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ADDENDA and CORRECTIONS

(ALL TIMES IN THIS BULLETIN ARE UTC)

MESSAGE FROM THE CHIEF INSPECTOR OF AIR ACCIDENTS

Special Bulletins

When required, and usually within a few weeks of a major accident, the AAIB publishes a Special Bulletin in order to release into the public domain information detailing the initial facts gathered in the investigation and/or to make safety recommendations requiring immediate action.

Traditionally, the Special Bulletin has been distributed to interested parties immediately, included on the AAIB website (www.aaib.gov.uk) on the day of publication and included in the next available monthly Bulletin as a loose leaf addition. Future Special Bulletins will continue to be published as before. However, they will now appear at the front of monthly Bulletins, with a yellow banner heading, bound into the fabric of the booklet.

David King
Chief Inspector of Air Accidents

ACCIDENT

Aircraft Type and Registration:	i) Scheibe SF27 glider, HGM ii) Schleicher ASW 19B glider, GDP
Serial Number:	i) 6017 ii) 19285
No & type of Engines:	i) None ii) None
Year of Manufacture:	i) 1965 ii) 1979
Date & Time (UTC):	2 October 2006 at 1515 hrs
Location:	Sutton Bank, North Yorkshire
Type of Flight:	i) Private ii) Private
Persons on Board:	i) Crew - 1 Passengers - None ii) Crew - 1 Passengers - None
Injuries:	i) Minor Passengers - N/A ii) Fatal Passengers - N/A
Nature of Damage:	i) Aircraft destroyed ii) Aircraft destroyed
Commander's Licence:	i) BGA Gliding Certificate ii) BGA Gliding Certificate
Commander's Age:	i) 50 years ii) 48 years
Commander's Flying Experience:	i) 733 hours Last 90 days – 20 hours Last 28 days – 5 hours ii) 280 hours Last 90 days – 10 hours Last 28 days – 1 hour
Information Source:	AAIB Field Investigation with BGA assistance

This bulletin contains facts which have been determined up to the time of issue. This information is published to inform the aviation industry and the public of the general circumstances of accidents and must necessarily be regarded as tentative and subject to alteration or correction if additional evidence becomes available.

History of the flight

The aircraft were both soaring in the vicinity of Sutton Bank, at a height above the airfield of about 1,500 ft, near to the base of cloud. The surviving (SF27) pilot recalled suddenly seeing the other aircraft coming towards him, very close, and attempted to manoeuvre to avoid collision. However, the two aircraft collided almost head on, each aircraft's canopy being severely damaged by the other aircraft's wing. The SF27 wing structure separated from the fuselage; one wing of the ASW 19B separated approximately half-way along its span. The ASW 19B and its pilot fell to the ground. The SF27 canopy and canopy frame were severely damaged in the collision, and the pilot abandoned the aircraft through a hole in the canopy. He deployed his parachute successfully, and landed safely amongst trees. His minor injuries were sustained in the collision and subsequent parachute landing.

ASW 19B canopy design

The clear canopy of the ASW 19B, and its glass-reinforced plastic (GRP) frame, are attached to the fuselage at the forward end by a pivoted lifting arm. Normal access to the cockpit is achieved by lifting the rear of the canopy. The canopy is locked in the closed position by two steel pins, in the rear of the canopy frame, which locate into recesses in the canopy surround. These pins are operated by push rods and levers on either side of the canopy frame. In an emergency the canopy may be jettisoned by pulling a knob on the instrument panel glare shield; this releases the forward edge of the canopy from the lifting arm. The process is completed by disengaging both of the rear locking pins, allowing the canopy to separate from the glider, although it may be possible for the canopy to be jettisoned without the rear pins being disengaged.

Initial investigation

A section of canopy of the ASW 19B was found at the top of Sutton Bank, and the rest of the canopy was found in close proximity to the glider's fuselage, some 500 m away. Examination of the glider confirmed that the jettison procedure had been initiated, but not completed, before impact with the ground. The forward section of the canopy frame had been released from the lifting arm prior to ground impact, but the canopy locking pins were in the 'LOCKED' position.

The ASW 19B pilot's harness had been unfastened prior to impact. It is unclear whether the pilot had exited his aircraft; his body was found close to the remains of his aircraft. He had sustained fatal impact injuries. His parachute had not been operated.

The investigation identified that this ASW 19B, GDP, had been fitted with electronic equipment, including a logger, GPS, and palmtop computer. These had been attached to the glare shield and canopy frame and were connected to other systems in the glider by a series of electric cables. These cables were secured to the canopy frame and to the structure behind the instrument panel with cable ties. Had the jettison sequence been completed, it is probable that the wiring to the components installed on the canopy frame and glare shield would have prevented the canopy from being successfully jettisoned, and the pilot would not have been able to leave the glider.

Previous Safety Action by the BGA

On a number of occasions, the BGA has reminded pilots of the need to ensure that nothing interferes with the correct operation of canopy jettison systems. This has included technical documentation and an article in the BGA's own '*Sailplane and Gliding*' magazine.

Safety Recommendations

AAIB discussion with experienced glider pilots and members of the BGA suggested that similar modifications may have been made to other gliders. Therefore, the following Safety Recommendations are made:

Safety Recommendation 2006-127

The British Gliding Association should advise glider pilots to incorporate, into their pre-flight checks, a check to ensure that no modifications have been made which would prevent the canopy being jettisoned in emergency.

Safety Recommendation 2006-128

The British Gliding Association should remind its inspectors of the provisions of BGA Glider Maintenance Schedule Task 8, specifically with regard to ensuring that any canopy may be fully jettisoned without restriction.

Originally published on the AAIB Website in November 2006

INCIDENT

Aircraft Type and Registration:	Airbus A320, C-GTDG
No & type of Engines:	2 CFM56-5B4 turbofan engines
Year of Manufacture:	2001
Date & Time (UTC):	20 June 2006 at 0700 hrs
Location:	Cardiff Airport, Wales
Type of Flight:	Public Transport (Passenger)
Persons on Board:	Crew - 7 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to leading edge of the left engine fan cowl
Commander's Licence:	Air Transport Pilot's Licence
Commander's Age:	43 years
Commander's Flying Experience:	12,050 hours (of which 3,875 were on type) Last 90 days - 141 hours Last 28 days - 68 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and subsequent AAIB enquiries

Synopsis

The aircraft taxied onto a parking stand and struck a small tug attached to a set of steps, which had been parked within the stand area, unattended. The airport authority carried out their own investigation into the incident and made a number of changes to the airport infrastructure and procedures. The AAIB forwarded copies of this report to ICAO for consideration.

History of the flight

The aircraft was being taxied onto Stand 9, in order to board passengers for a flight. The commander, in the left seat, used the Visual Docking Guidance System (VDGS) to position the aircraft accurately onto the stand. However, he did not see a small baggage tug, with a set of steps attached behind it, on the left side of the stand. As the aircraft approached the stop line, the left engine fan cowl struck the tug, causing damage to the fan cowl and the tug. The aircraft was brought to a stop and the crew disembarked without further incident.

Some eye witnesses commented that the aircraft was taxied at a higher than normal taxi speed, but the commander reported that there was no undue pressure of time on the operation.

Background information

Prior to the incident, another aircraft (a Boeing 737), had been parked on Stand 9 for boarding with a set of steps positioned at the front passenger door. Once embarkation was complete, but some time before the aircraft's departure slot, a tug was used to reverse the set of steps away from the aircraft. However, the driver found that he was unable to move the combination completely clear of the stand area; he could not drive away forwards because the aircraft to which the steps had been attached was close in front, and his path to the rear was blocked by a white van. He was unable to establish to whom the van belonged, and decided to leave the tug and steps where they were, with the intention of moving them once the departing aircraft was clear of the stand. The driver returned to his crew room and was allocated other duties. In due course, the Boeing 737 departed.

When the duty ramp controller received a request for a parking stand for the Airbus A320, he observed (by CCTV) that Stand 9 had become vacant, and allocated it to the aircraft.

The airport authority reported that extensive construction work was underway on the ramp at the time of the incident. Vehicles had from time to time been parked in unassigned locations as a result. Parking arrangements had also been in a state of flux, and parking had not been effectively policed. Until changes made in light of the incident, the VDGS devices fitted to each stand were permanently illuminated, enabling pilots to taxi onto parking stands without reference to ground personnel.

Information to pilots

Civil Aviation Publication (CAP) 637 is a loose leaf guide for pilots, tug drivers, and ramp staff, entitled 'Visual Aids Handbook'. In the chapter on VDGS, three notes are published:

> *'NOTE 1: A pilot **should not** assume that a stand is safe to enter simply because the stand VDGS is active or lit. Where ground handling personnel are not present on the stand or if the pilot has any doubt about the position of any equipment on **or NEAR** to the stand, the aeroplane should be stopped immediately and assistance requested.'*
>
> *'NOTE 2: Except under the guidance of a marshaller, an aeroplane should not be taxied onto a VDGS equipped stand when the guidance system is switched off.'*
>
> *'NOTE 3: Ground staff should NOT activate a VDGS until a thorough inspection of the stand and its immediate surrounds has been made in order to ensure that all equipment is correctly parked in allocated areas and that the stand is safe for use by the type of aeroplane assigned.'*

These notes were discussed with members of the CAA Aerodrome Standards Division, who reported that a new version of the Handbook is in production, and an attempt will be made to clarify and distil the advice above in the new version.

Activation of VDGS and AAIB Safety Actions

The investigation identified that, whilst there is much guidance material regarding design and installation of VDGS, there are no ICAO Standards or Recommended Practices concerning when it should be activated. The CAA advises aerodromes that the equipment should only be activated when an aircraft is expected on a parking stand, and after the stand has been inspected by ramp staff; this procedure appears to have considerable safety benefits. The CAA informed the AAIB that all UK aerodromes now follow this procedure. The position elsewhere in the world was less clear, and the AAIB has forwarded copies of this report to the Chairman of the ICAO Aerodromes Panel and the Rapporteur (Chairman) of the Visual Aids Working Group (which reports to the Aerodromes Panel) for consideration.

Airport Authority Safety Actions following the incident

The airport authority investigated the incident and made a copy of its report available to the AAIB. The report identified both the immediate and underlying causes of the incident, and detailed action to be taken:

- *Switches for VDGS systems to be installed on each stand, and ground crew to be instructed to carry out safety checks of the stand areas before switching the equipment on.*
- *Improved parking arrangements for equipment to be introduced and policed.*
- *Consideration to be given to re-locating the duty ramp controller's working position into the operations tower, where there is a better view of the parking stands.*
- *Risk assessments of aircraft marshalling and docking procedures to be reviewed.*

Conclusion

It was not possible to determine why the aircraft commander did not see the tug and steps. In the last stages of manoeuvring onto the stand, it is probable that his attention was concentrated on the VDGS system and the need to stop the aircraft accurately.

Clear international Standards or Recommended Practices concerning when the VDGS should be activated would remove the potential for confusion in the congested ramp environment. Nevertheless, in spite of the availability of VDGS or other aids, it remains the responsibility of the pilot in command to avoid collision, whether on the ground or in the air.

INCIDENT

Aircraft Type and Registration:	Boeing 737-300, EC-JUC
No & type of Engines:	2 CFM 56-3C1 turbofan engines
Year of Manufacture:	1990
Date & Time (UTC):	18 July 2006 at 1425 hrs
Location:	Near Aldergrove Airport, Belfast
Type of Flight:	Public Transport (Passenger)
Persons on Board:	Crew - 6 Passengers - 142
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	39 years
Commander's Flying Experience:	7400 hours (of which 5800 were on type) Last 90 days - 210 hours Last 28 days - 90 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot, radar data, R/T transcripts and witness information

Synopsis

Whilst flying a non-precision approach, the flight crew mistook an unlicensed runway under the final approach track to be Runway 07 at Belfast (Aldergrove) Airport. A go-around was carried out from a low height and the aircraft subsequently positioned visually for a landing at Aldergrove. The final approach was unstable and included significant manoeuvring close to the ground.

History of the flight

The aircraft was flying from Liverpool to Belfast (Aldergrove) Airport when the incident occurred, and was being operated by a Spanish airline on a charter arrangement for a British carrier. The aircraft had been vectored by Aldergrove Approach Control for a VOR/DME approach to Runway 07. The weather was fine, with CAVOK conditions reported. Once established on final approach, the crew were transferred to the Aldergrove Tower controller and, after calling 'short finals,' were cleared to land.

The Approach controller was alerted to the fact that the aircraft had descended to an unusually low altitude by the lower height filter on his display, set to trigger an alert as an aircraft descended below 400 ft. He warned the Tower controller that the aircraft was apparently preparing to land at Langford Lodge, a private and unlicensed airfield 3.5 nm south-west of the Runway 07 threshold. The Tower controller immediately instructed the crew to climb, which they did. In a brief report, the commander stated that the crew were aware of Langford Lodge airfield, but that in the excellent visibility they still mistook it for Aldergrove Airport. He also reported that he checked the approach chart when it became clear that the aircraft was high on the approach and, realising at that point that they had misidentified the runway, initiated a go-around.

After the go-around the crew were given the option of repositioning visually for landing, which was accepted. The Tower controller watched the aircraft fly a wider than normal visual circuit, before 'flying through' the runway centre line, prompting her to think that the crew may have misidentified the runway again. However, the aircraft corrected to the centre line by making a series of turns at low altitude before landing. There were no injuries to the 6 crew or 142 passengers on board, though several passengers appeared upset and at least one made an official complaint to the chartering airline about the incident.

The low approach at Langford Lodge and the unstable approach at Aldergrove were reported to the chartering airline by a positioning staff member on board the aircraft. The subsequent return flight to Liverpool was cancelled as a result, and passengers were accommodated on later flights.

Recorded information

Radar and R/T data were recorded and available to the investigation. On first contact with Aldergrove Approach Control, the crew acknowledged receipt of the current ATIS information and were placed under radar vectoring for a VOR/DME approach to Runway 07. When the crew reported that they had established on final approach, they were cleared to descend on the VOR/DME procedure and were transferred to the Aldergrove Tower controller.

There was other landing traffic ahead, and the crew were instructed by the Tower controller to continue the approach. About two minutes later the crew made a 'short final' call, but this was made over the transmission of another aircraft and so was partly blocked. The controller asked the crew to confirm that they were calling 'short final', to which the crew replied "SHORT FINAL" again, and then the controller issued clearance to land on Runway 07. Very soon afterwards the Approach controller said to the Tower controller "(CALLSIGN)'S GOING FOR LANGFORD". The Tower controller immediately transmitted "(CALLSIGN) CLIMB IMMEDIATELY, I SAY AGAIN CLIMB IMMEDIATELY". The crew responded with "WE ARE CLIMBING IMMEDIATELY".

The Tower controller then said "…ALDERGROVE IS THREE MILES FURTHER ALONG THE APPROACH, ARE YOU VISUAL WITH THE LIGHTS OF ALDERGROVE?", and the crew replied "OK SORRY SORRY, WE WAS APPROACHING TO AN OLD RUNWAY". The crew then reported visual with Aldergrove and were cleared to reposition visually for Runway 07.

