SOUTH AFRICAN CIVIL AVIATION AUTHORITY

ACCIDENT REPORT – EXECUTIVE SUMMARY

Date of Accident	10/12/1999	**Time of Accident**		1440Z	
Aircraft Registration	**ZS-RWP**	**Type of Aircraft**		**Bell 407**	
Pilot-in-command Licence Type		Private		**Licence Valid**	Yes
Pilot-in-command Flying Experience		Total Flying Hours	3 020.0	Total Hours on Type	Unknown
Type of Operation		Private			
Last point of departure		Wonderboom Aerodrome			
Next point of intended landing		Farm near Lydenburg			

Location of the accident site with reference to easily defined geographical points (plus GPS readings if possible)

Farm Rooipoortjie, Groblersdal district (GPS position 25° 31' 30" South 028° 48' 30" East)

Meteorological Information	Overcast with rain a few hours prior to the accident and light rain shortly after the accident occurred.				
Number of people on board	One	**No. of people injured**	None	**No. of people killed**	One

Synopsis

The pilot departed Wonderboom Airport at 1416Z on the afternoon of the 10th December 1999 on a VFR (Visual Flight Rules) flight to his farm near Lydenburg.

Approximately 20 minutes after take-off he crashed in a fairly remote open grassland. According to an eyewitness he was flying at a height of approximately 20 feet above ground level, flying straight and level when he saw the helicopter pitching up slightly and at the same time starting to roll to the left. The nose then suddenly dropped and it impacted the ground. On impact the wreckage caught alight.

The eyewitness and a neighbor rushed to the scene in an attempt to extinguish the fire but at first the fire was too intense. They then managed to extinguish the fire by throwing sand onto it. They were, however, unable to rescue the pilot. The helicopter crashed approximately 500m from where the eyewitness was standing when he first saw the helicopter.

Probable Cause/s

The cause of the accident could not be determined with certainty, as no pre-impact failures or malfunction of the engine or airframe were detected. The cause of the pilot's death could also not be determined with certainty.

Investigator-in-charge: J Grobbelaar

AIRCRAFT ACCIDENT REPORT

Ref : J10/2/7133

Name of Owner/Operator	: Mr. W. Piso
Manufacturer	: Bell Helicopters Textron
Model	: 407
Nationality	: South African
Registration Marks	: ZS-RWP
Place	: Farm Rooipoortjie
Date	: 10 December 1999
Time	: 1440Z

All times given in this report are Co-ordinated Universal Time (UTC). South African Standard Time is UTC plus 2 hours.

Disclaimer:

This report is given without prejudice to the rights of the CAA, which are reserved.

Purpose of the Investigation:

In terms of Regulation 12.03.1 of the Civil Aviation Regulation, 1997, this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accident or incidents and **not to establish legal liability**.

1. FACTUAL INFORMATION.

1.1 History of Flight:

1.1.1 On the morning of 10 December 1999 the pilot accompanied by one passenger departed Lydenburg to Wonderboom Airport. After completion of his business during the morning in Pretoria, he attended a business lunch with eight other

colleagues. During lunch he had a calamari starter, a kebab fillet for main course and five non-alcoholic beverages. He left the restaurant at approximately 1330Z that afternoon where after he returned to Wonderboom Airport.

1.1.2 He departed Wonderboom Airport at approximately 1416Z on a VFR (Visual Flight Rules) flight to Lydenburg. The helicopter crashed approximately 20 minutes after take-off in a fairly remote area in the Verena area near Groblersdal.

1.1.3 The only eyewitnesses to the accident were members of a family who stayed in the house that the helicopter overflew shortly before it crashed. According to the father he and his wife were sitting inside the house listening to the radio at approximately 1400Z when he heard the noise of an aircraft and a sound like a "backfire". He went outside to show his six children the aircraft. He saw the aircraft flying over his house at a very low altitude. Next to his house is a tree approximately 8-10 metres in height, which the eyewitness said the helicopter would have struck if he was not flying to the right of the tree. The aircraft was flying in an easterly direction straight and level. He again heard a loud noise like a "backfire" where after the helicopter started turning to the left in a northerly direction. While it was turning it pitched up slightly and continued turning left, the nose then dropped and the helicopter impacted the ground in a steep nose down attitude. On impact the wreckage caught alight. The witness heard another loud noise shortly before it crashed. From the first moment he heard the aircraft until the point of impact the engine sounded normal. Not at any time had he seen anything breaking off or falling from the aircraft. He then rushed to the scene in an attempt to extinguish the fire, assisted by another person from a nearby house. They managed to extinguish the fire by throwing sand onto the wreckage. The weather at the time was overcast but it did not rain. The eyewitness was familiar with the helicopter, as it had over flown his house on a regular basis.

1.1.4 The accident occurred in day light at a geographical position determined as 25° 31' 30" South and 028° 48' 30" East, at an elevation of approximately 4 905 feet AMSL.

