

List of Aircraft Accident Reports issued by AIB in 1976

Date of Publication

Short title

No.

(Continued)

Sikorsky S-67 Blackhawk, N612A at
Lambourn, Berkshire, England
September 1974

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Department of Trade

ACCIDENTS INVESTIGATION BRANCH

**Hughes 269C Helicopter G-BABN
Report on the accident at Beech Farm,
near Barnby Moor, Nottinghamshire
on 15 January 1975**

LONDON
HER MAJESTY'S STATIONERY OFFICE
1976

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<i>No.</i>	<i>Short title</i>	<i>Date of Publication</i>
1/76	Sikorsky S-67 Blackhawk N671SA at Farnborough, Hampshire, England September 1974	<i>(forthcoming)</i>

ACCIDENTS INVESTIGATION BRANCH

Hughes 369C Helicopter G-BABN
Report on the accident at Beech Farm,
near Hornby Moor, Nottinghamshire
on 12 January 1975

Department of Trade
Accidents Investigation Branch
Shell Mex House
Strand
London WC2R 0DP

6 February 1976

The Rt Honourable Peter Shore MP
Secretary of State for Trade

Sir,

I have the honour to submit the report by Mr P J Bardon, an Inspector of Accidents, on the circumstances of the accident to Hughes 269c Helicopter G-BABN which occurred at Beech Farm, near Barnby Moor, Nottinghamshire on 15 January 1975.

I have the honour to be
Sir
Your obedient Servant

W H Tench
Chief Inspector of Accidents

Aircraft: Hughes 269C Helicopter G-BABN

Engines: Lycoming H10-360-D1A

Registered Owner and Operator: Point to Point Helicopters Ltd

Crew: One – killed

Passenger: One – killed

Place of Accident: Beech Farm, near Barnby Moor, Nottinghamshire
53° 21' 30''N 01° 01' 09''W

Date and time: 15 January 1975 at 1329 hrs

All times in this report are GMT

Summary

Whilst it was engaged on a gas pipe line survey in the East Midlands area the aircraft was seen to go out of control and crash. On impact the aircraft broke up and both occupants were killed; there was no fire.

The accident resulted from the failure of the tail rotor spar and the consequent detachment of one of the rotor blades. The failure was due to fatigue, originating from severe corrosion pitting of the tail rotor blade steel spar at the aerofoil root.

1. Investigation

1.1 History of the flight

The helicopter was engaged on a routine aerial pipeline inspection for the East Midlands Gas Board. For this purpose an employee of the Gas Board was being carried in the aircraft as an observer.

The aircraft had flown twice during the morning and had then landed at Doncaster Airport to refuel. It took off again at 1315 hrs and the pilot called RAF Finningley Air Traffic Control to advise that he was intending to carry out an inspection of the pipeline between the west of Doncaster and East Retford and that he would be flying at 500 feet above ground level.

At 1329 hrs the helicopter was seen about 1 nm north of the village of Barnby Moor and to be flying quite normally in a south easterly direction, close to and on the south side of some power cables which lay parallel to its track. It then suddenly appeared to go out of control and rotate rapidly to the left and at the same time descend at a high rate into the ground. Both occupants were killed on impact and the aircraft was destroyed. There was no fire.

1.2 Injuries to persons

<i>Injuries</i>	<i>Crew</i>	<i>Passengers</i>	<i>Others</i>
Fatal	1	1	—
Non-fatal	—	—	—
None	—	—	—

1.3 Damage to aircraft

Destroyed.

1.4 Other damage

None.

1.5 Crew information

Pilot: Aged 32.

Licences: Commercial pilot licence (Helicopters/Gyroplanes) with aircraft rating A and B for Hughes 269, and limitations restricting the holder to day flying only and not out of sight of ground or water nor by sole reference to instruments.

Flight radio-telephone operators licence.

Neither of these licences had been signed by the holder but were otherwise valid.

Medical: Medical certificate Class One issued on 23 January 1974 valid for 12 months.

Flying experience: Total all types – 1,144 hours.

Total Helicopters – 996 hours.

Total Hughes 269 and 300 – 546 hours.

Last proficiency check – 9 August 1974. Had completed over 400 pipeline survey flights.

1.6 Aircraft information

(a) Type: Hughes 269C.

Registration: G-BABN.

Date of manufacture: 1972.

Certificate of airworthiness: In the General Purpose Category: Valid until 19 September 1976.

Certificate of maintenance: Valid until 7 February 1975 or on the completion of 786 flying hours. The aircraft was maintained in accordance with an approved maintenance schedule, ARB/GPMS/H 1971 Issue 3.

Total airframe hours: 735 hours 14 minutes.

Hours since last inspection (Check 2): 48 hours 56 minutes.

Maximum total weight authorised: 862 kg.

Accident weight: Not determined.

Accident C of G: Not determined.

Fuel type: AVGAS 100 L.

Fuel on board at time of accident: 30 gallons (estimated).