Radar data shows that the aircraft began to deviate to the right of the inbound VOR/DME course at about 2.5 nm from Runway 08 at Langford Lodge, or about 6.5 DME from the VOR/DME (Figure 1). Descent from 2,400 ft had begun at 7.2 DME, which was the correct descent point for the procedure. Mode C information showed the average descent rate to the point of go-around to be about 1,700 ft/min. The vertical profile also showed a gradually increasing rate of descent, with the lower 1,000 ft being flown at an average of approximately 2,000 ft/min. The aircraft took 74 seconds to travel from the final descent point at 7.2 DME to the point of go-around, just short of the runway at Langford Lodge. There are two returns at a minimum altitude of 300 ft amsl, about 200 ft above the airfield level, before the aircraft Mode C indicated a climb.

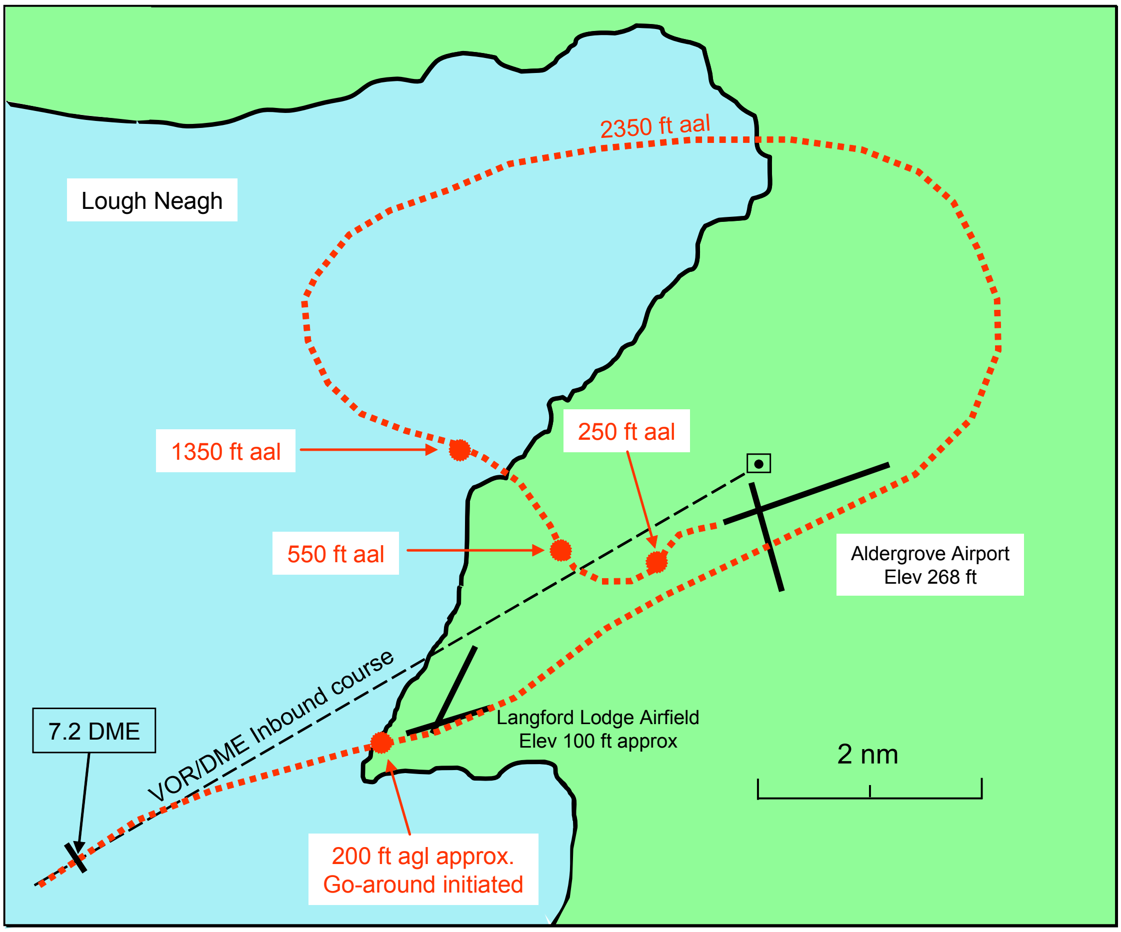


Figure 1

Radar-derived track and height information

The aircraft then flew a wide visual circuit to the north of the airport. Limitations on the accuracy of the radar data precluded a highly detailed analysis of the aircraft's manoeuvres on finals to Runway 07, but the aircraft appears to have turned inside the runway centre line initially, and then 'flew through' the centre line to the south. It then corrected to the centre line again with a relatively large angle, before manoeuvring at low altitude to align with the runway. The 'fly through' occurred at about 500 ft aal and the subsequent manoeuvring to regain the centre line was still taking place as the aircraft descended through 250 ft aal.

Witness information

A captain with the chartering airline, who was familiar with Aldergrove Airport, was positioning on the aircraft and occupying a window seat. He reported that the aircraft was not on the normal approach path and thought that the crew was probably making an approach to Langford Lodge. A go-around was made at an estimated 50 to 100 ft, after which a public address was made by the flight crew informing the passengers that a landing had not been possible due to a blocked runway. The passengers reportedly remained calm until the later stages of the next approach, when the aircraft executed steep turns, first to the right and then to the left, at an estimated 100 to 200 ft just before landing. The Tower controller also described significant manoeuvring close to the ground before the aircraft was aligned with the landing runway.

Aerodrome information

Aldergrove Airport

Aldergrove Airport is 11.5 nm north-west of Belfast. The main instrument runway was designated 07/25, and was 2,780 m in length. Runway 07 was equipped with high intensity centre line lighting with one crossbar, high intensity green threshold lights with wing bars, and Precision Approach Path Indicators set for a 3º glide slope. The runway itself had high intensity runway edge lights and colour-coded centre line lights at 15 m spacing. The runway was marked with the runway designator, threshold bars, centre and edge lines, fixed distance markings and touchdown zone markings. Runway 07/25 was crossed by Runway 17/35, which was 1,891 m in length.

The VOR/DME, coded 'BEL' was situated on the airport, and was the only instrument approach aid for Runway 07. The VOR/DME final approach track (FAT) was 059º(M), 12º offset from the runway heading, and intercepted the runway centre line at 1.5 nm from the threshold. From the correct intermediate procedure altitude of 2,406 ft, final descent commenced at 7.2 DME, and an altitude / distance table was published to assist crews to fly the recommended 3º approach path. The approach chart published in the UK Aeronautical Information Publication carried the warning:

> *"Langford Lodge aerodrome lies under the FAT 3.5 nm before THR (threshold)"*

Local procedures at Aldergrove required that all runway and approach lights be switched on whenever Runway 07 was in use, regardless of the weather conditions. The following message was attached to the ATIS broadcast during Runway 07 operations:

> *"There is a disused airfield three miles west of Aldergrove with a similar runway layout. Runway zero seven at Aldergrove is lighted."*

Langford Lodge Airfield

Langford Lodge (elevation approximately 100 ft) was an unlicensed private airfield, used on occasions for light aircraft movements by the corporate airfield owner. The airfield was situated near to the shore of Lough Neagh and had cross runways designated 08/26 and 03/21. Runway 08 was about 1,450 m in length. There were no runway or approach lights and, because of the possibility of pilots mistaking the runway for that at Aldergrove, all runway markings with the exception of the centre line markings, had been removed. Additionally, buildings on the site were closer to the runways than would have been allowed at a licensed aerodrome. At the time of the incident, a Beech aircraft was taxiing for departure on Runway 21 and was in radio contact with the Aldergrove Tower controller.

Air Traffic Control

The Manual of Air Traffic Services (MATS) Part 1 contains procedures, instructions and information which are intended to form the basis of air traffic services within the United Kingdom. MATS Part 1 contained the following text:

> *"A landing aircraft, which is considered by a controller to be dangerously positioned on final approach, shall be instructed to carry out a missed approach. An aircraft can be considered as 'dangerously positioned' when it is poorly placed either laterally or vertically for the landing runway."*

Analysis

The presence of Langford Lodge Airfield was well documented in the relevant publications, and a warning message was included in the ATIS report received by the crew. Although the commander reported that this had been considered by the crew, subsequent events indicate they had underestimated the potential for misidentification, particularly in the prevailing good visibility.

Although the aircraft began its final descent from the correct point on the VOR/DME procedure, its rate of descent increased quickly to a value at least twice that which the crew would normally expect to use, and the aircraft deviated towards the runway at Langford Lodge. The crew must therefore have been visual with the private airfield from a very early stage on the approach, since otherwise they would have been following the recommended 3º approach using altitude / distance information and would not have deviated from the inbound course.

There were multiple cues to warn the crew that they were making an approach to the wrong airfield. Despite descending at the correct point, the apparent requirement for an immediate and sustained high rate of descent of up to 2,000 ft/min throughout the approach, which itself was a significant cue, clearly did not alert the crew to the situation. The crew's workload would have been high during the steep final approach, particularly if the aircraft still needed to be configured for landing and the landing checklist completed. It is probable that the crew's attention would have been so focused on flying the aircraft that their ability to assimilate the other cues was drastically reduced, until the point that environmental cues became overwhelming or ATC broadcast their 'climb immediately' instruction. The recorded data indicates that these things happened almost simultaneously.

The crew's public address that the runway was blocked may have been prompted by the presence of the Beech aircraft taxiing on Runway 21 which, if seen early enough, may have reinforced the crew's belief that they were approaching what appeared to be an active airfield.

The subsequent visual approach at Aldergrove caused more concern to the passengers than the missed approach at Langford Lodge. Radar data supports the accounts of passengers and the Tower controller that the aircraft carried out significant manoeuvres at a very late stage on the approach. As the approach was clearly unstable, the crew would be expected to have carried out a further go-around. Additionally, the Tower controller, who was observing the aircraft's manoeuvres, had the authority to instruct the crew to go-around if she considered that the aircraft was 'dangerously positioned' according to the definition in MATS Part 1.

INCIDENT

Aircraft Type and Registration:	Boeing 747-400, 9M-MPL
No & Type of Engines:	4 Pratt and Witney 4056 turbofan engines
Year of Manufacture:	1998
Date & Time (UTC):	18 May 2006 at 0425 hrs
Location:	Over the Thames Estuary, England
Type of Flight:	Public Transport (Passenger)
Persons on Board:	Crew - 20 Passengers - 348
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	47 years
Commander's Flying Experience:	13,493 hours (of which 2,804 were on type) Last 90 days - 72 hours Last 28 days - 38 hours
Information Source:	AAIB Field Investigation

Synopsis

A passenger saw what appeared to be small flames coming from between the No 1 engine exhaust shroud and its pylon; the flight crew were informed. The engine indications were normal; nevertheless, the commander decided to shut the engine down. The 'flames' continued until the aircraft was slowed for an approach. The aircraft landed uneventfully. Investigation revealed that a rubber seal had torn, and that when agitated by the air flow it gave the appearance of flames. There had been eleven previous events reported on similar aircraft.

History of the flight

The aircraft departed Kuala Lumpar on a scheduled flight to London (Heathrow), with a flight crew of two captains and two co-pilots. One captain and co-pilot operated the aircraft for its takeoff, climb and the early part of the cruise; this captain was designated as the commander for the flight. The other captain and co-pilot flew the cruise portion of the flight until a little more than one hour from landing when the original crew resumed control of the aircraft.

The flight was uneventful until shortly before the aircraft commenced its descent towards London. A passenger observed what appeared to be orange flames between the No 1 engine exhaust shroud and its pylon. The passenger pointed this out to one of the cabin crew, who immediately informed the flight crew via the interphone. The 'cruise' co-pilot was sent to the rear of the passenger cabin to look at the engine through a window. He also saw what appeared to be flames, and went back to the flight deck to report this. Having discussed the situation, the 'cruise' co-pilot returned to the rear of the passenger cabin and remained there, in interphone communication with the flight crew, for the remainder of the flight. The 'cruise' captain also went to the passenger cabin to assess the situation, before returning to the flight deck where he confirmed the co-pilot's report.

The flight crew and the 'cruise' captain evaluated all of the available information, including the engine indications, which were normal. As the aircraft descended, they shut down the No 1 engine, and pulled the fire handle (in order to shut off the fuel and hydraulic connections to the engine and isolate it electrically). As there were no flight deck indications of an engine fire, they did not discharge the fire extinguisher bottles.

After the engine had been shut down, the 'cruise' co-pilot reported that the 'flames' appeared to remain, and when the aircraft decelerated from 290 kt to 250 kt, they appeared to increase slightly.

The flight crew informed ATC that they had a problem and that there was a "ONE FOOT FLAME" from the No 1 engine. They requested a priority landing with the fire service placed on standby. The controller explained that the flight crew would need to declare an emergency in order to be given priority; the flight crew declared a 'PAN' and the aircraft was then radar vectored for a priority landing. When Flap 5 was selected, the 'flames' appeared to extinguish. The commander completed an uneventful automatic approach and landing, and the aircraft was inspected by the airport fire service before taxiing to the terminal buildings.

Communications

Radio communications between the flight crew and ATC were analysed. Although the flight crew did inform ATC of the aircraft's problem, they did not use the stipulated phraseology[1]; nonetheless, the communication was clearly understood by ATC. Later, the flight crew did not inform ATC when the 'fire' had ceased, nor that the No 1 engine had been shut down. Given the benign nature of the problem, and the fact that the landing was uneventful, there was no detrimental outcome of these omissions.

Recorded data

The aircraft was fitted with a Cockpit Voice Recorder (CVR) and a Flight Data Recorder (FDR). The CVR recorded the last two hours of cockpit audio. However, despite timely requests to isolate power from the CVR, the useful recordings were overwritten by the time that the AAIB attended the aircraft. The FDR recorded over 53 hours of data.

The aircraft took off at 1557 hrs on 17 May 2006 and landed at Heathrow at 0442 hrs on 18 May 2006. At 0417 hrs, the aircraft commenced its descent from FL360. The autothrottle was in VNAV mode and the thrust levers were retarded to facilitate the descent. The parameters for the No 1 engine indicate that it was shutdown at 0429 hrs with the aircraft at a pressure altitude of approximately 10,000 ft.

There were no indications of an engine fire, engine overheat or any other engine abnormality.

Footnote

[1] CAP 413, the *Radiotelephony Manual*, gives the correct phraseology for declaration of urgency ('PAN') or emergency ('MAYDAY')

Engineering examination

Initial examination of the rear lower pylon area did not reveal any evidence of burning or of fluid leaks. The area, both externally and internally, showed evidence of a dark 'sooting' type of staining that was dry and of a long-term nature. There was no evidence of hydraulic fluid loss from the aircraft reservoirs nor a fuel loss or fuel tank imbalance. The aircraft's hydraulic and fuel systems were 'powered up' and no fluid leaks were observed. The No 1 engine was 'motored' with the fuel selected off and on and no fluid leaks were observed. All the pylon panels, including the upper wing panel, and the engine cowls, including the 'C' duct, were opened and no evidence of any fluid leaks was seen.