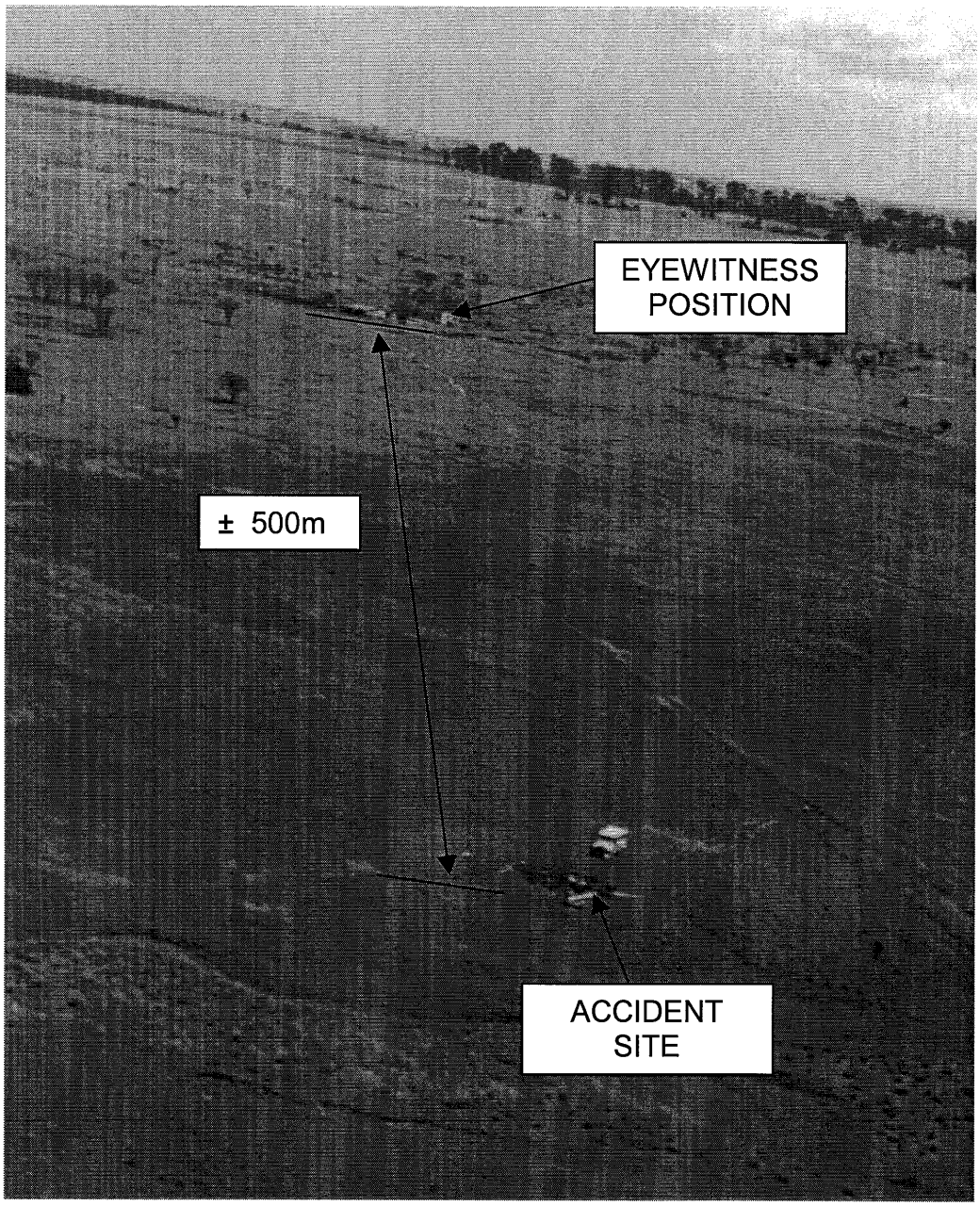


Figure 1. Aerial photo of the accident site also indicating eyewitness position.

1.2 Injuries to Persons:

Injuries	Pilot	Crew	Pass.	Other
Fatal	1	-	-	-
Serious	-	-	-	-
Minor/None	-	-	-	-
TOTAL	**1**	-	-	-

1.3 Damage to Aircraft:

1.3.1 The helicopter was destroyed by the high impact forces and the post impact fire.

1.4 Other Damage:

1.4.1 There was no other damage caused.

1.5 Personnel Information:

1.5.1 The pilot-in-command was a male aged 38 years. He held an appropriately type rated Helicopter Private Pilot's License No. PR 23729, valid until 17 November 2000. Also endorsed in his license was a Night Rating.

1.5.2 His medical examination for the renewal of his license was conducted on 17 November 1998, when he was declared fit from 17 November 1998 until 17 November 2000 as a Private Pilot. The pilot's license was endorsed with the requirement to wear corrective lenses while executing the privileges of his license.

