tests which have been performed since we were informed of these two accidents.

Pending the results of the investigations in progress, we would like to make a point of reminding our operators of the need to ensure strict compliance with the visibility limitations characteristic of flights in VMC conditions."

1.24 It was evident from investigation of previous accidents that a potential existed for a flame-out if a quantity of snow, or ice, from the airframe of the AS350B helicopter was ingested by the engine.

1.25 While preparing ZK-HWW for flight the pilot had removed all snow from the vicinity of the engine intake carefully, and had ensured that the inlet duct was clear. The accumulation of snow which he had noted earlier on the rotor head cover appeared to have been thrown off, as expected, during the initial start and ground run. However, the pilot later considered it possible that in viewing the rotor head cover in the flat light conditions a residual layer or "cap" of snow may have merged with the cloudy background and could have been overlooked during the pre-flight inspection.

1.26 In the absence of other evidence to account for the engine failure, the lack of damage to the compressor section and the general circumstances and sequence of events supported the conclusion that as ZK-HWW gained speed in forward flight shortly after lift-off, sufficient snow was ingested into the engine intake duct to result in flame-out.

1.27 No photographs or video records were available to confirm the pilot's suggestion that a cap or layer of snow may have remained on the rotor head cover at the time of departure. However the location of the engine intake grid aft of the rotor head and below its level rendered it feasible that some residual snow dislodged from the rotor head cover could have been ingested. The combination of the helicopter's low nose attitude, forward acceleration, and high downflow through the rotor system as ZK-HWW departed from the take-off pad increased the probability that snow from the rotor head cover could have been drawn into the engine at that time.

1.28 The Bureau Equetes Accidents advised that the technology associated with the fuel injection of the Turbomeca Arriel precluded the incorporation of an auto-reignition system on this design of engine.

2. FINDINGS

2.1 The pilot in command was appropriately qualified to conduct the flight.

2.2 The pilot was experienced in operating the helicopter in a snowy environment.

2.3 Prior to the accident the helicopter had been parked in the open in conditions of falling snow.

2.4 The pilot had removed residual snow from the cabin roof and the vicinity of the engine intake and had checked that the intake duct was clear.

2.5 The possibility existed that a layer of snow remained on the rotor head cover.

2.6 Shortly after lift-off the helicopter's engine flamed out. The helicopter was damaged in the ensuing autorotational landing.

2.7 The probable cause of the flame-out was the ingestion of a quantity of snow dislodged from the rotor head cover on departure.

11 February 1993

M F DUNPHY
Chief Commissioner