A telephone call from the aircraft manufacturer's Safety Services Department informed the AAIB of a number of previous incidents of reported airborne fire in the area of the lower rear pylon and the engine tail pipe. In each case extensive examination on the ground found no evidence of a fire having taken place but that the inboard 'sacrificial' bulb seal between the lower rear area of the pylon and the tail pipe had torn/failed. These bulb seals, part number 313T3371-21, are circular in cross-section, hollow, approximately 1.25 inches in diameter, 14 inches long, and made from flame-orange-coloured, high temperature, silicon rubber. Examination of the aircraft involved in this incident showed that the bulb seal on the inboard side of the No 1 lower rear pylon (Figure 1) had torn/failed along its fore/aft axis allowing the outer section to protrude into the air stream around the pylon.

Following replacement of the engine cowls and pylon panels the aircraft was taken to an isolated area of the

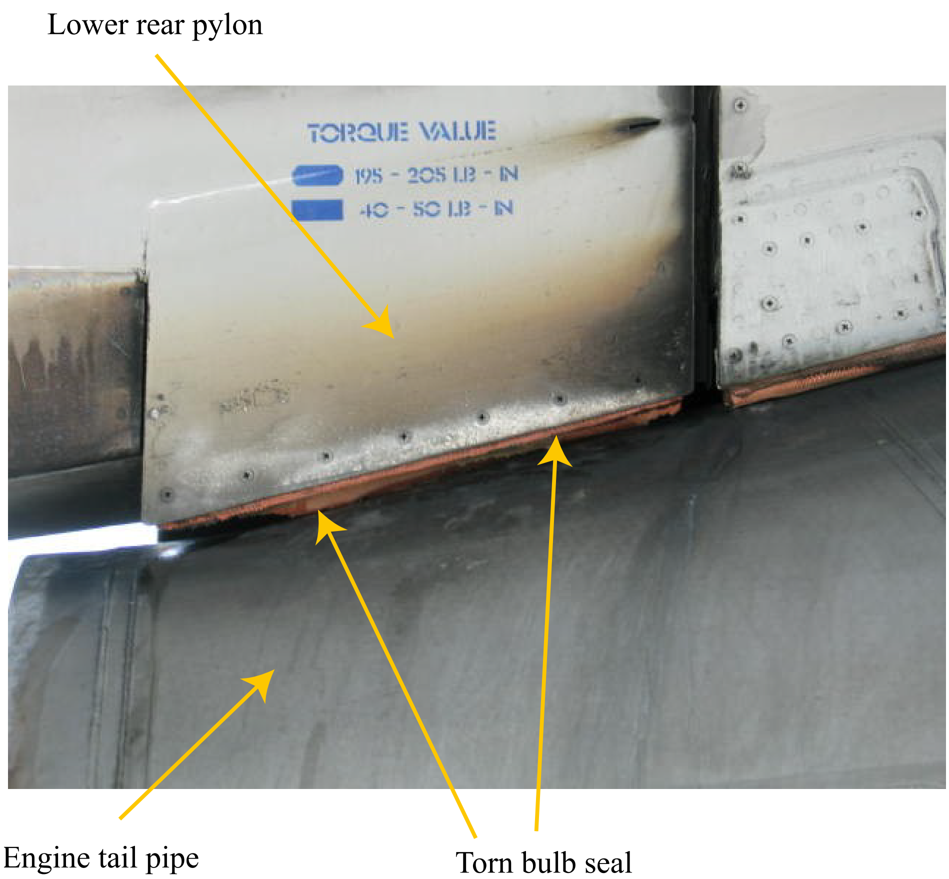


Figure 1

airport where low and high engine power runs were carried out. During these engine runs no fluid leaks were noted and all flight deck indications were normal. An observer was placed in the seat in the cabin from where the 'cruise' co-pilot observed the flames during the aircraft's descent and he noted that during the full power run the torn bulb seal 'flapped' in the airflow in a way that could very easily be mistaken for a flame. This 'flapping' bulb seal was also seen by ground observers.

The torn bulb seal was changed and the aircraft returned to service with no further problems reported regarding airborne fires in the areas of the pylon tail pipe interface.

Previous history

In January 2002 the aircraft manufacturer issued 747-400-FTD (Fleet Team Digest)-54-02001, revised April 2006, alerting Boeing 747-400 operators with PW 4000 series engines to the possibility of torn/damaged pylon tailpipe bulb seals being mistaken by passengers and flight crew members for flames as it fluttered in the air stream.

The FTD article advised operators of Boeing's efforts to find a suitable replacement for the orange/red seal that would be less likely to be mistaken for a flame. In March 2006, Boeing advised operators that a suitable 'brown' coloured replacement part for the orange/red seal had been identified, although production and retrofit incorporation had not yet been scheduled. Boeing recommended that operators inspect the affected area on a periodic basis and replace damaged seals.

In the light of the aircraft manufacturer's continuing review of this issue, together with the provision of an alternative 'brown' coloured seal, the AAIB does not see the need for any recommendation.

INCIDENT

Aircraft Type and Registration:	Bombardier DHC-8-311 Dash 8, G-WOWC
No & Type of Engines:	2 Pratt & Whitney Canada PW123 turboprop engines
Year of Manufacture:	1991
Date & Time (UTC):	11 April 2006 at 1250 hrs
Location:	Plymouth Airport, Devon
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 5 Passengers - 42
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to tail strike sensor and its fibreglass cover
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	41 years
Commander's Flying Experience:	8,947 hours (of which 2,349 were on type) Last 90 days - 97 hours Last 28 days - 20 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

After a turbulent ILS approach to Runway 31 at Plymouth Airport the aircraft landed firmly and bounced. During the landing the aircraft's TOUCH RUNWAY warning light illuminated, indicating that the aircraft's tail had made contact with the runway. There was no structural damage to the aircraft. The incident occurred through a combination of turbulence, windshear and the pilot's inappropriate response to reducing airspeed throughout the final 10 seconds of the approach.

History of the flight

The aircraft was operating from London Gatwick Airport to Plymouth Airport. Before departing from Gatwick the flight crew noted that the wind at Plymouth was forecast to be strong and gusty from the south-west.

The TAF for the period 1000 hrs to 1900 hrs forecast a wind from 240º at 15 kt gusting to 25 kt. The weather recorded at the time of the incident indicated that the wind was predominately from 230º, but varying in direction between 200º and 280º, at 16 kt gusting to 27 kt. The visibility was 5,000 m in moderate rain and mist, with scattered cloud at 400 ft agl and broken cloud at 800 ft agl.

The departure and cruise phases of the flight progressed uneventfully. Before descent the flight crew obtained the actual weather for Plymouth Airport from ATC; it was similar to the forecast obtained at Gatwick. As a result the commander, who was PF, briefed the co-pilot about the possibility of windshear and asked him to monitor carefully the aircraft's IAS and vertical speed during the approach. He added that in accordance with company's Standard Operating Procedures, he would add a "pad" to the V_{REF} speed due to the strong and gusty wind. These procedures specify that an increment of half the wind speed and the entire gust factor should be added to V_{REF} subject to a minimum increment of 5 kt and a maximum increment of 20 kt. The additional speed is to guard against sudden drops in airspeed due to wind shear. The commander also decided to use the normal landing configuration of Flap 15 because this setting permitted a higher crosswind limit than Flap 35.

The landing weight of the aircraft was 39,000 lb. As a result, the operating crew would have used the speeds listed on the 40,000 lb landing card. The V_{REF}, with Flap 15, would have been 107 kt. Given the wind conditions, the commander would have been expected to fly a V_{APP} of approximately 125 kt; the aircraft should have touched down approximately 6 kt less, at 119 kt. The centre of gravity of the aircraft was in the middle of the allowable range.

The ILS progressed normally despite conditions being very turbulent. The commander reported that he became visual with the runway at approximately 300 ft aal, 100 ft above Decision Height, and he disconnected the autopilot. He then lowered the nose in order to bring the touchdown point closer to the threshold than the touchdown markers 1,000 ft from the threshold. As the aircraft crossed the runway threshold, at approximately 15 ft aal, just as the commander commenced the landing flare, both he and the co-pilot reported sensing a "sinking feeling". The commander applied a small amount of power and pulled the control column back slightly in an attempt to arrest the rate of descent. There was no GPWS sink rate warning.

The aircraft landed firmly and the operating crew perceived that it "bounced slightly". At this point the co-pilot reported that he noticed the TOUCHED RUNWAY warning light had illuminated. The commander stated that he could not recall if the warning illuminated as a result of the first or second touchdown.

The aircraft was then taxied onto its stand where the commander reported the warning light to the engineers and the awaiting operating crew. Upon inspection, the only damage found was to the 'touched runway' sensor and its fairing; there was no structural damage to the aircraft.

Plymouth Airport

The UK Aeronautical Information Package (AIP) contains the following warnings in the section for Plymouth Airport:

> *'In strong wind conditions windshear and turbulence may be experienced on the approach to or climb out from any runway. Downdraught effect and sudden changes in wind velocity are possible in light wind conditions.'*
>
> *'Significant differences may occur between the surface wind velocity reported by ATC and the actual wind at approximately 100 ft aal.'*

These warnings are also printed on the airfield charts for Plymouth used by the operator's flight crew.

Aircraft handling qualities

Flap 15 is the normal landing configuration for a Dash 8. Flap 35 is available, but normally it is only used when landing distance is a limiting factor. Due to the wind conditions the commander elected to make a Flap 15 approach and landing because the crosswind limit with Flap 15 is 6 kt greater than with Flap 35. With Flap 15 set, the aircraft had a crosswind limit of 27 kt on a wet runway. Also, the aircraft is more responsive with Flap 15 due to the lower airframe drag.

The operating company commented that during a normal landing, the aircraft should be flared at or just below 10 ft agl and the throttles closed at the same time. Additionally, if the aircraft is flared to a pitch attitude of more than 6º nose up, there is a risk of tail strike.

Flight Data Recorder

The Flight Data Recorder (FDR) was sent by the operator to an approved commercial avionics servicing facility for download and the recovered data was subsequently supplied to the AAIB for analysis.

A time-history of the relevant parameters during the incident landing is shown at Figure 1. The data presented at Figure 1 starts as G-WOWC was established on the glideslope, flaps up, descending through 2,000 ft amsl, with 150 kt airspeed and decelerating. The engine torques were 5% and the propeller speeds were just over 900 rpm. The autopilot was engaged.

The flaps were then lowered, extending to the approach and landing setting of 15º by 1,600 ft amsl as the aircraft continued to descend and slow down (with small adjustments in engine torque and aircraft pitch to maintain this descent profile). As the aircraft passed through 1,450 ft amsl and 117 kt (8 kt below the appropriate V_{APP}), there was an increase in engine torque (to 25%) followed by an increase in propeller speed (to the 1,200 rpm maximum).

Continuous changes to pitch (between -1.5º and +2.5º) and torque (between 18% and 41%) were made for the next 60 seconds as G-WOWC continued to descend at a rate of about 670 ft/min. During this portion of the descent the airspeed slowed to 110 kt (15 kt below the appropriate V_{APP}) before increasing to about 125 kt, the appropriate V_{APP}, as the aircraft passed through 820 ft amsl. At this point, just under 30 seconds before touchdown, the autopilot was disconnected.

Immediately after autopilot disconnect, there was a nosedown elevator input causing the aircraft to pitch down to -6º and accelerate to 131 kt. The descent rate also increased to 750 ft/min and the aircraft descended below the glideslope. The airspeed then began to reduce as the pitch attitude started to increase and the engine torque started to reduce. Ten seconds before touchdown, the airspeed was 125 kt (V_{APP}) and still reducing, the engine torques were 7% and reducing, and the height above ground level was 122 ft over rising terrain towards the airfield. The propeller speed for Engine 2 then reduced, gradually at first then more rapidly together with Engine 1 just before touchdown; these changes were a consequence of the reducing air speed in the landing flare. Coincidentally, there was also a small increase in engine torques. The pitch attitude during the flare was checked at +4º for about one second as the aircraft descended below 20 ft agl.

G-WOWC touched down with a maximum recorded pitch attitude of +8º at 94 kt (31 kt below the appropriate V_{APP} and 13 kt below V_{REF}), with a peak vertical acceleration of +2.3g. The nose gear contacted the ground 1.6 seconds later.

The data sampling rate of one sample/second for both radio height and pressure altitude meant that detecting signs of sink in the final stages of the approach using the recorded data would be unreliable, particularly if the sink was transitory.

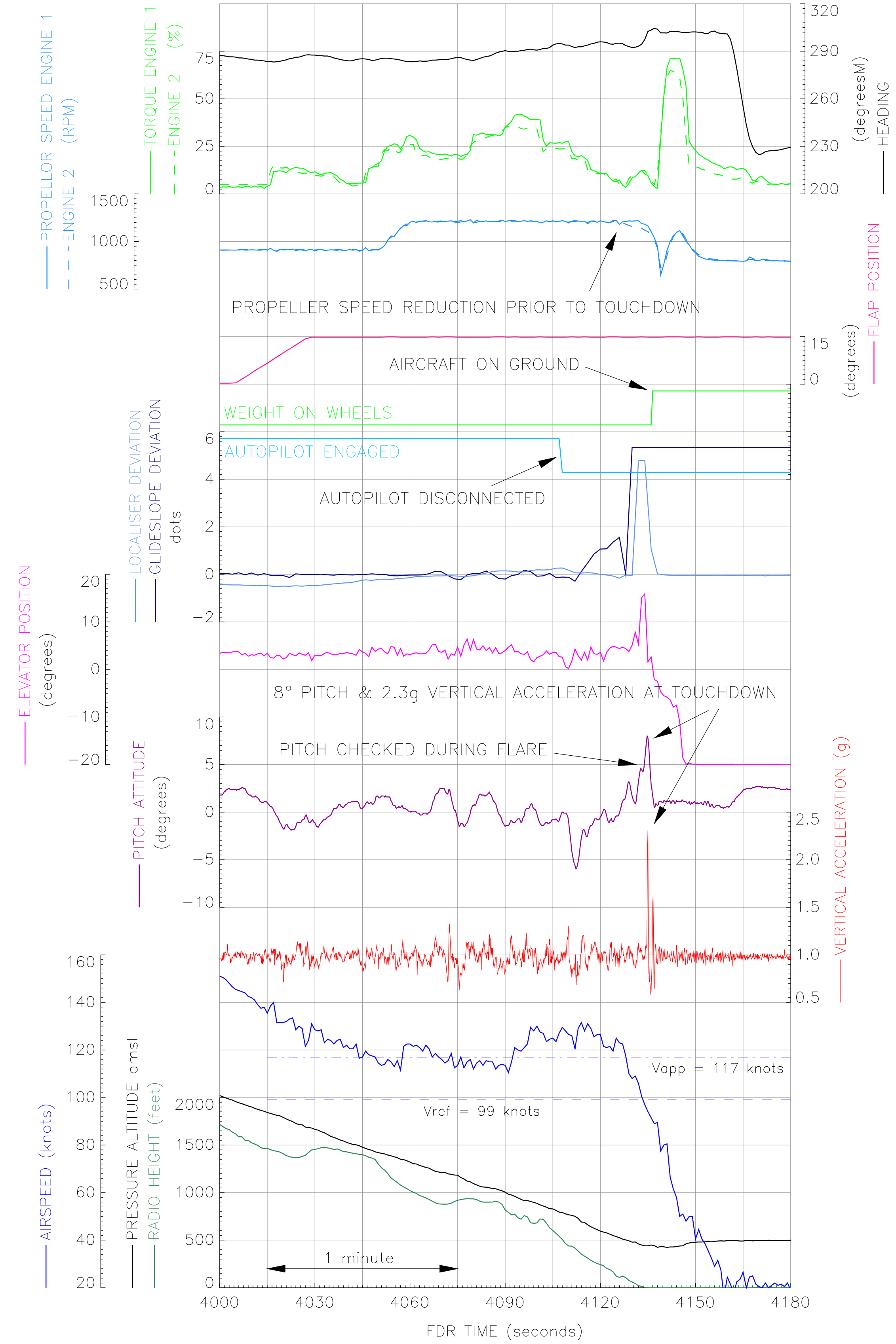


Figure 1

Salient FDR Parameters - Approach and Landing

Analysis

The commander commented he had experienced the conditions mentioned in the AIP when landing on Runway 31 at Plymouth. Given the wind at the time and bearing in mind the AIP warnings, it is likely that some form of windshear reduced the aircraft's IAS during the final stages of the approach.