1.5.3 According to CAA records this was the third accident in which the pilot was involved.

(i) The first accident occurred on 20 January 1991, whilst attempting to take-off from a confined space one skid dug in and the helicopter, a Hughes 269C, rolled over.

(ii) The second accident occurred on 22 July 1991, when he was unable to maintain hover flight at 6 500 feet and descended onto a rocky surface, extensively damaging the helicopter type, Hughes 269C.

1.5.4 The pilot also competed as a member of the South African National Helicopter Precision Flying team in 1992, 1994 and in 1996. He was awarded National Colours but did not participate in 1996 due to business commitments.

(i) In 1992 he attended the World Helicopter Championships at Wroughton, Wiltshire, England, period 1st to 6th September 1992.

(ii) In 1994 he attended the World Helicopter Championships at Moscow, USSR, during September 1994.

(iii) In 1996 the pilot was included in the South African National Team that attended the World Helicopter Championships at Salem, Oregon, in the USA but due to business commitments he did not compete in 1996.

1.5.5 The pilot's logbook could not be obtained. The flying hours listed below were obtained from the pilot's file when he applied for his last pilot's licence renewal dated 17 November 1998.

1.5.6 Flying Experience:

Total Hours	3 020.0
Total Past 90 Days	Unknown
Total on Type Past 90 Days	Unknown
Total on Type	Unknown

1.6 Aircraft Information:

1.6.1 The Bell 407 is approved for seven-place seating and is certified for land operation under day or night VFR non-icing conditions. The helicopter involved in the accident Serial No. 53111 was manufactured in Canada and imported into South Africa in 1997. The Certificate of Registration that was current at the time of the accident was issued on 23 April 1997. The Certificate of Airworthiness that was current at the time was issued on 20 October 1999 in the "Standard" category.

1.6.2 The last Mandatory Periodic Inspection (MPI) prior to the accident was certified on 1 March 1999, at 600.0 airframe hours. It was not possible to determine how many hours were flown since the last MPI was certified as the post impact fire destroyed the helicopter. The post impact fire also destroyed the flight folio that is presumed to have been in the aircraft at the time.

Sub Assembly	Type	Serial No.	Hours
Airframe	Bell 407	53111	> 600.0
Engine	Allison 250-C47B	CAE 847131	> 600.0

1.6.3 Mass and Balance:

	Weight (kg)	Arm (CG) (mm)	Moment (kg*mm/100)
A/C Empty Weight	1 364.8	3327	45406.9
Oil	5.9	5207	307.2
Pilot	126.0	1651	2080.3
Front Passenger	-	-	-
Mid Passenger	-	-	-
Aft Passenger	-	-	-
Baggage	20.0	4420	884.0
Fuel ½ -Tank	197.0	3249	6400.5
Total T/O Weight	**1 713.7 kg**	**3214**	**55078.9**

The maximum gross weight for take-off and landing according to the Pilot's Operating Handbook: (POH, Section 1, Pg. 1-4)

Internal - 5 000 lbs
2 268 kg

External Cargo - 5 500 lbs
2 495 kg

The Longitudinal Centre of Gravity limits are from station: (POH, Section 1, Pg. 1-9)

Forward - 119.0 (3035 mm)
Aft - 129.0 (3290 mm)

Therefore, at a mass of 1713.7 kg (3770.1 lbs) and a CG located 3214 mm (126.6 inches) aft of the datum, the helicopter was correctly loaded at the time it departed Wonderboom Airport.

The weight of the pilot was obtained from his last flying medical, dated 17 November 1998.

The baggage was estimated at approximately 20 kg, consisting of a golf club, brief case full of documents, a box of litchis and a set of dual controls (consisting

of a cyclic lever and collective pitch lever).

1.7 Meteorological Information:

1.7.1 Surface Observations:

A surface high-pressure cell was over the Indian Ocean with a surface trough over the central interior. Thunderstorms were present over the interior to the east of the surface. The nearest observations to Groblersdal are at Johannesburg International Airport (FAJS) and the Pretoria Weather Office.