(b) The tail rotor assembly on the aircraft was installed at the time of manufacture. The approved maintenance schedule required only a visual inspection of the assembly but this would not have revealed any signs of internal corrosion or cracking of the tail rotor blade spars.

The tail rotor assembly was scheduled for replacement on the completion of 9,000 hours flying.

1.7 Meteorological information

According to eye witnesses the weather in the area of the accident was fine with good visibility though with a fairly strong gusty wind from a westerly direction. The weather was not considered to have been a factor in the accident.

1.8 Aids to navigation

Not applicable.

1.9 Communications

The pilot was in radio communication with Finningley ATC on 120.35 MHz, for a period of about one minute, just after leaving Doncaster, approximately 14 minutes before the accident. This communication, which was routine, gave brief details of the initial stages of the intended flight for this survey. There was no other radio contact with the aircraft during the flight.

1.10 Aerodrome and ground facilities

Not applicable.

1.11 Flight recorders

Not required and none fitted.

1.12 Examination of the wreckage

1.12.1 Accident site

The aircraft crashed on very soft ground in a ploughed field, some 200 yards to the north of the power cables alongside which it had been flying. No part of the aircraft had struck the power cables themselves. The initial impact was taken by the left skid, which broke off together with the forward part of the right skid. The attitude of the aircraft at impact had been substantially level.

After the initial impact, the aircraft nosed over and disintegrated, coming to rest some 15 yards further on in an inverted position. All three main rotor blades, which were still attached to the transmission mast, showed evidence of rotation at the time of impact. The engine had torn free of the main wreckage, and from marks on the fly wheel, it was evident that it had been rotating when the aircraft had struck the ground.

The tail rotor transmission torque shaft had failed in bending and torsion at the forward end of the tail boom. This unit also showed evidence of rotation prior to impact. Some components of the tail rotor assembly were missing and could not be found. It is probable that these had become buried in the soft ploughed surface of the field.

The two red and white painted tail rotor blades together with a navigation bag belonging to the crew and a large piece of cockpit canopy were found 185 and 260 yards respectively to the south west of the main site and on the south side of the power cables. The tip of one of the blades was missing and this was subsequently found close to the main wreckage.

A red jockey type cap, the right hand side of which had been cleanly severed, was found in the main wreckage.

1.12.2 *Subsequent examination*

An examination of the tail rotor blades indicated that the tubular steel spar of one of the blades had failed at a fracture which had originated from a fatigue crack located on the trailing edge and extending some 120 degrees around the circumference. The remainder of the fracture was due to overload in tension. There was also some marked corrosion pitting to a depth of 18 per cent sectional thickness on the outside of the spar in the area of the fatigue. One side of the first tail rotor blade to detach had abrasions consistent with a high speed contact. Some red fibres were also found in the torn end of this blade, and on microscopic examination were found to correspond with the material of the pilot's cap. The other blade was almost unmarked. The pitch arm and drive fork bearing were still attached, but the spindle carrying the bearing had been pulled through the shaft and severely bowed. There were no defects found on the tail rotor transmission itself and the condition of both tail bearings and the shaft lever gear was normal.

Red and white paint smears were found on the left upper cyclic control rod and also on numerous fragments of cockpit canopy. Some flakes of white paint were also found on the pilot's cap.

The fuel shut-off valve was found in the closed position, but there were indications that it had been moved to that position by impact forces. The fuel shut-off control in the cockpit was in the ON position.

No other defects that could have had a bearing on the accident were found and all mechanical damage to the controls occurred during the in-flight break up and on impact with the ground.

The collective pitch lever was approximately 5 cm from the full down position and the throttle twist grip was closed.

1.13 **Medical and pathological information**

Both occupants of the aircraft died from multiple injuries sustained in the accident. The injuries to the pilot included one to the back of his head.

1.14 **Fire**

There was no fire.

1.15 **Survival aspects**

The accident was not survivable. Both occupants were secured by lap straps only and these had been torn from their anchorages. Both lap straps were found to be fastened.

1.16 **Test and research**

Nil.

1.17 **Other information**

1.17.1 *Subsequent preventive action*

On the morning of 16th January, when examination of the tail rotor blades indicated the possibility of fatigue failure, the operator was advised by telephone that an immediate

inspection of all their Hughes 269C helicopters should be carried out with respect to the tail rotor assemblies. In view of the location of the suspected fatigue crack on the examined tail rotor, it was also suggested that X-ray checks should be undertaken since visual inspection would not be effective.

After confirmation of the fatigue failure by metallurgical examination on 20th January, the Civil Aviation Authority was immediately informed by telephone. The Authority telexed all UK operators of Hughes 269 and 369 Helicopters on the same day, requiring the removal and X-ray inspection of tail rotor assemblies for corrosion. Any that were found to be corroded were to be withdrawn from service. Copies of the telex were forwarded to Hughes Helicopters USA and the FAA Western Region and later confirmed in writing, giving details of the X-ray inspection.