Soon after the autopilot was disconnected, the aircraft pitched nose down and descended below the glideslope. This happened at about the time the commander became visual with the runway and at the same time the throttles were retarded. The IAS then fluctuated between 120 kt and 130 kt until 7 seconds before touchdown. In turbulent conditions it is common practice for pilots to allow the speed to fluctuate around V_{APP} whilst ensuring that it does not go below V_{REF}.

Next, at about 90 ft aal, the IAS reduced below the appropriate V_{APP} and the throttles were retarded a little further. Because the aircraft was relatively heavy, this closure of the throttles would have increased drag caused by the propellers and reduced lift over the inboard sections of the wings. All of these factors combined would have caused the IAS to continue decreasing and for the aircraft's sink rate to increase. Flaring the aircraft at 20 ft agl, higher than the recommended 10 ft agl, further reduced the aircraft's airspeed.

The reduction in thrust, combined with a slow and heavy aircraft, would have increased the aircraft's rate of descent and may have caused the "sinking feeling" felt by the crew. Any negative wind shear would also have aggravated the reduction in airspeed and wing lift. Just after the "sinking feeling" was perceived, the throttles were advanced slightly, and the commander raised the aircraft's nose to reduce the rate of descent prior to touchdown. This pitch up led to a slight over-rotation of the aircraft at touchdown and the 'touched runway' sensor contacting the runway.

Conclusion

The incident occurred through a combination of turbulence, windshear and the pilot's inappropriate response to reducing airspeed throughout the final 10 seconds of the approach. The handling pilot's control inputs caused the aircraft's pitch attitude to exceed the 6º nose-up limit, beyond which there is a risk of a tail strike. In this incident the consequential damage was limited to the 'touched runway' sensor.

ACCIDENT

Aircraft Type and Registration:	Beagle B121 Series 1 Pup, G-AZSW
No & Type of Engines:	1 Continental Motors Corporation O-200-A piston engine
Year of Manufacture:	1969
Date & Time (UTC):	3 September 2006 at 1453 hrs
Location:	Sandown Beach, Isle of Wight
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to nose landing gear and propeller engine cowling, immersion in salt water
Commander's Licence:	Private Pilot's Licence
Commander's Age:	68 years
Commander's Flying Experience:	5,029 hours Last 90 days - 19 hours Last 28 days - 10 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and subsequent telephone enquiries made by the AAIB

Synopsis

After taking part in an air race, as the pilot slowed the aircraft to join others preparing to land, the aircraft's engine progressively lost power. This resulted in the aircraft ditching in shallow water just offshore from Sandown Beach.

History of the flight

The pilot had just taken part in the Royal Aero Club's 'Schneider Trophy Air Race'. In preparation to rejoin the circuit at Bembridge Airfield on the Isle of Wight, he enriched the mixture, throttled back and pitched up to slow the aircraft, when the engine progressively lost power. At this point, the weather had just started to close in and the aircraft was at an altitude of around 500 ft to 600 ft, over the sea, just offshore at Sandown. The pilot reported that he selected the fuel pump, changed fuel tanks and pulled the carburettor heat control, but this did not restore power on. He then decided to abandon any further attempt to restart the engine and to carry out a precautionary landing on the beach at Sandown. However, realising that breakwaters positioned across the beach precluded this, he decided instead to put down on the shallow water just offshore. A successful ditching was made, with the aircraft floating initially before drifting to the beach. The pilot was wearing a full harness, was uninjured and vacated the aircraft through the left side door.

In his report to the AAIB, the pilot stated that the right fuel tank was selected when the power loss occurred. The contents of this tank were low but, in his judgement, adequate, and he reported that there was some 60 kg of fuel on board the aircraft at the time.

Examination of the aircraft by a maintenance organisation failed to reveal any obvious reason for the engine failure. The pilot has offered several possible reasons for the failure, including unporting of the fuel offtake in the tank as the aircraft pitched up, rich cut due to the abrupt mixture enrichment with a hot engine and going from full to low power too quickly. However, carburettor icing would seem the most likely reason, given the following SYNOP[1] report for St Catherine's on the Isle of Wight at 1450 hrs:

Temperature 18.8ºC, Dew point 18ºC
(a relative humidity of 95%)

These conditions would have been conducive to the formation of severe carburettor icing at any power.

Footnote

[1] A maritime meterological report from a land or ship based observing station.

ACCIDENT

Aircraft Type and Registration:	Cessna A152 Aerobat, G-BRCD
No & type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1978
Date & Time (UTC):	25 August 2006 at 1225 hrs
Location:	White Waltham Airfield, Berkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Minor) Passengers - 1 (Minor)
Nature of Damage:	Extensive
Commander's Licence:	Private Pilot's Licence
Commander's Age:	53 years
Commander's Flying Experience:	189 hours (of which 1.15 were on type) Last 90 days - 10 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft landed normally from a steeper than usual approach. During the landing roll the aircraft hit a bump and bounced twice, landing heavily. The nose wheel detached from the nose leg, causing the leg to dig into the grass surface. The aircraft pitched forward and came to rest upside down. Neither of the two occupants was seriously injured and both were able to vacate the aircraft. A fatigue fracture in the nose gear leg was considered a possible cause of the nose wheel detaching from the aircraft.

History of the flight

The pilot had recently joined a syndicate which owned the aircraft. She had completed a check flight and one other flight in the aircraft prior to the accident flight. The pilot had planned to fly with a colleague from her home airfield at Shoreham in Sussex to White Waltham. In preparation for the flight, and since it was her first visit to White Waltham, the pilot spent some time studying the airfield details, which included specific noise abatement procedures.

The flight to White Waltham was uneventful and conducted in fine conditions and light winds. An overhead join was flown for the grass Runway 25. When the aircraft was downwind, the pilot's colleague prompted her to turn finals, being aware of the noise abatement circuit pattern. The pilot thought this was a bit early but nevertheless commenced a turn onto base leg. As the aircraft became established on finals, it became clear to the pilot that the aircraft was high on the approach, and she considered a go-around. However, as the aircraft was correcting to a normal approach path satisfactorily she continued the approach.

Although the final stage of the approach was still steeper than usual, the pilot reported that the touchdown itself appeared normal. The pilot was expecting the landing surface to be bumpy, but the initial roll-out was quite smooth. Then, after six or seven seconds, the aircraft hit a bump which caused it to become airborne again temporarily. The aircraft landed again heavily, apparently on all three wheels together, before bouncing a second time. When the aircraft came down again, the pilot felt the nose leg dig into the ground before the aircraft pitched forwards and turned over.

The aircraft suffered extensive damage but there was no fuel leak and no fire. Emergency services attended the scene, though both occupants had been adequately restrained by full harnesses and received only minor injuries. With minor damage to the cabin, they were able to leave via the main door.

Possible causes

Engineering personnel at the airfield inspected the aircraft and commented to the pilot that there was a possible fatigue fracture in the nose leg. From photographs supplied by the pilot, it was clear that the nose leg fork had detached from the scissor link assembly on the shock strut. Although the photographs showed signs of an overload failure in the fork attachment to the strut, it was not possible to say from the photographs whether the failure was caused in overload or precipitated by fatigue.

The pilot considered that it had not been practical to initiate a go-around at the time of the first bounce, as the aircraft had lost too much energy at that point and to attempt to do so may have made matters worse. She also considered whether a go-around would have been advisable from finals, particularly considering her lack of experience on the aircraft. However, she felt that the landing itself was good, so did not think the steeper than normal approach was a factor in the accident. As for the nose gear failure, the pilot thought that she had experienced several occasions when the nose gear had landed harder, so considered it likely that fatigue had indeed been a factor in the nose gear failure.

ACCIDENT

Aircraft Type and Registration:	Cessna F150L, G-AYKL
No & type of Engines:	1 Continental O-200-A piston engine
Year of Manufacture:	1970
Date & Time (UTC):	16 August 2006 at 1322 hrs
Location:	Netherthorpe Airfield, Nottinghamshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Minor) Passengers - 1 (Minor)
Nature of Damage:	Severe damage to propeller, fuselage and wings
Commander's Licence:	Private Pilot's Licence
Commander's Age:	57 years
Commander's Flying Experience:	459 hours (of which 325 were on type) Last 90 days - 5 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft was departing from Runway 24 at Netherthorpe. During the takeoff the initial acceleration was normal, but as the aircraft became airborne the engine power appeared to reduce. The pilot attempted to increase airspeed by lowering the nose, but after a short distance the right wing dropped and the aircraft struck the ground.

History of the flight

The pilot had planned to take a friend on a local flight before returning to Netherthorpe. They arrived at the airfield at approximately 1240 hrs and the pilot carried out the normal daily inspection. The fuel sample check was satisfactory with no indication of water contamination. As the fuel state was low the pilot refuelled the aircraft, uplifting 29.5 litres. A visual inspection of the fuel tanks, following the refuelling, showed them to be just under half full. The weather was good with a surface wind from 270º at 5 kt, visibility of approximately 8 km and broken cloud at 3,000 ft. Whilst the temperature was not recorded, the pilot described the ambient conditions as warm but not hot.

Netherthorpe Airfield has two runways, Runway 06/24 and Runway 18/36: Runway 24 was the active runway at the time of the accident. Runway 24 is 553 metres long and 36 metres wide with a grass surface; at the time of the accident the surface was dry, hard and had recently been mown. It also has a 1.9% uphill slope and the airfield elevation is 254 ft amsl.

The engine start and the power checks were normal and the pilot explained to his passenger the actions that he was performing. He emphasised the importance of checking for a drop in rpm during the magneto and carburettor heat check, and ensured that the rpm returned to normal when both magnetos were selected and when the carburettor heat was selected OFF. Having completed the relevant checks the pilot taxied the aircraft to the holding point for Runway 24.

At the holding position the pilot carried out the pre-takeoff checks following his checklist. This included another check for carburettor icing, although none was evident. It was also the pilot's practice to keep his hand on the carburettor heat knob until he pushed it back in; this was to prevent leaving it inadvertently selected to ON. The pilot selected the flaps to 10º. Having completed the pre-takeoff checks, the aircraft was lined up on Runway 24 ready for departure. The windsock was hanging limply in the light breeze with the general wind direction from 270º.

The pilot applied full throttle; the engine responded and the aircraft accelerated normally. The intersection of the two runways was the point at which the pilot normally decided whether to continue or abandon a takeoff. At this point the IAS was 45 mph, which was normal, and the pilot continued towards the 55 mph required for lift off. The pilot reported that, shortly after the intersection, the rate of acceleration reduced. He considered abandoning the takeoff but believed that there was insufficient runway remaining to stop and, with the aircraft responding to aft control column inputs, he raised the nose and lifted off.

The aircraft climbed slowly to approximately 50 ft, at which point the pilot lowered the nose in an attempt to increase the airspeed. Approximately 400 metres from the up-wind end of the runway, the right wing dropped and the aircraft impacted the surface of a grass field. The airframe was heavily disrupted and both persons on board were slightly injured. The pilot and his passenger were able to release their harnesses and vacate the aircraft through the normal access doors. The airfield Rescue and Fire Fighting Service attended the scene promptly.

Weight and CG

The calculated weight of the aircraft for the departure was 1,591 lbs, with the CG at + 34.9 inches from the manufacturer's datum. The aircraft was thus close to its maximum takeoff weight of 1,600 lbs with the CG near the mid-point of its permitted range.

Performance

The Owner's Manual provides performance data for the pilot to determine the Take-Off Run Required (TORR) and Take-Off Distance Required (TODR) to 50 ft. The manufacturer's performance data was applied to the following conditions: a level, hard, dry, grass surface at 254 ft amsl, with an ambient temperature of 15ºC, a zero headwind component and flaps set to 10º. The resultant TORR was 220 metres and the TODR was 460 metres. The manufacturer's data required these distances to be increased by 10% for each additional 35ºF; thus at an ambient temperature of 34ºC the TORR was 242 metres and the TODR was 506 metres. No distance increment for the up slope was available in the Owners Manual. The CAA Safety Sense Leaflet 7C '*Aeroplane Performance*' suggests an increment of 10% for a 2% uphill slope. This increases the TORR to between 242 metres and 266 metres for the temperature range considered.

The following information is included in the Owner's Manual regarding the use of flap during takeoff:

FLAP SETTINGS

Normal and obstacle clearance take-offs are performed with flaps up. The use of 10° flaps will shorten the ground run approximately 10%, but this advantage is lost in the climb to a 50 foot obstacle. Therefore the use of 10° flaps is reserved for minimum ground runs or for take-off from soft or rough fields with no obstacles ahead.

If 10° of flap are used in ground runs, it is preferable to leave them extended rather than retract them in the climb to the obstacle. The exception to this rule would be in a high altitude take-off in hot weather where climb would be marginal with flap 10°. Flap deflections of 30° and 40° are not recommended at any time for take-off.

The CAA Safety Sense Leaflet 7C '*Aeroplane Performance*' recommends that the appropriate Public Transport factor should be applied for all flights. For takeoff this factor is 1.33 and applies to all single-engined aeroplanes and to multi-engined aeroplanes with limited performance scheduling (Group E). This factor takes into account:

- Lack of practice
- Incorrect speeds / techniques
- Aeroplane and engine wear and tear
- Less than favourable conditions

Analysis

The aircraft was operating close to its maximum weight with the CG at a mid-position. The pilot had operated from Runway 24 at Netherthorpe in similar weather conditions and close to the maximum weight on previous occasions. With 10° of flap selected the performance during these departures had been adequate. However, the Owner's Manual states that normal and obstacle clearance takeoffs should be performed with the flaps up.