1.7.2 The Metar (aviation routine weather report) observations at Pretoria on 10 December 1999 at 1400Z were as follows:

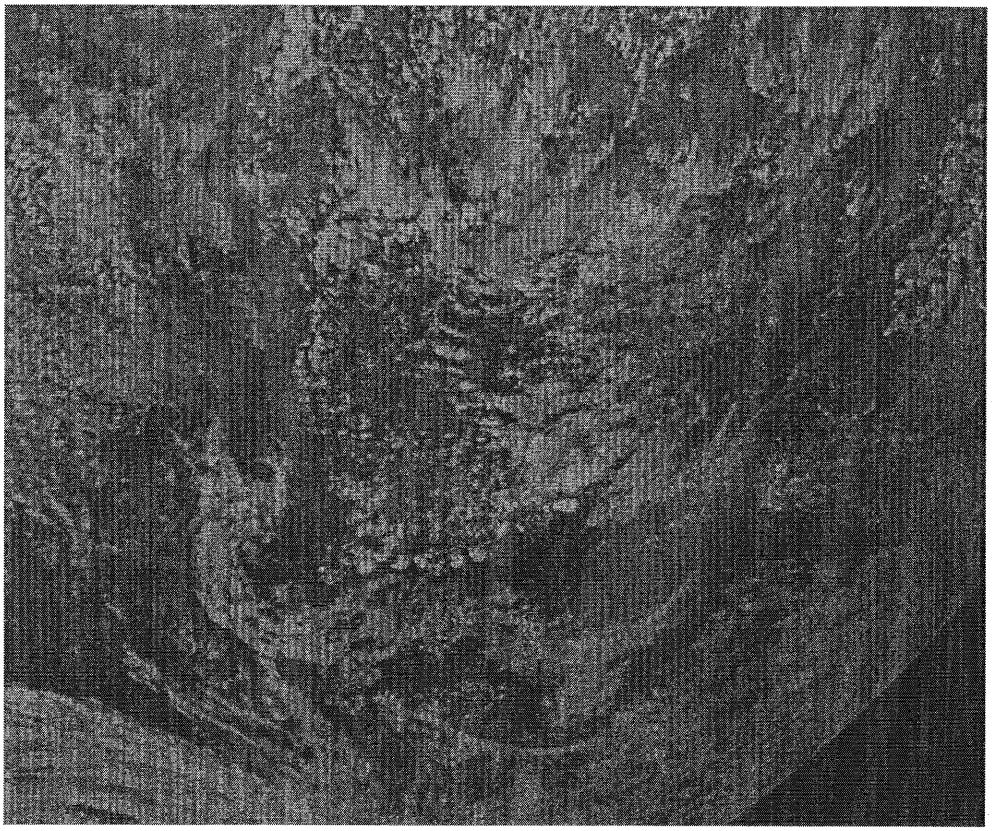
Wind	-	350° True / 2kt
Visibility	-	Greater than 10km
Cloud Cover	-	Scattered at 2 500 feet
		Broken at 10 000 feet
Temperature	-	+ 24°C
Dewpoint	-	+ 16°C
Pressure Altitude (QNH)	-	1018 hPa (hecto Pascal)
Rain	-	Recent Rain

1.7.3 The Metar observation at Pretoria on 10 December 1999 at 1500Z were as follows:

Wind	-	360° True / 4kt
Visibility	-	Greater than 10km.
Cloud Cover	-	Few at 3 000 feet.
		Broken at 10 000 feet.
Temperature	-	+ 24°C
Dewpoint	-	+ 15°C
Pressure Altitude (QNH)	-	1018 hPa (hecto Pascal)

From the observations it can be seen that there were recent rain showers present with convective cloud (including thunderstorm cloud) and a broken to overcast layer of middle layer cloud.

1.7.4 Satellite Image:



The satellite image was taken on 10 December 1999 at 1400Z, showing convective development over the eastern part of the country.

1.7.5 Upper Air:

The upper air sounding at 1200Z at Irene, near Pretoria, indicates an extensive layer of moist air up to about 13 000 feet MSL. The freezing level was at 14 000 feet MSL.

Indicated winds:

Direction	Speed	Height (MSL)
010° True	7 knots	5 000 feet
020° True	9 knots	7 000 feet
340° True	11 knots	8 000 feet

1.7.6 Forecast:

The Terminal Aerodrome Forecast (TAF) issued for Johannesburg International Airport on 10 December 1999 based on the 0900Z synoptic chart, valid from 1200Z until 2100Z follows:

FAJS 100900Z 101221 34010KT 9999 SCT025 FEW025CB BKN080 PROB40 TEMPO 1220 5000 TSRA SCT025CB SCT030 BKN080 T25/12Z=

Wind	-	340°True / 10kt
Visibility	-	Greater than 10km
Cloud Cover	-	Scattered at 2 500 feet above ground level
		Few at 2 500 feet Cumulonimbus
		Broken at 8 000 feet above ground level
Change in weather	-	Probability 40%
Temporary Change	-	TEMPO
Time	-	1200Z to 2000Z
Visibility	-	Decreased to 5 000m
Rain	-	TSRA (Thundershowers and rain)
Cloud Cover	-	Scattered at 2 500 feet above ground level
		Cumulonimbus
		Scattered 3 000 feet above ground level
		Broken at 8 000 feet above ground level
Forecast		
Max Temperature	-	+ 25°C expected at 1200Z

1.8 Aids to Navigation:

1.8.1 The helicopter was equipped with the following navigational aids:

One VHF Omni Range (VOR) receiver.
One Automatic Direction Finding (ADF) receiver.
One panel mounted Global Positioning System (GPS) Bendix/King KLN89.
One Transponder KT70 XPDR.

1.9 Communications:

1.9.1 The following is a transcript of recorded communications between the aircraft and ATC (air traffic control) Wonderboom on the frequency 120.6 MHz.