The result of the check was as follows:

Blades examined by X-ray	30
Blades with X-ray indication of corrosion	8

In addition, visual examination of the blade spar bore gave the following results:

Blades visually examined	30
Blades rejected for corrosion of bore	14

Within the above data, are included the findings of the operator of G-BABN. These are detailed below:

Blades examined by X-ray	8
Blades with X-ray indication of corrosion	5

In addition, one blade was rejected for X-ray indication of a material flaw, and one blade was rejected during visual inspection for corrosion of the bore.

1.17.2 *Corrosion protection of the tail rotor spar*

The manufacturer has stated that the corrosion and pitting seen on the tail rotor blades inspected at its laboratory had resulted from a combination of a slightly permeable organic finish; imperfections in the surface treatment of the spar before the bonding process; and a highly corrosive atmosphere. However, the manufacturer found that none of the spars inspected appeared to have 'the corrosion of a sharp line' as seen on the spar of G-BABN. It was assumed that the corrosion in this instance must have resulted from a different set of conditions, possibly aggravated by a crack in the protective coating.

The manufacturer has stated that the blades now being produced have an additional coating of EPON followed by 'a second bake operation to ensure total coverage'. The EPON itself has been changed to 'a 10 per cent solids formulation' as compared to the previous 5 per cent. Furthermore, the interior is protected additionally by ZINCILATE, a finish rich in zinc dust.

1.17.3 *Remedial action taken*

The manufacturer has confirmed that detrimental corrosion can occur both inside and outside of the steel rotor blade spars now in service. A manufacturer's Service Information Notice (N-130) to check this has been issued in respect of the 269 series and the FAA has since issued an Airworthiness Directive (AD) requiring compliance with the Notice. The United Kingdom Civil Aviation Authority has stated that the FAA AD will be mandatory for all UK operators. The Notice requires an annual X-ray inspection of tail rotor blade spars now in service and provision is also made for a method to measure the depth of internal corrosion.

A similar Service Information Notice (HN-88) has also been issued in respect of the 369 series and an AD requiring compliance is expected.

2. Analysis and Conclusions

2.1 Analysis

From the positions of the tail rotor blades relative to the main crash site, it is evident that both blades became detached in flight. After this had occurred, the aircraft went out of control and in the process, diverged some 90 degrees off its course. It then flew over the power cables alongside which it had been flying before crashing in the field beyond.

The paint marks on the cyclic control rod and cockpit canopy indicate that the first blade to become detached travelled forward and entered the cabin. The fibres found embedded in the blade fragment, indicate that it struck the pilot on the back of the head.

Following the detachment of the first blade, the out-of balance forces on the tail rotor gear box assembly would have been considerable and the relative proximity of the tail rotor components indicate that the detachment of the second blade and gear box/pitch change mechanism occurred virtually simultaneously. The loss of the tail rotor assembly together with the gear box would have resulted in not only a loss of directional control, but could also have caused pitch control difficulties due to the sudden forward shift of the centre of gravity.

There was practically nothing that the pilot could have done in these circumstances to avert impact with the ground, even supposing that the injury he sustained from the blade strike was not totally disabling. The fact that the collective lever was almost fully down and the throttle twist grip was in the closed position, was not necessarily indicative of an attempt by the pilot at recovery action. Impact loads could also have lowered the lever and the coordinated throttle control would therefore have rotated to the closed position.

The failure of the tail rotor was precipitated by the presence of a large pre-existing fatigue crack extending for some 120° around the tubular tail rotor spar at the aerofoil root end. Severe corrosion pitting of the outside of the spar to 18 per cent sectional thickness was shown by metallurgical examination to be the origin of the fatigue propagation.

It was obviously a serious matter that the failure occurred so early in the life of the component. Prompt action was taken by the airworthiness authorities concerned and the manufacturer, not only to check the tail rotor blade spars already in service but also to ensure that the spars produced in future have a higher standard of anti-corrosion protection.

2.2 Conclusions

(a) Findings

- (i) The pilot was properly licenced and experienced on the type.
- (ii) The aircraft had been maintained in accordance with an approved maintenance schedule and its documentation was in order.
- (iii) Whilst in level cruising flight a tail rotor blade became detached following the failure of its spar due to fatigue.
- (iv) The separated blade entered the cabin and struck the pilot's head, and in doing so almost certainly brought about some degree of incapacitation.

- (v) Following the separation of the first blade, the remaining blade and the tail rotor gear box also separated from the aircraft, thereby causing a sudden forward displacement of the centre of gravity.
- (vi) The complete loss of control of the aircraft following the detachment of the tail rotor assembly was most probably due to some degree of pilot incapacitation caused by the blade fragment striking his head. Even without pilot incapacitation, it is considered unlikely that the outcome would have been materially different.

(b) *Cause*

The accident was caused by a fatigue failure of the tail rotor spar which resulted in the disintegration of the tail rotor leading to a complete loss of control of the aircraft.

P J Bardon
Inspector of Accidents

Accidents Investigation Branch
Department of Trade

February 1976