The pilot had carried out the engine pre-takeoff checks, which were normal, and had checked the carburettor heating, which he then selected off immediately prior to departure. The runway length available was sufficient in accordance with the manufactures performance requirements, even allowing for the Public Transport takeoff safety factor of 1.33.

No explanation for the loss of power was identified and although the ambient temperature was not recorded, it was described as warm rather than hot. The wing drop and loss of control were considered to be the result of the pilot attempting to maintain or increase height, with a subsequent loss of airspeed leading to a stall.

ACCIDENT

Aircraft Type and Registration:	Cessna R172K Hawk XP, G-BPCI
No & type of Engines:	1 Continental Motors IO-360-K piston engine
Year of Manufacture:	1977
Date & Time (UTC):	7 August 2006 at 1330 hrs
Location:	Plockton Airfield, Kyle of Lochalsh, Scotland
Type of Flight:	Private
Persons on Board:	Crew -1 Passengers - 2
Injuries:	Crew - None Passengers - None
Nature of Damage:	Fracture to left nosewheel hub, substantial damage to the engine bulkhead, distortion to the fuselage side panels, and a strike on one propeller blade tip
Commander's Licence:	Private Pilot's Licence
Commander's Age:	50 years
Commander's Flying Experience:	446 hours (of which 79 were on type) Last 90 days - 6 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further AAIB enquiries

Synopsis

On landing the aircraft was reported to have touched down on its main wheels first but when the nosewheel touched down, the aircraft became hard to control. The aircraft was brought to a halt on the runway. Subsequent inspection revealed damage consistent with a heavy impact on the nosewheel.

History of the flight

After an uneventful flight from Cumbernauld to Plockton the pilot flew an approach to Runway 20. He stated that because the runway was quite short, he selected full flap and maintained both the correct height and airspeed throughout the approach. The pilot reported that the weather at the time was good with a south-westerly wind of less than 5 kt.

The pilot believed the main wheels touched down first but stated that when the nosewheel touched down the aircraft 'reacted badly'. The two passengers reported hearing a noise as the nosewheel touched down. The pilot brought the aircraft to a halt on the runway and shut down.

Aircraft inspection

Subsequent inspection of the aircraft revealed part of the left side of the nosewheel hub had fractured, deflating the tyre. Further examination revealed substantial damage to the engine bulkhead and distortion to the fuselage side panels, consistent with a heavy impact on the nosewheel. One of the propeller tips also showed evidence of having struck the ground.

ACCIDENT

Aircraft Type and Registration:	Cessna R182, G-BOWO
No & type of Engines:	1 Lycoming O-540-J3C5D piston engine
Year of Manufacture:	1978
Date & Time (UTC):	1 September 2006 at 1637 hrs
Location:	Runway 22, Wolverhampton Airport
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Nose landing gear and propeller damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	76 years
Commander's Flying Experience:	660 hours (of which 4 were on type) Last 90 days - 6 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft landed in gusty wind conditions and the nosewheel collapsed.

History of the flight

The pilot had recently purchased the aircraft and was carrying out circuits using Runway 22 at Wolverhampton Airport. This asphalt runway has an available landing distance of 574 m (1,880 ft), a width of 18 m (59 ft) and a downslope. The surface wind was gusty and the reported wind at the time of the accident was from 230º at 15 kt.

The Flight Information Service Officer (FISO) on duty in the tower reported that on the third or fourth circuit the aircraft bounced on landing and carried out a go-around. The pilot then called to say that he was leaving the circuit for a local flight. After about 10 minutes the aircraft returned to the airfield and the pilot made a further approach to Runway 22. The FISO watched the aircraft landing, saw it 'porpoise' and then land nose down, whereupon the nose landing gear collapsed. Neither person on board was injured in the accident.

The pilot reported that he had experienced a sudden gust of crosswind as the aircraft touched down, which lifted the aircraft back into the air and then dropped it suddenly, causing a hard landing on the nosewheel. The maximum demonstrated crosswind component for the Cessna 182 series of aircraft is 15 kt.

An Aircraft Owners and Pilots Association (AOPA) study on landing accidents showed that landing was the phase of flight when most Cessna 182 accidents occurred, and that the type had a greater proportion of hard landing accidents relative to other comparable types. The study noted that common factors in the accidents were: pilots transitioning from types of aircraft with lighter elevator controls; a forward centre of gravity, which typically occurred with two persons on board, and poor speed control on short finals.

ACCIDENT

Aircraft Type and Registration:	Denney Kitfox Mk 3, G-DJNH
No & type of Engines:	1 Rotax 582 piston engine
Year of Manufacture:	1991
Date & Time (UTC):	13 July 2006 at 1355 hrs
Location:	Old Sarum Airfield, Wiltshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to left landing gear, left wing tip and propeller
Commander's Licence:	Air Transport Pilot's Licence
Commander's Age:	60 years
Commander's Flying Experience:	24,395 hours (of which 40 were on type) Last 90 days - 25 hours Last 28 days - 15 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The pilot reported that the aircraft encountered a gust of wind shortly after takeoff which caused the aircraft to contact the ground.

Circumstances

The aircraft was taking off from the grass Runway 06 at Old Sarum. The surface wind was reported by the pilot as being from 030º(M) at 15 kt and gusty. At an estimated 5 ft above the runway, a gust of wind caught the aircraft, causing the left landing gear to contact the ground and collapse. The left wing tip also suffered slight damage. The pilot and his passenger, who were both wearing full harnesses, were uninjured and able to leave the aircraft through the normal door.

ACCIDENT

Aircraft Type and Registration:	Luton LA4A Minor, G-AYSK
No & type of Engines:	1 Continental A65-8F piston engine
Year of Manufacture:	1971
Date & Time (UTC):	8 September 2006 at 1505 hrs
Location:	Barton Aerodrome, Manchester
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Severe damage to propeller, engine and forward fuselage, slight damage to wings
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	70 years
Commander's Flying Experience:	410 hours (of which 28 were on type) Last 90 days - 1 hour Last 28 days - None
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

After starting the engine the pilot taxied the aircraft to the appropriate holding point where he positioned the aircraft into the light and variable wind to complete the engine power checks. The engine stopped abruptly. The pilot, having closed the throttle, exited the aircraft to 'hand swing' the propeller. When the propeller was swung the engine started immediately and the aircraft moved forward. The pilot held onto the left wing strut in an attempt to steer the aircraft towards an open area. The aircraft tracked in an arc to the left and the pilot was eventually forced to let go of the strut. The aircraft became airborne and stalled into an open area of the airfield.

History of the flight

The pilot arrived at the airfield to carry out a flight in the local area. He pulled the aircraft out of its hangar, onto the grass area adjacent to the tower, and chocked both main landing gear wheels before carrying out the pre-flight checks. Having donned a flying suit and protective helmet, the pilot started the engine.

The surface wind was from the south-east at 6 kt; the weather was CAVOK with a temperature of 19ºC. The runway in use was 09R which has a grass surface. The pilot was cleared to taxi to holding point Bravo 3 where he intended to carry out the pre-takeoff and engine power checks.

On reaching Bravo 3 the pilot turned the aircraft into the light wind and then closed the throttle. Although the pilot expected the warmed up engine to run at tick-over, it stopped abruptly. Another aircraft was parked directly ahead, approximately 150 ft away. The pilot contacted ATC and obtained clearance to re-start the engine in his present position. He ensured that the throttle was closed and switched both magnetos to OFF before climbing out of the aircraft. He pulled the propeller to compression, selected the impulse magneto to ON and then swung the propeller. The engine started, ran to a high rpm and the aircraft moved forward accelerating towards the aircraft parked ahead. The pilot was unable to switch off the magneto or enter the cockpit but held onto the wing strut, which caused the aircraft to turn to the left. He attempted to continue to turn the aircraft to the left in order to point it at the wooded area on the south-west side of the airfield. Despite his efforts he lost his grip, the aircraft became airborne and then climbed steeply, banking to the right. It entered what witnesses described as a loop before crashing inverted in an area of rough ground on the south-western edge of the airfield.

Conclusion

The pilot believes that whilst exiting the aircraft after the engine had stopped his left leg may have contacted the top of the throttle lever thus opening the throttle. He did not feel this contact due to the padded clothing that he was wearing.

Whilst the pilot had checked the magneto settings at each stage of the propeller swinging process, he had not checked the throttle position. He concluded that in order to prevent such an incident recurring, it is essential to confirm that the throttle is set in accordance with the recommended starting procedure before swinging the propeller. When possible the main landing gear should also be chocked.

ACCIDENT

Aircraft Type and Registration:	Piper PA-22-150, G-ARCC
No & type of Engines:	1 Lycoming O-320-A2B piston engine
Year of Manufacture:	1956
Date & Time (UTC):	30 July 2006 at 1110 hrs
Location:	Popham Airfield, Hampshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 3
Injuries:	Crew - 1 (Minor) Passengers - 3 (Minor)
Nature of Damage:	Damage to rear fuselage, wing tips, propeller and engine
Commander's Licence:	Private Pilot's Licence
Commander's Age:	42 years
Commander's Flying Experience:	90 hours (of which 10 were on type) Last 90 days - 3 hours Last 28 days - 0 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot, statements of witnesses and examination by an AAIB inspector

Synopsis

The aircraft adopted a very high pitch attitude on takeoff, climbed at a low rate but failed to gain speed. It then stalled, dropped a wing and descended into the ground, striking it with a wing tip before somersaulting and coming to rest inverted.

History of the flight

The pilot had planned a local flight with two friends and their son. He carried out pre-flight checks on the aircraft before refuelling to two-thirds full. He considered that everything was normal until he began the takeoff run from the grass Runway 26.

The aircraft had one stage of flap set for the takeoff and the pilot considered that acceleration was normal; temperatures and pressures were in the normal range and the airspeed was rising satisfactorily. As the speed passed 50 mph, he applied back pressure to the control column and the aircraft took off and began to climb. Shortly after takeoff, the pilot realised he had selected an inappropriately high nose attitude and the airspeed was not rising as it should have been. Although he knew that the solution to the problem was to lower the nose, he was uncertain of his position relative to the runway and felt that lowering the nose might result in the aircraft's inability to clear a hedge on the airfield boundary. He decided to continue at the higher attitude until he was certain that the aircraft had climbed above the level of some neighbouring trees before lowering the nose to gain an increase in speed. Before the aircraft reached the desired height, it began to roll and yaw violently to the left.

The aircraft was observed from the clubhouse, approximately 200 metres from the start of the runway, just airborne and flying at a steeply nose-up attitude. Another observer, positioned approximately mid-way down the runway, first saw the aircraft at an estimated 30 to 40 ft, with a nose high attitude. He estimated that it climbed to approximately 130 ft by the time it was two-thirds of the way down the runway, before sinking 20 to 30 ft and suffering a wing drop to the left. A third observer, also positioned approximately two-thirds of the way along Runway 26, on the north side, saw the aircraft pass him at a height he judged to be level with the lower trees on the south side of the field, in a steep nose-up attitude. From the engine noise he deduced that it was operating at high power. The aircraft was not, however, gaining height. He noted that the wing shuddered and the left wing began to drop, followed by the nose. This altered the aircraft's track by 30º to 50º before it struck the ground on the southern edge of the field close to the Runway 08 threshold. In the observer's opinion, the engine noise remained unchanged until the impact occurred.

Examination of the wreckage site indicated that the aircraft impacted initially on the left wing tip and the nose before coming to rest inverted but facing in the original takeoff direction. The pilot confirmed that the aircraft somersaulted two or three times before coming to rest. Although it was very extensively damaged, the cabin area was not significantly deformed. The occupants were able to evacuate with minimum delay and only minor injuries.

According to the pilot's calculations the aircraft was flying at almost its maximum all-up weight. The Met Form 214 covering the relevant period, together with the TAF for the period at nearby Southampton, indicated that the ambient temperature would have been 20ºC or above and little wind would have been present.

Discussion

The evidence is that the aircraft climbed at too steep a pitch angle. The symptoms described are consistent with a stall and entry to the incipient spin and are the expected consequences of persisting to climb with decaying airspeed.

According to the pilot's figures, the aircraft was operating at almost its maximum takeoff weight. Meteorological information and ground observations showed that there was a relatively high ambient temperature and no significant wind. A relatively inexperienced pilot, in a low performance aircraft, faced with a 900 metre grass strip having a slight down slope followed by a gentle up slope, surrounded by trees and having a fairly high hedge at the end, could, under these atmospheric conditions, find the takeoff challenging. The difference in behaviour from that of the same aircraft without passengers and with less fuel, on a cooler day, with a significant wind down the runway, is considerable. Under the former adverse circumstances, pilots might inadvertently achieve high pitch attitudes immediately after takeoff, thereafter preventing the aircraft from reaching the normal speed and climb rate. The process of establishing and maintaining a suitable pitch attitude immediately after takeoff and allowing speed to build before initiating a cautious climb, is increasingly important as weight and ambient temperature increase. These last two factors reduce climb rate and hence angle. Careful pitch angle selection is particularly important with a low or zero head wind component since a particular rate of climb creates a lower climb angle than would occur with a greater headwind. This lower climb angle can create a compelling but false impression of low climb rate, encouraging the pilot to raise the nose higher than optimum, in an effort to achieve the anticipated climb angle.

At smaller airfields, calculations of runway distance available compared with the distance required, help to reassure pilots that obstructions at the end of the runway can be cleared comfortably. Should such calculations suggest that the takeoff performance is other than generous for the available distance, inexperienced pilots need to take particular steps to improve the margin, such as greatly reducing the passenger load and/or carrying less fuel. If necessary the intended flight should not be attempted until conditions become more favourable. It should be borne in mind that many private aircraft fly from much smaller airfields, with different surfaces from those on which their pilots train. The problems highlighted at such fields generally do not exist at the airfields from which flying schools operate.

Although the aircraft was very extensively damaged, the cabin area did not deform significantly. This fact, coupled with the nature of the initial impact on the wing tip, followed by crumpling of the outer wing, reduced the deceleration on ground impact and appears to have limited the occupant injuries.

ACCIDENT

Aircraft Type and Registration:	Pitts S-1C (4 Aileron), G-LOOP
No & type of Engines:	1 Lycoming O-320-E2D piston engine
Year of Manufacture:	1973
Date & Time (UTC):	17 September 2006 at 1425 hrs
Location:	Isle of Wight (Sandown) Airport
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Propeller, lower cowling, fairings and undercarriage damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	49 years
Commander's Flying Experience:	616 hours (of which 101 were on type) Last 90 days - Information not provided Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and AAIB telephone enquiries

Synopsis

During a takeoff on the grass Runway 23, the aircraft became airborne at a low speed and landed heavily, sustaining damage.

History of the flight

The pilot had flown from France to Sandown Airport with other owners of similar aircraft, and intended to depart for his home airfield. He commenced a takeoff on Runway 23, which has a grass surface and is 884 m long. He reported that at about 40 mph, his aircraft hit a bump in the runway surface, and became airborne with insufficient speed to fly. The aircraft landed heavily, and sustained damage, causing it to slew off the runway. The pilot discontinued the takeoff attempt and the aircraft came to a halt. The pilot shut the aircraft down and vacated the cockpit without injury. There was no fire.