TIME	FROM	MESSAGE
14:15:53	ZS-RWP	Wonderboom RWP.
14:15:56	ATC	RWP Wonderboom.
14:15:59	ZS-RWP	Afternoon Sir, permission for lift off hangar 5 low level to Lydenburg in an Easterly direction RWP.
14:16:08	ATC	WP, lift off your discretion, Surface wind Northerly at 5 knots 1017 QNH remain South of RWY 29 report the CTR outbound to the East.
14:16:15	ZS-RWP	CTR outbound to the East next call, 1017 5 knots Northerly Wind and Sir do you got any TFC (traffic) in the CCT (circuit).
14:16:24	ATC	Affirm RWY 29 Right hand CCT (circuit) active.
14:16:26	ZS-RWP	Ah ift's possible I would like to cross your RWY and then head directly if it suits you.
14:16:36	ATC	Roger remain below 4 600 feet report before crossing the RWY.
14:16:41	ZS-RWP	Thanks a lot for your accommodation Sir, RWP.
14:17:06	ZS-RWP	Wonderboom, RWP ready to cross.
14:17:10	ATC	RWP cross the active 29 report CTR outbound to the East.
14:17:16	ZS-RWP	RWP outbound to the East next call thank you Sir.
14:22:50	ZS-RWP	Wonderboom, RWP outbound.

14:22:54	ATC	WP continue 125.4 good day.
14:22:59	ZS-RWP	Thank you Sir 125.4 and 124.4 going to GF2 thank you Sir, RWP.

There was no further communication between ATC and the aircraft.

1.10 Aerodrome Information:

1.10.1 Not Applicable.

1.11 Flight Recorders:

1.11.1 The aircraft was not equipped with a flight data recorder (FDR) or cockpit voice recorder (CVR), nor was either required by regulation.

1.12 Wreckage and Impact Information:

Fig 2. A general view of the accident site, with the main wreckage destroyed by the post-impact fire.

1.12.1 The accident occurred in a grassy open field area. Components and structural pieces of the helicopter were scattered over an area of not more than 10 meters in diameter along an axis which was oriented on a Northerly heading from the initial ground impact point.

1.12.2 The initial ground contact by the helicopter was a ground scar probably caused by one of the main rotor blades. A few meters down the wreckage path from the initial impact point was, an area of heavy ground scrub, which contained components from the skids, the baggage door situated on the left-hand side of the helicopter as well as the left front cabin door. The major portions of the tail boom including the tail rotor were located further down and to the right of the wreckage path. The main fuselage wreckage was at the end of the wreckage path to the left of the tail boom assembly. The main fuselage had been exposed to an intense post-impact fire and was completely destroyed by the impact forces and post impact fire.

1.12.3 The left side of the nose structure was severely fragmented. The airframe fuel system including the tank, fuel lines and boost pumps were completely destroyed by the ground impact and exposure to the post-impact fire.

1.12.4 The helicopter was equipped with the standard skid landing gear configuration. The complete forward cross tube with portions of the skid tubes were found to the right side of the main impact point.

1.12.5 The Electronic Control Unit (ECU) of the FADEC (Full Authority Digital Engine Control) system was located in the burnt area of the cabin roof. The investigating team was unable to obtain any information from the ECU unit due to fire and impact damage.

1.12.6 The main transmission was located with the fuselage wreckage. The mast and main rotor assembly was also still attached. The four main rotor blades were still attached to the main rotor head with one of the blades extensively damaged. The blade dug into the ground and was positioned underneath the main wreckage. Two of the composite main rotor blades were fractured with the other two blades still intact but substantially deformed along the leading edges.

1.12.7 The engine was lying on its right-hand side in the fuselage wreckage. The exterior of the engine was heavily scorched from the post-impact fire. The engine air inlet appeared clear and the centrifugal compressor appeared intact when viewed through the inlet.