The airfield owner, who was present but did not witness the accident, recalled that the weather was deteriorating at the time of departure, and the pilot had seemed in a hurry to depart. He reported that he was not aware of any bumps on the runway surface which could cause such an accident. A search of the AAIB database (for the ten years prior to the accident) revealed no other accidents in which the runway surface at Sandown was suggested as a factor.

ACCIDENT

Aircraft Type and Registration:	Socata TB10, G-BNRA
No & Type of Engines:	1 Lycoming O-360-A1AD piston engine
Year of Manufacture:	1987
Date & Time (UTC):	16 February 2006 at 1120 hrs
Location:	Nottingham Airport (Tollerton), Nottinghamshire
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Propeller blade shed, propeller and drive flange separated from engine, crankcase damaged and engine partly separated from mounting structure
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	41 years
Commander's Flying Experience:	2,198 hours (of which 10 were on type) Last 90 days - 90 hours Last 28 days - 30 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot; debris plot made by the maintenance company; photographs of damaged aircraft; examination of failed propeller components and of maintenance documentation by the AAIB

Synopsis

This accident was the subject of AAIB Special Bulletin S2/2006. A propeller blade detached during a touch-and-go landing, leading to loss of the propeller and partial separation of the engine from the aircraft. An existing Manufacturer's Service Bulletin was identified as being relevant to the failure. Three Safety Recommendations were made, to the Civil Aviation Authority (CAA), the Federal Aviation Administration (FAA) and the European Air Safety Agency (EASA). Subsequent metallurgical analysis confirmed the cause as a fatigue failure.

Since publication of the Special Bulletin, the CAA has issued a Letter to Operators on the subject and the FAA and the EASA have produced appropriate Airworthiness Directives. This final report expands on the Special Bulletin.

History of the flight

The pilot reported that during a touch-and-go landing, as he applied full power smoothly for takeoff, a loud bang was heard, the propeller detached and the engine shook from its mountings. He brought the aircraft to a halt maintaining it level despite asymmetric effects.

Engineering investigation

Analysis of the photographs provided to the AAIB confirmed that the engine had partly separated from the aircraft structure and had become re-orientated both in plan and in side elevation at angles between 30 and 40 degrees to the normal location (Figure 1). The two-bladed, constant speed propeller had detached and was found, with one blade missing, alongside the runway close to the point at which the aircraft came to a halt. The missing blade was on the other side of the runway closer to the touch-down point. Two depressions in the paved surface indicated where propeller debris had impacted with considerable force.

Figure 1

This model of propeller, a Hartzell HCC2YK-1BF, is of the variable pitch type in which the blades are located by thrust bearings within a two-piece hub (see Figure 2). The hub components consist of an aft casing bolted to the drive flange of the crankshaft and a forward casing upon which is mounted the cylinder and piston of the pitch change mechanism. The two casings are secured together by a series of bolts whose axes are parallel to that of the crankshaft. The plane of the joint between forward and aft casings coincides with the axes of the blade pitch change bearings.

Examination of the separated components indicated that the engine crankshaft had fractured close to its forward end, as had part of the crankcase casting in which it was located. The isolated blade appeared to have been released as a result of the fracture of part of the hub which carried a blade pitch change bearing and hence the centrifugal blade force.

Examination of the crankshaft fracture face revealed that its condition was consistent with the effects of bending load and exhibited no evidence of fatigue or corrosion. The fracture of the crankcase casting also appeared to have occurred as a result of overload. The hub was dismantled to enable its fracture faces to be examined under laboratory conditions (Figure 3). It was noted that the pitch change bearing of the blade which remained attached was fully charged with grease, whilst those components of the bearing securing the separated blade, recovered from the proximity of the accident site, indicated a marked lack of lubrication.

Initial metallurgical examination of the fracture faces of the hub indicated that although the fracture of the aft section of the casing appeared to be in simple overload, the forward section had a more complex failure mechanism which included some fatigue.

More detailed examination confirmed that a crack, circumferential to the blade root, had propagated from several closely spaced locations on the inside surface of the hub forward casing. An axial fatigue fracture had also propagated from the outer corner of the blade

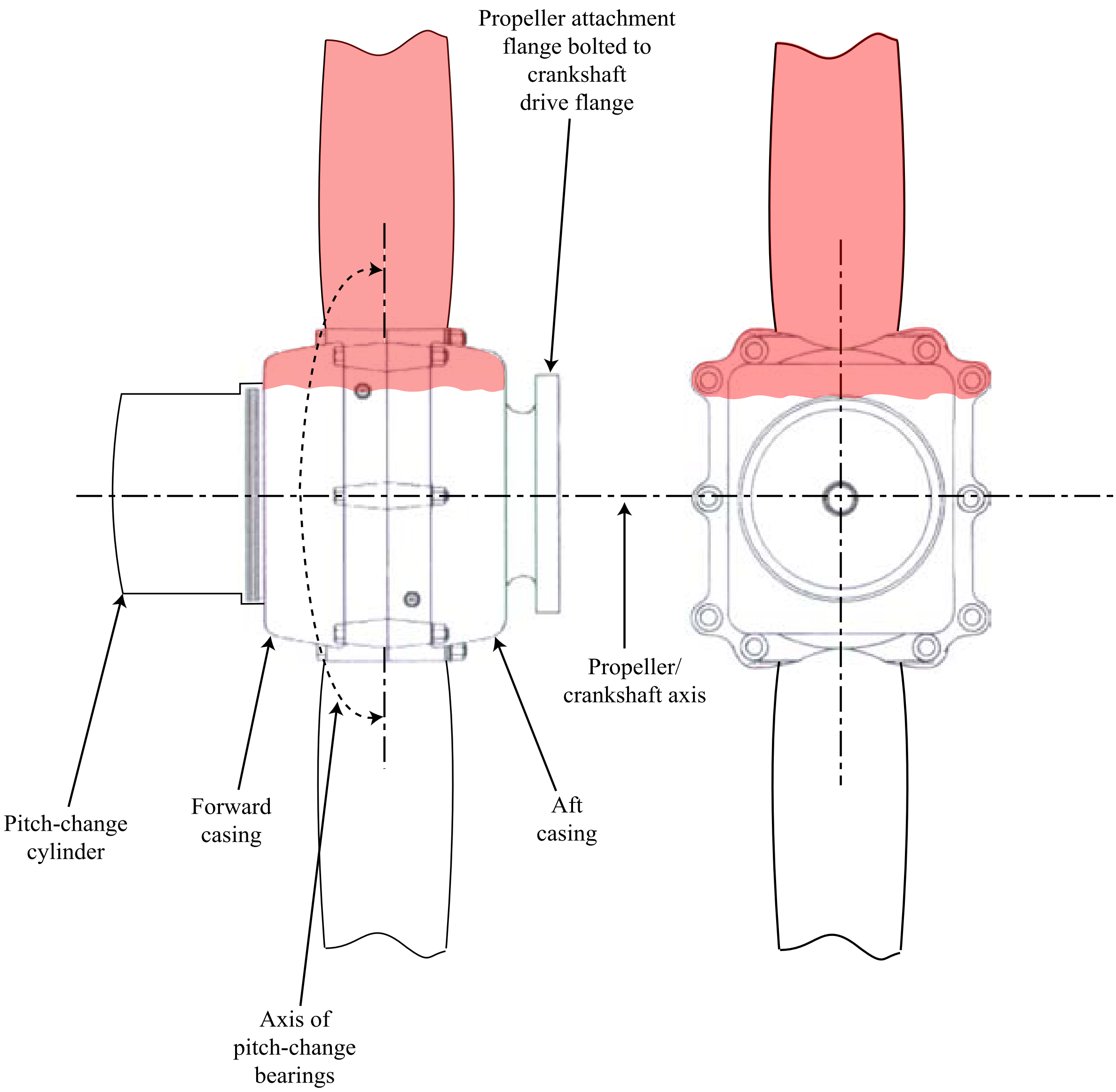


Figure 2

Schematic view of propeller hub with separated portion shown in orange

seal face. It was not clear which initiation occurred first, although the axial failure formed the single 'leg' of a three-way fracture junction showing that it joined the circumferential failure after the latter was well developed. No evidence was present to suggest that abnormal service conditions had been present.

Service Bulletin information

The manufacturer's Service Bulletin HC-SB-61-269 drew attention to:

> *'numerous occurrences of hub fillet cracks, including incidents of in-flight blade separation in Hartzell two blade "compact" series aluminium hub propellers'.*

The failed propeller on G-BNRA was of the type to which this problem applied. The Service Bulletin noted that cracks were typically discovered during inspection following reports of abnormal vibration or grease leakage. The Service Bulletin required visual and eddy current inspection of fillet radii in the general area where unusual fracture surface conditions were observed on G-BNRA. Inspection was to be carried out within 50 flying hours of the receipt of the bulletin and repeated at 100 hour intervals.

The Service Bulletin was issued in April 2005 and the records showed that the aircraft had completed approximately 105 hours operation between the end of that month and the date of the accident. There was no indication that the Service Bulletin had been implemented on this propeller.

The aircraft was maintained by an M3 maintenance organisation in accordance with the CAA/LAMS/A schedule which uses a 50 hour/150 hour/annual cycle of inspections. They confirmed that Service Bulletin HC-SB-61-269 had not been implemented on the propeller. During normal aircraft scheduled inspections specific work on the propeller is limited to a general examination and implementation of any applicable Airworthiness Directives. This is the normal procedure for M3 organisations. Eddy current inspection equipment and appropriate expertise is not required and not normally possessed by such organisations.

The Service Bulletin noted that 'Regulatory action is expected'. At the time of the accident this Service Bulletin had not been the subject of such action and was not, therefore, mandatory.

The similarity of the position of the unusual fracture face on the hub to the area highlighted in the Manufacturer's Service Bulletin, as well as the absence of grease from the pitch-change bearing of the separated blade, strongly suggested that the failure was of the type which the Service Bulletin was intended to address. The absence of an Airworthiness Directive on the subject had inhibited the ability of maintenance companies and operators to identify the propellers at risk of blade loss and to take steps to prevent such hazardous situations from occurring.

Figure 3
Hub fracture faces

The manufacturer had replaced this type of hub with one of a different design on propellers in production some time before the accident occurred. The later design of hub is interchangeable with the type involved in this event. However the different hub designs do not have identification marks on them; they can only be differentiated by comparing details of their profiles with the manufacturer's descriptions. It is not known how many of the type of hub involved in the accident remain in service either in the UK or elsewhere.

AAIB Special Bulletin S2/2006 contained three Safety Recommendations which are reproduced here:

Safety Recommendation 2006-046

It is recommended that the CAA take immediate action to alert M3 organisations and other relevant maintainers in the UK to the existence and importance of Hartzell Service Bulletin HC-SB-61-269.

Safety Recommendation 2006-047

It is recommended that the FAA take urgent steps to issue an Airworthiness Directive making the inspection requirements of Hartzell Service Bulletin HC-SB-61-269 mandatory.

Safety Recommendation 2006-048

It is recommended that the EASA take urgent steps to issue an Airworthiness Directive making the inspection requirements of Hartzell Service Bulletin HC-SB-61-269 mandatory.

Regulatory responses to Safety Recommendations

The CAA has since responded to Safety Recommendation 2006-046 as follows:

The CAA accepts this recommendation insofar as it relates to the need to alert relevant persons to the existence and importance of Hartzell Service Bulletin HC-SB-61-269. To that end CAA issued, on 30 March 2006, a letter to relevant UK operators strongly recommending that owners of aircraft affected by Hartzell Service Bulletin HC-SB-61-269 arrange for an eddy current inspection to be performed in accordance with the Service Bulletin instructions as soon as possible.

Since that letter, the Federal Aviation Agency has responded to Safety Recommendation 2006-047 and has introduced an Airworthiness Directive 2006-18-15 which is subject to a consultation process but which must, nonetheless, be implemented by 25 September 2006. It requires adoption of an inspection procedure in accordance with the existing Hartzell Service Bulletin.

On 3 May 2006 the EASA responded to Safety Recommendation 2006-048 by issuing Airworthiness Directive No 2006-0092, which mandated the inspection procedure or optional terminating action (replacement of the hub) described in the Hartzell Service Bulletin.

Conclusions

The engine partly separated from the airframe as a result of propeller imbalance following the release of one blade due to fatigue failure in its hub. The fatigue cracking appears to have been partly a consequence of non-optimum temperature conditions in the hub material during the forging process. Recommendations within an existing Service Bulletin addressed the problem although the absence, at the time, of an Airworthiness Directive rendering such checks mandatory contributed to its non-implementation on this aircraft before the accident. The UK CAA, the EASA and the FAA have all responded positively to contain the hazard by introducing inspections and/or replacement of the hub parts.

ACCIDENT

Aircraft Type and Registration:	Tecnam P92-EA Echo, G-TCNM
No & type of Engines:	1 Jabiru Aircraft Pty 2200A piston engine
Year of Manufacture:	2002
Date & Time (UTC):	10 September 2006 at 1050 hrs
Location:	Greenlands Airstrip, near Holywell, Denbighshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to the nose landing gear, propeller, engine, cowlings, fuselage and wings
Commander's Licence:	Private Pilot's Licence
Commander's Age:	59 years
Commander's Flying Experience:	258 hours (of which 43 were on type) Last 90 days - 23 hours Last 28 days - 6 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft was landing after carrying out a series of circuits. The pilot had decided to use a runway with a downwind component because of the presence of sheep near the threshold of the reciprocal runway when he took off. After landing, the aircraft swerved to avoid a sheep and ran off the end of the damp grass landing surface on to rough ground.

History of the flight

The pilot was practising circuits at his 'home' airfield in good weather, with a surface wind of 150º/10 kt. He reported that, during the landing on grass Runway 32, the aircraft experienced a tailwind which increased its stopping distance and, in avoiding a sheep, G-TCNM ran off the end of the runway on to rough ground. In the process, the nose landing gear collapsed and the aircraft sustained damage to its propeller, engine, cowlings, forward fuselage and wings. The pilot was uninjured and exited the aircraft through the cabin door.

In his report, the pilot concluded that the accident was the result of not taking into account the combination of the down slope on the runway after the first 200 metres, the dampness of the grass surface and the tail wind. He had decided to use Runway 32, as opposed to the into-wind Runway 14, because of the presence of sheep clustered near the threshold of Runway 14. While the aircraft was airborne, these sheep moved on to the runway.