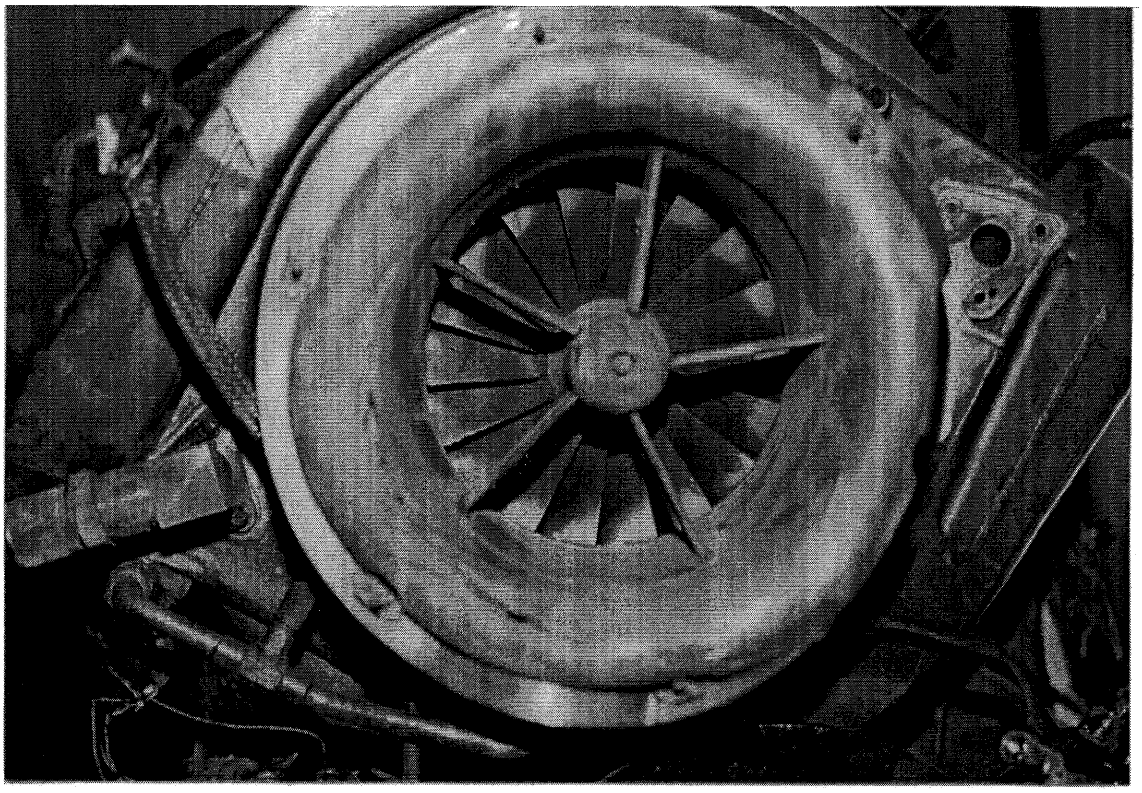


Fig 3. A view through the air inlet with the first stage centrifugal compressor visible.

1.12.8 The tail rotor drive shafting was heavily damaged from impact, post-impact fire and overload separation of the tail boom. All the sections of the drive shafting on the tail boom failed in torsional overload. The tail rotor gearbox failed from its attachment during the impact sequence and was located next to the tail boom, drive continuity was established from the input of the gearbox to the output. Both tail rotor blades were intact with minor damage. The pitch-change mechanism was found to be intact and operable.

1.12.9 The tail boom failed during the impact sequence. The right-hand horizontal stabiliser remained attached to the tail boom and the left-hand stabiliser failed during impact. The vertical stabiliser remained attached to the tail boom and sustained very little damage.

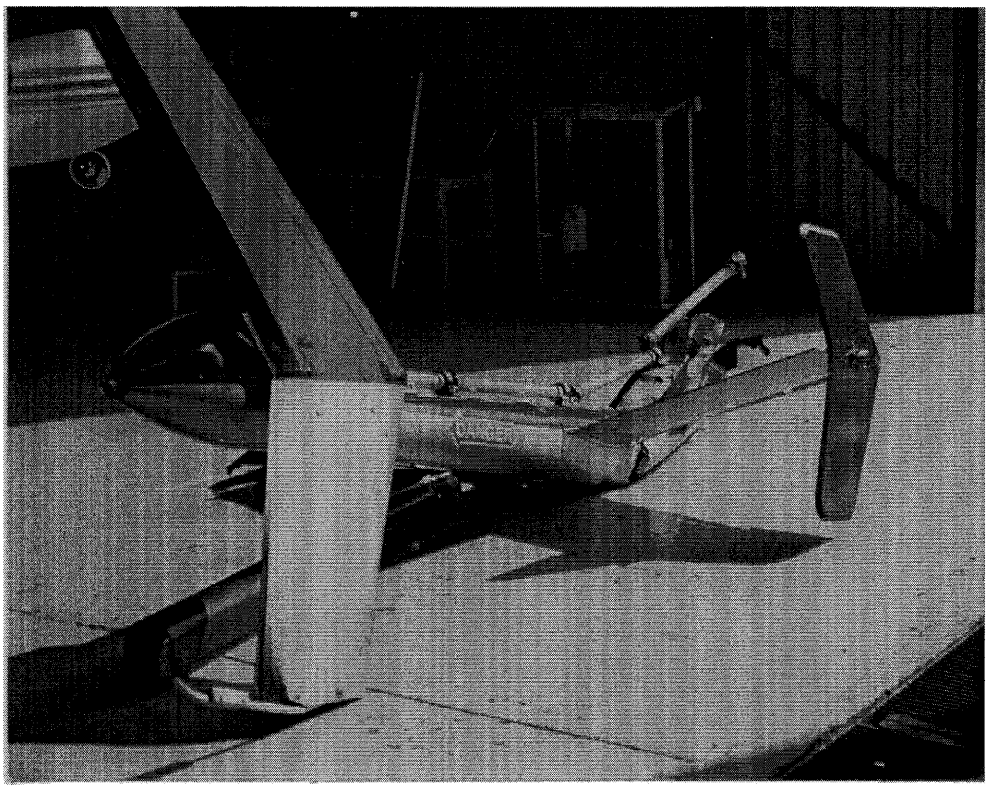


Fig. 4 A view of the tail boom that failed during the impact sequence. Substantially more damage was caused to the horizontal and vertical stabiliser assembly on the left-hand side.