CAA General Aviation Safety Poster, entitled:

AIRSTRIPS, think Hedgerow NOT Heathrow

reminds pilots of the operational considerations regarding airstrips, namely to check length, obstructions, slope, surface and animals. The CAA's General Aviation Safety Sense Leaflet 12d, entitled *Strip Sense*, advises that:

> *'it is vital to remove all live-stock from the runway prior to take off and prior to landing. Thus, if animals have access to the strip, assistance by a friend or farmhand is essential. Animals are unpredictable.'*

The publication *Lockyears Farm 'Strips' and Private Airfields Flight Guide*, contains an entry for Greenlands Airfield which includes:

> ***Remarks****: Livestock on field.*

ACCIDENT

Aircraft Type and Registration:	Yak-52, G-YKYK
No & type of Engines:	1 Ivchenko Vedeneyev M-14P piston engine
Year of Manufacture:	1998
Date & Time (UTC):	4 October 2006 at 1120 hrs
Location:	Stockhall Farm, Ulting, Maldon, Essex
Type of Flight:	Private
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to propeller and trailing edge of flaps
Commander's Licence:	Private Pilot's Licence
Commander's Age:	56 years
Commander's Flying Experience:	653 hours (of which 510 were on type) Last 90 days - 12 hours Last 28 days - 6 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft suffered a sudden loss of engine power whilst in the cruise at 1,500 ft. The pilot made a forced landing in a field. Some damage was sustained by the aircraft during the landing but there were no injuries. The loss of power is believed to have been a result of a broken accessory drive within the engine.

History of the flight

The purpose of the flight was to practise formation and tactical fighting manoeuvres with three other similar aircraft. The weather conditions were fine with clear skies, a westerly wind and a surface temperature of 15ºC. The pilot was flying straight and level at 1,500 ft on the way to the intended practice area when the aircraft engine lost power; the propeller slowed but continued to windmill. The pilot handed control of the aircraft to the rear seat pilot whilst he carried out a number of checks within the cockpit in an attempt to recover power. Pumping of the fuel primer gave a short burst of engine power once or twice, but there was no continued response. The pilot resumed control of the aircraft and prepared to make a forced landing; the rear seat pilot made a radio transmission to one of the accompanying aircraft advising of the situation.

The pilot selected a field for the forced landing and lowered the flap. The landing gear remained in the UP position, as recommended in the Pilot's Standard Operating Notes. (On this aircraft type the landing gear does not retract fully when it is UP.) At about 50 ft agl the pilot selected the magnetos to OFF. The propeller struck the ground in a ploughed field just before the chosen landing field, and the landing gear made contact with the surface in the field margin. The aircraft continued ahead and came to rest some 140 metres into the field. The rear seat pilot turned the fuel OFF while the pilot made a radio transmission to advise the other aircraft of a safe landing, this transmission was not received. Neither pilot was injured in the accident.

Post-accident testing of the aircraft systems and the engine showed that the magneto system was faulty. This appeared to be due to a broken accessory drive shaft within the engine; the precise reason will be determined when the engine is stripped down for overhaul. A driveshaft problem of this nature has not been experienced before with the UK based YAK-52 aircraft.

ACCIDENT

Aircraft Type and Registration:	Bell 206B Jet Ranger II, G-WLLY
No & Type of Engines:	1 Allison 250-C20 turboshaft engine
Year of Manufacture:	1969
Date & Time (UTC):	21 December 2005 at 1015 hrs
Location:	3 nm north-east of Coupar Angus, Tayside
Type of Flight:	Aerial Work
Persons on Board:	Crew - 1 Passengers -1
Injuries:	Crew - 1 (Fatal) Passengers - 1 (Fatal)
Nature of Damage:	Helicopter destroyed
Commander's Licence:	Airline Transport Pilot's Licence (Helicopters)
Commander's Age:	48 years
Commander's Flying Experience:	Approximately 15,000 hour (of which at least 2,500 were on type) Last 90 days -126 hours Last 28 days - 42 hours
Information Source:	AAIB Field Investigation

Synopsis

The pilot of the helicopter and an observer were carrying out a pipeline inspection flight between Cumbernauld Airport and Aberdeen. Approximately 45 minutes after takeoff, the helicopter descended to low level where debris was seen to fall from its aft section. Control of the helicopter was lost and it struck the ground, fatally injuring both occupants. The investigation found that the vertical stabiliser had detached from the tail boom and struck the tail rotor. This subsequently caused the tail rotor and associated gearbox to become detached from the tail boom, resulting in the helicopter's centre of gravity moving outside controllable limits.

The cause of the fin detachment was fatigue, in the fin attachment supports. It was concluded that this was the result of insufficient torque in the fin attachment fasteners.

History of the flight

The pilot and observer arrived at Cumbernauld Airport on the morning of the accident in order to carry out a standard pipeline inspection flight. On completion of the task the helicopter was to be delivered to a maintenance organisation near Aberdeen for a scheduled inspection. The pilot was observed starting the helicopter, which lifted off at 0922 hrs. It departed from Runway 26 and turned right to leave the airport boundary heading north-east. There were no further radio transmissions from the helicopter. On board GPS equipment recorded the route which closely followed a gas pipeline heading approximately north-east. The airspeed throughout the flight varied between 100 kt and 120 kt and the short section of the flight captured on radar showed the height to be between 500 ft and 1,000 ft agl. At approximately 1010 hrs a witness on the road between Coupar Angus and Meigle observed the helicopter heading northwards in a gentle descent. As it descended through approximately 100 ft agl, part of the rear section was seen to fall from the helicopter which began a right-hand turn. Another witness observed that it had no tail rotor or vertical stabiliser and that they saw it roll on to its left side before pitching nose-down into the ground. Debris was seen falling from the helicopter before impact with the ground. Both occupants were fatally injured.

Meteorology

An aftercast from the Met Office described a cold front passing through the area during the early morning of 21 December 2006. This left a fresh to strong north-westerly flow established over the accident area with patchy cloud and excellent visibility. The surface wind was estimated at 260º at 15-20 kt gusting 25-30 kt and the wind at 500 ft agl was estimated to be from 290º at 25 kt. The aftercast noted that significant turbulence was likely to have existed over the area and unexpected changes in windspeed and direction could also have been experienced.

Pathology

A pathological examination revealed that both occupants died from severe multiple injuries. No evidence was found of pre-existing disease or medical factors which could have had any influence on the accident.

Accident site details

The helicopter had come down in a freshly ploughed field that sloped gently downwards towards the north-west. The wreckage trail extended for several hundred metres in a generally northerly direction, with the vertical fin, tail rotor assembly and gearbox being among the earliest items found along the flight path. Other debris found in this area included parts of the tail rotor drive shaft and its cover.

The final item in the wreckage trail was the rotor head complete with the rotor blades. The rotor mast had broken immediately below the bump stops and it was apparent that this had occurred in the air. The liberated rotor disc had then sliced off the nose of the helicopter at an angle approximately parallel to the leading edge of the forward doors. The right-hand forward door had been cut in two and it was evident that the nose had been removed by a single rotor strike, in an upwards direction and from right to left, across the floor of the aircraft immediately ahead of the front seats.

The fuselage, minus the nose, had struck the ground in an inverted attitude at an estimated dive angle of 60º, making a shallow crater. It had then rolled out of the crater and come to rest on its left side. The upper cabin area, transmission deck and engine compartment had sustained severe damage as a result of the ground impact.

The aircraft wreckage was recovered to the AAIB's facility at Farnborough, where it was subjected to a detailed examination.

Aircraft history

The helicopter, serial number 405, was built as a 206A model in 1969 and had a United States registration until it was imported to the United Kingdom, where it was registered as G-AXMM. The available records show that it was re-registered as G-RODR from January 1982 to November 1991. In October 1984 the helicopter was damaged as a result of an accident when one of the skids caught on a tree root whilst taking off (AAIB File EW/G84/10/09, report published in Bulletin No 2/85). Repairs, which were of a major nature, were conducted by a company in Canada. In October 1987 the aircraft was damaged after being blown over in a storm. The log book for the period lists the repairs that were carried out, including the fitting of a 'new tail cone'. However, the organisation that conducted the work no longer exists. The work pack associated with the repairs was not available and so details such as part and serial numbers fitted at that time are not known.

In July 1991 the helicopter sustained significant damage during a heavy landing following an engine failure. This accident was the subject of an AAIB Field Investigation (File EW/C91/7/3 and the report was published in Bulletin No 1/92). The helicopter was repaired by the same Canadian company as before, and the work included repairs to the tail boom, which had been cut into three pieces in the accident. The aircraft flew briefly in late 1992 with the registration G-RODY, but was on the ground from September 1993 to July 1996. During this period, it was converted to a 206B model, the principal feature of this being the installation of an up-rated engine. Further ownership changes resulted in the registration changing to G-WLLY in March 1993 and G-OBHH in March 1996, before reverting to G-WLLY in June 1997.

The current owner acquired the helicopter in May 2004 and took it from its base in southern England before placing it with a maintenance organisation close to his home near Aberdeen. It was this company that negotiated the lease with the operator that held the pipeline inspection contract and which conducted most of the subsequent maintenance.

In April 2005 during an annual inspection, corrosion was found in the lower fuselage which necessitated replacing the 'bathtub' section. The rotor assembly, tail boom, vertical fin and horizontal stabiliser were removed and the fuselage was sent away for this work to be carried out. On its return, the helicopter was reassembled. The relevant documentation showed that the vertical fin was refitted on 13 September 2005 and was the subject of a duplicate inspection. The fin supports were, it was reported, inspected visually with the aid of a magnifying glass prior to attaching the fin.

After returning to service the helicopter had a 50 hour inspection on 24 October followed by a 100 hour inspection that was signed off on 14 November. This included an inspection of the vertical fin 'for condition and security', as required by the Maintenance Schedule. A further 50 hour check was carried out on 6 December 2005 at 5,103 flight hours. It had been planned to deliver the helicopter to the maintenance organisation for the next 100 hour check on 21 December, with part of the flight to be spent conducting a pipeline inspection. This would have been approximately 15 flying hours before the inspection was due; however, the operator required the aircraft to be available, with adequate flight hours in hand, between Christmas and New Year, during which period the maintenance organisation had planned to be closed. In the event, the helicopter crashed en-route to Aberdeen, having achieved a total of approximately 5,135 airframe hours.

On inspecting the wreckage at Farnborough it was noted that the tail boom part number was 206-031-004-71B, with the serial number BCJN 5186. According to the aircraft manufacturer, this component left the factory on an unspecified date during the 1970s, on a helicopter with the serial number 1069. This helicopter was damaged in an accident in Guatemala in May 1979, since when nothing more has been heard of it. It is thus not clear how the tail boom from helicopter No 1069 came to be fitted to G-WLLY. The available documentation from the Canadian company that twice rebuilt the helicopter indicates that the tail boom was repaired, as opposed to replaced. Thus, in the absence of any other documentation, it appears that the most likely occasion the subject tail boom was fitted was during the repairs following the 1987 storm damage.

The helicopter was equipped with floats and, as part of this modification, the 'stinger' at the base of the vertical fin was fitted with a triangular alloy plate designed to resist penetration of the tail into water.

Detailed examination of the wreckage

The sequence of the components found in the wreckage trail indicated that the vertical fin, tail rotor assembly and its gearbox had departed the helicopter during flight. Whilst there was a possibility that something fell via an unsecured door from the cabin or baggage compartment into the tail rotor, all the articles that were known to be in the aircraft were accounted for in, or near, the main wreckage. Attention was subsequently focused on the tail rotor (which had remained attached to the gearbox) and vertical fin, with the latter clearly having been struck by a tail rotor blade. One blade tip, including its weights, had been removed as a result of this contact. This left a chamfered edge that matched the profile of the cut in the fin that ran forward from the trailing edge, and which had severed the steel 'stinger' from its mounting in the leading edge. A metallurgical examination of the gearbox mounting bolts indicated they had all failed in bending overload. This was the result of severe out-of-balance forces that occurred following the loss of the tip weights. It was evident that the lower portion of the fin had moved into the tail rotor arc rather than the other way round, indicating that the fin was the first component to become detached.

On all Bell and Agusta-Bell helicopters, the vertical fin is attached to the tail boom by four bolts, which locate into holes in two fin supports positioned at the front and rear of the tail rotor gearbox platform. (See Figure 1.) On G-WLLY this platform is of a fabricated sheet metal construction. The bolts are secured with stiff-nuts. The fin supports are machined forgings; the rear support is riveted in position such that it effectively forms the rearmost frame of the tail boom. The front support is bolted to the structure. Note: There is a later design in which the platform and fin supports are an integral, one-piece forging. According to the manufacturer this was first introduced on the 206L series and then to the 206B model as a way to reduce the spares inventory.

The separated portions of the fin supports had remained attached to the inboard surface of the fin (see Figure 2), which, apart from being struck by the tail rotor, had sustained relatively little damage. Before removing these, the 'breakout' torque for each of the nut and bolt assemblies was measured. These were as follows:

Top aft	30 lbf.in	Top forward	22 lbf.in
Bottom aft	25 lbf.in	Bottom forward	15 lbf.in (but see below)

The Maintenance Manual specifies assembly torque values of 50-70 lbf.in. It should be noted that the bolt in the bottom forward attachment was found to be slightly bent; any structural joint in which plastic deformation has occurred is likely to have lost the torque figure set on assembly, thus the 15 lbf.in value was not considered reliable.

The riveted and bolted attachments of the rear and front supports on the tail boom respectively were found to be secure. The rear support had the number 206-031-418-1

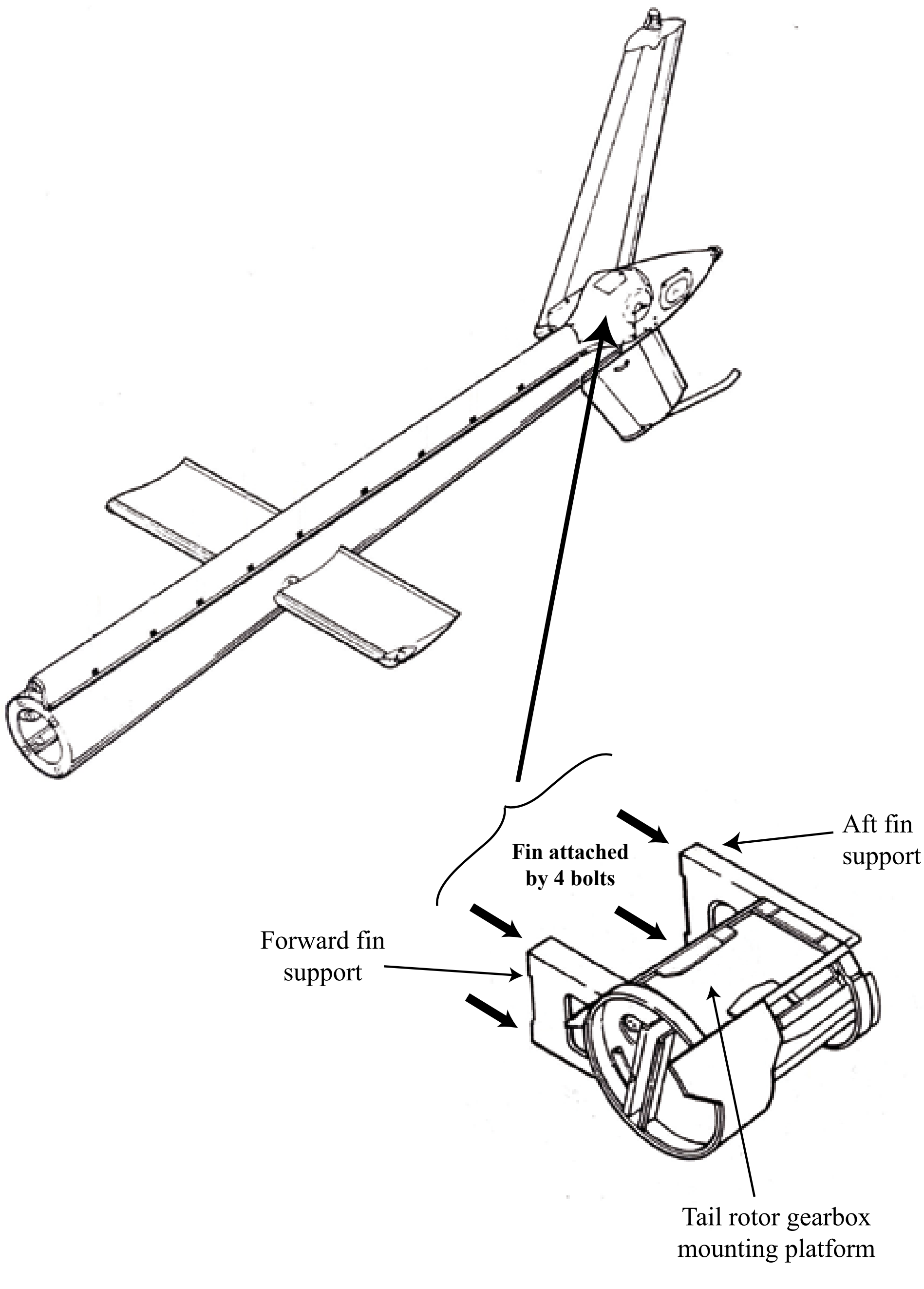


Figure 1

Tail boom and fin support

stamped on it, which was one of several part numbers listed in the Illustrated Parts Breakdown (IPB) for this component. However it was specified for use on tail booms with the part number 206-031-426-001 (as opposed to 206-031-004-71B, the subject tail boom). The front support had no number on it; the appropriate part number in the IPB was 206-031-417-003 or -007.