1.13 Medical and Pathological Information:

1.13.1 Description of Post Mortem findings:

a) General

The entire body was severely burnt with charring of the head and neck. The face was burnt beyond recognition. It could be determined that it was the body of a big and obese man.

Despite the burns, areas of skin were visible which were covered with characteristic thick hair, which could aid in identification.

Multiple fractures were noted, of which the majority had been caused by the heat.

A metal object of 25 cm in length was lodged in the right fore-arm. Whole-body X-rays were taken which confirmed the presence of further

smaller mechanical objects in the body. The objects could have come from an aircraft.

The body was identified on the grounds of dental records.

b) External Injuries:

Severe crush and de-gloving injuries were noted. A fracture of the base of the skull was evident, with concomitant fractures of the eye sockets, nose, mouth and ears. Multiple rib fractures were also present. Whole body X-rays showed several skeletal fractures.

c) Internal Organs:

Brain:

Changes are consistent with the heat. No intra-vital pathology could be determined.

There was no free blood in the chest or abdominal cavities and no soot in the airways.

Heart:

The heart was enlarged with dilatation and hypertrophy of the left ventricle. The coronary arteries showed atherosclerotic changes resulting in occlusion of 50% of the diameter in places. However, no signs of recent bleeding, thrombosis or rupture of atheromateus plaques could be demonstrated.

The aorta showed signs of early complicated atherosclerosis.

Liver was enlarged with severe steatosis.

Spleen was also slightly enlarged.

d) Histology:

Heart:

Muscle hypertrophy, 50% occlusion of coronary arteries, no evidence of thrombosis, rupture or bleeding of atheromateus plaque. Eosinophilic

muscle fibres were noted as well.

Lung:

Microscopic changes of emphysema, with areas of irregular athelectasis.

Liver:

Conspicuous fatty change and lymphocyte infiltration. No signs of Mallory-hyaline.

Kidney, spleen and pancreas: Nothing of note.

1.13.2 Routine Toxicology Screening:

a) Alcohol:

The concentration alcohol in the blood sample was 0,00 grams per 100ml. The sample contained sufficient sodium fluoride to prevent the formation of alcohol therein.

b) Carbon Monoxide:

The carbon monoxide saturation of the haemoglobin in the sample was 8%.

1.13.3 Pre-existing disease – physical:

a) Medical History:

According to his treating physician he was "overweight and a big man", but healthy. He has never been treated for a medical condition.

He did not drink alcohol excessively or on a continuous basis. Liver function tests, submitted for life insurance purposes in the past, showed abnormalities of liver enzymes. Unfortunately there was not a copy of this available.

b) Previous Examination:

Previous aviation medical examinations were normal, except for weight,

which was above the normal value.

c) Restrictions and Limitations:

He was restricted to fly with corrective lenses.

d) Medication:

He was not using any medication on a regular basis.

e) Post-mortem findings:

Post-mortem findings were consistent with pre-existing ischaemic heart disease and steatohepatitis.

1.13.4 Important Points to Consider:

a) Severe steatosis of the liver has been documented to be a cause of sudden death.

In the majority of cases, steatosis is due to excessive alcohol use over a long period. However, according to his physician, this patient seldom drank any alcohol.

Other diseases may also cause steatosis of the liver. There has been an abnormal liver function report, which is unfortunately unavailable at this time. Thus there could have been another reason for the steatosis.

b) Macroscopic and microscopic examination of the heart confirms pre-existing heart disease.

There is no evidence of a recent acute myocardial infraction, which could have been the cause of the accident.

There was, however, eosiniphilic muscle fibres present, thus recent hypoxia cannot be excluded for certain.

c) The pathologist remarked that there was a lack of vital reaction in the tissues. If this is seen on context with the injuries, it has to be considered that the injuries sustained during the accident, may not have been the reason for death or the sole reason for death.

d) Taken into account the pre-existent heart disease has been confirmed on post-mortem examination, a pre-terminal cardiac arrhythmia has to be considered as a possible cause of death (and of the accident).

5. Conclusion:

The cause of death couldn't be determined with certainty. Multiple injuries were present, but an acute pre-terminal cardiac arrhythmia, probably secondary to ischaemic heart disease, cannot be excluded with certainty. Thus a medical condition or complication of a medical condition could have caused the accident, however, it can not be determined with certainty.

6. Recommendation:

a) Intense research must be performed pertaining to the causes, diagnosis and prevention of ischaemic heart disease in flight crew and they must be made aware of all aspects of prevention on a regular basis.

b) Aviation medical examiners, doctors, flight crew and the public must be made aware of the risks of flying with unexplained symptoms or diseases which have not been fully investigated.

1.14 Fire:

1.14.1 During the impact of the helicopter, the fuel tank ruptured. This caused the fuel to spill, which was probably ignited when it came into contact with the engine that was operating at approximately 800° C. The fuselage caught alight and the forward and centre section of the helicopter was destroyed in the ensuing fire. The eyewitness and a nearby neighbour rushed to the scene in an attempt to extinguish the fire by throwing sand onto the wreckage.

1.15 Survival Aspects:

1.15.1 This was not a survivable accident due to the impact forces and the post impact fire. It was not possible to determine if the pilot was wearing his available seat and shoulder harness at the time of the accident due to the cockpit area being destroyed by the post-impact fire.

1.16 Tests and Research:

1.16.1 Selected components were removed from the accident site and transported to Precision Aviation at Wonderboom and to National Airways Corporation, Allison Engine Workshop at Rand Airport. The components consisted of the engine, freewheeling unit, transmission and mast, main rotor blade pieces and the aft section of the tail boom including the tail rotor assembly.

1.16.2 The engine was dismantled. Partial disassembly of the turbine section revealed that the gas producer and power turbine wheels were intact. The engine accessory gearbox assembly was dismantled and all the accessory gear drives were found to be intact. Metal splatter was seen on the No.1 turbine wheel. The magnetic plugs were removed and no chips were found.

1.16.3 The freewheeling unit was removed from the engine and found to be intact. The magnetic plug on the freewheeling unit was removed and no chips were found.

1.16.4 The main rotor head assembly was intact but extensively damaged during the impact sequence. No disassembly of the hub was performed.

1.16.5 The main rotor drive shaft and main rotor gearbox were inspected. No damage was found to the main rotor drive shaft. No damage was seen on the planetary assembly, ring gear and sun gear. The upper and lower mast bearings appeared normal. The oil pump was removed and found to be intact. The magnetic plug was removed and no chips were found.

1.16.6 The tail rotor assembly was inspected, limited damage was caused to the tail rotor blades. Further verification of the operation of the gearbox and pitch change mechanism was accomplished. The magnetic plug was removed and no chips were found. No disassembly of the hub was performed.

1.16.7 The engine and main transmission was dismantled to determine the extent of the damage and if any failures could be detected that could have contributed to the accident or could have been the cause. Although these components sustained extensive damage due to the post-impact fire, no evidence could be found indicating that any of these components contributed to the accident.

1.17 Organizational and Management Information:

1.17.1 It was a private flight.

2. ANALYSIS:

Examination of all the available evidence suggests that the aircraft was not under control at the time of impact. According to an eyewitness it was flying at low level, approximately 20-30 feet above ground level when it suddenly pitched-up and rolled to the left and impacted the ground. The helicopter was flying at a considerable speed when it passed over the eyewitness and crashed approximately 500m from where he was standing.

1. The flight was conducted under VFR conditions. Although it was overcast at the time of the accident, weather was not considered to be a factor in this accident.

2. The impact sequence suggested that the aircraft was in a nose down attitude with a considerable amount of bank angle to the left.

3. The backfiring noise referred to by the eyewitness could not have originated from the engine. The type of sound referred to usually originates from the main rotor blades, which are subjected to a specific load at a specific time, depending on the weight of the helicopter the bank angle and the airspeed at the time.

3. CONCLUSION:

a) Findings:

(i) The pilot was the holder of a valid private pilot's licence and had the aircraft type endorsed in his licence.

(ii) The helicopter was maintained in accordance with the approved maintenance schedule.

(iii) There were no indications of any pre-impact failures or malfunctions of the engine or airframe that could have caused the accident.

(iv) The helicopter was correctly loaded and there was adequate fuel on board.

(v) Although overcast conditions prevailed at the time of the accident, weather was not a factor in the accident.

4. Safety Recommendations:

4.1 Due to the fact that various verbal reports of the pilot falling asleep while flying were obtained, (though no one wanted to write a statement for fear of incrimination), it is recommended that a confidential hazard reporting system be implemented as soon as possible. These hazard-reporting forms must be made available to all training facilities, the flying public, aircrew, cabin crew, maintenance personnel and air traffic control. It must be located on all airports and aerodromes at clearly visible locations.

4.2 Intense research must be performed pertaining to the causes, diagnosis and prevention of ischaemic heart disease in flight crew and they must be made aware of all aspects of prevention on a regular basis.

4.3 Aviation medical examiners, doctors, flight crew and the public must be made aware of the risks of flying with unexplained symptoms or diseases which have not been fully investigated.

4.4 It is recommended that with every renewal of a pilot's licence the required documentation must be accompanied by a certified copy of the pilot's logbook for the last year or six months period he had flown depending on his type of licence. The information being obtained from the pilot's flying logbook is the only reflection of his flying experienced which is of vital importance during an accident investigation.