The vertical fin bore no part number, but there was a log book certificate that stated: '..*unserviceable fin replaced with P/N 206-020-113-011*', dated 3 August 1990. This was found listed in an old IPB, although the current version lists only -005, -007, -009, -107, and -109. It can be seen from Figure 2 that the inboard skin had been reinforced with a doubler. This was the result

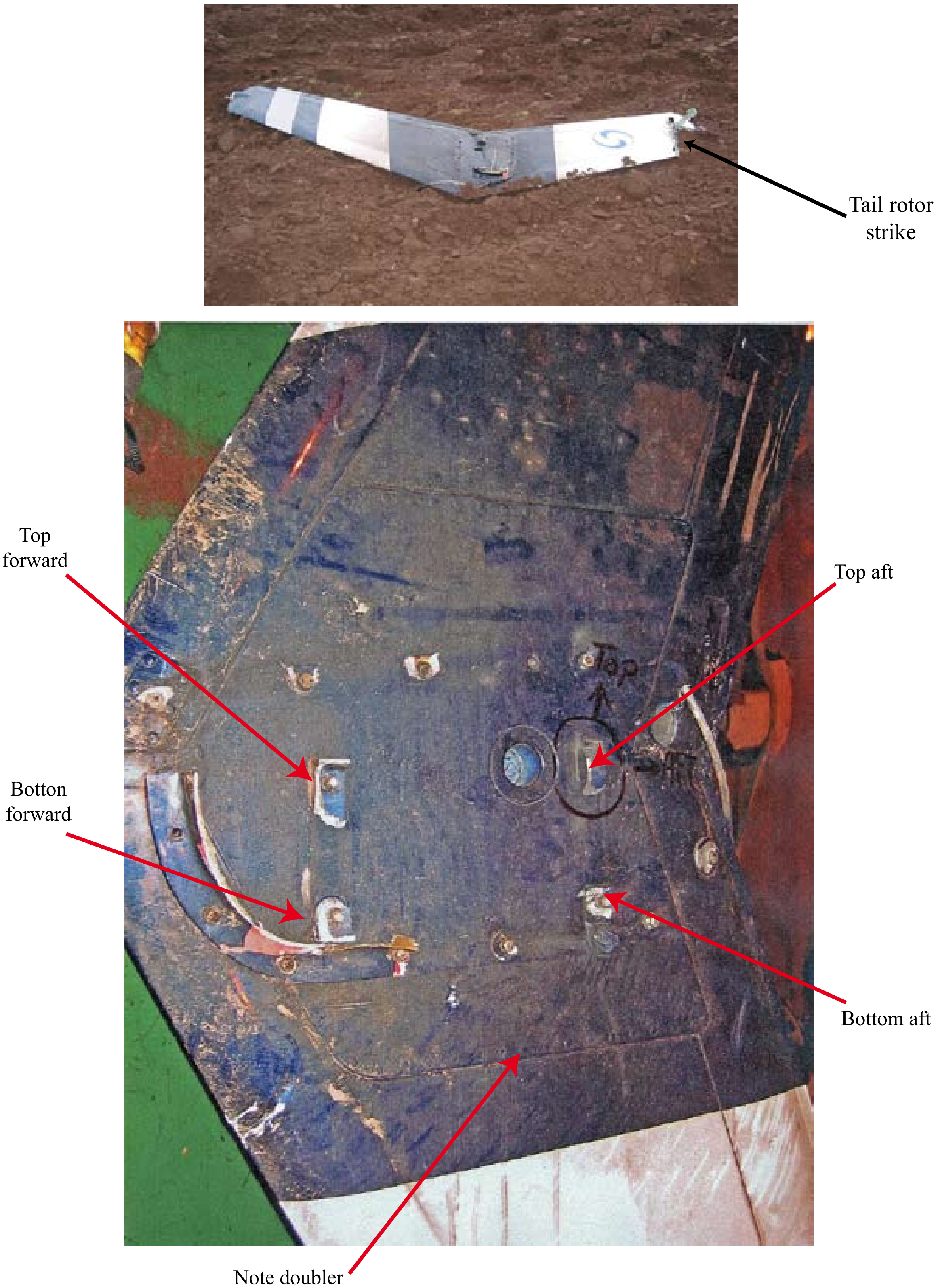


Figure 2

Views of inboard surface fin showing attached portions of fin supports of complying with Bell Service Letter 206-203, dated December 1972, which was introduced following an in-service problem of cracks developing in the fin. Later fins were manufactured with a strengthened central area, dispensing with the need for a doubler.

The fin was of lightweight honeycomb construction and was found to weigh 8.2 kg, including the 'stinger' and alloy plate assembly, which, as noted earlier, had been parted from the fin by the tail rotor. The steel 'stinger' was mounted in a steel block that was embedded in the leading edge at the base of the fin. It was found that this 'stinger', block and alloy plate assembly weighed 1.2 kg. The tail rotor assembly and its associated gearbox weighed 11.3 kg. Thus, together with the pieces of the tail rotor drive shaft and cover that were liberated shortly after the departure of the fin, tail rotor and gearbox, a total mass of approximately 20 kg was lost from the rear of the helicopter. It was calculated that the loss of these components shifted the centre of gravity forward to a point forward of the longitudinal centre of gravity limits.

Metallurgical examination of the fin and supports

The vertical fin and the supports were subjected to a detailed metallurgical examination by QinetiQ at Farnborough. This revealed evidence of fatigue in the fractures that had occurred through and around all four bolt holes in the supports. Figure 2 shows the inboard face of the fin, as found, with the fractured portions of the supports still attached. Figures 3 to 6 show photographs of the supports with the detached portions loosely replaced, and with the cracks highlighted. It can be seen that three cracks were present in the top aft attachment, with two present in each of the other three attachments. In addition to the fastener holes, the photographs show adjacent rivet holes, most with their rivets still in position. These were the result of complying with FAA Airworthiness Directive No 92-09-07, which mandated Bell Alert Service Bulletin No 206-91-60, dated June 1991 (described later), which removed nut plates (anchor nuts) from the supports and filled the holes with plug rivets.

There was no evidence of fretting damage around any of the attachment locations on the fin, although there were rectangular witness marks from the support edges in the painted surface around each of the attachment bolt holes. These took the form of indentations below the lower attachments and indicted the manner of the departure of the fin: the upper attachments failed first, allowing the top of the fin to move outboard as it pivoted about the lower supports. It would have been this sequence which resulted in the bending in the lower forward attachment bolt.

The upper fractures exhibited a considerable degree of corrosion and surface deposits. There was also evidence of post-failure mechanical damage (due to the fracture faces remaining in contact), which masked surface detail, but which indicated that the fatigue cracks had been growing over a period of time. The precise length of time could not be determined. The fracture surfaces from the lower attachments were comparatively clean.

The majority of the undamaged crack lengths in the upper attachments were due to fatigue, whereas the fractures in the bottom sections had smaller fatigue cracks in the bolt and rivet holes and larger areas of overload failure. Significantly, the cracks passed through the bolt holes at all four attachments, with origins visible on opposite sides of the outboard surface of the bore of the top forward attachment. It can also be seen from Figures 3 to 6 that, on the other attachments, the cracks passed through one of the rivet holes in each case, with origins occurring on opposite sides of the bore in the top aft attachment.

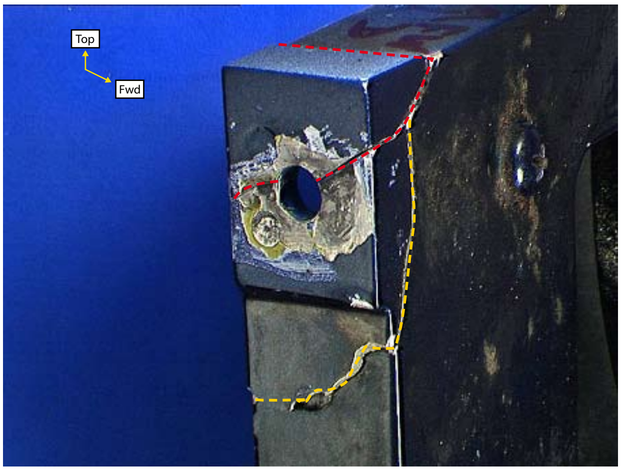


Photo: QinetiQ

Figure 3

Top forward attachment

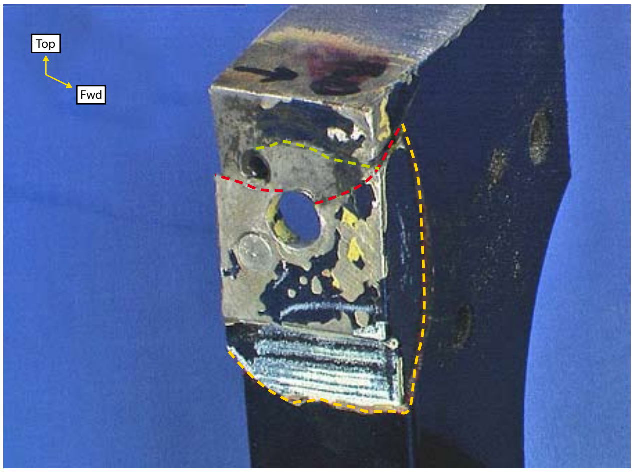


Photo: QinetiQ

Figure 4

Top aft attachment

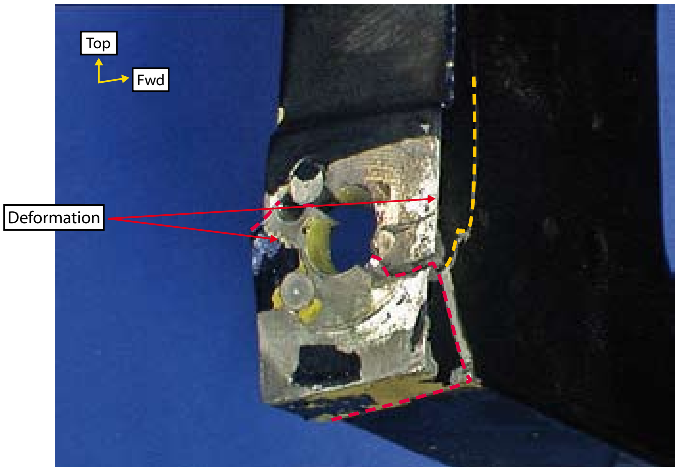


Photo: QinetiQ

Figure 5

Bottom forward attachment

Photo: QinetiQ

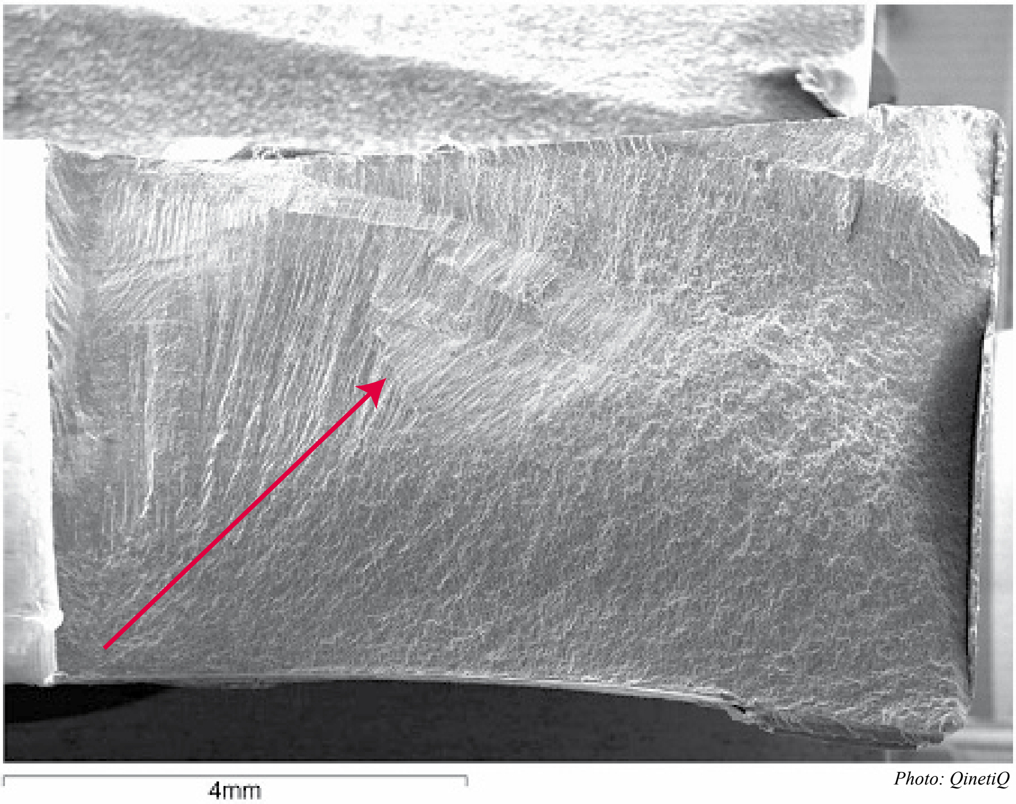
Figure 6

Bottom aft attachment

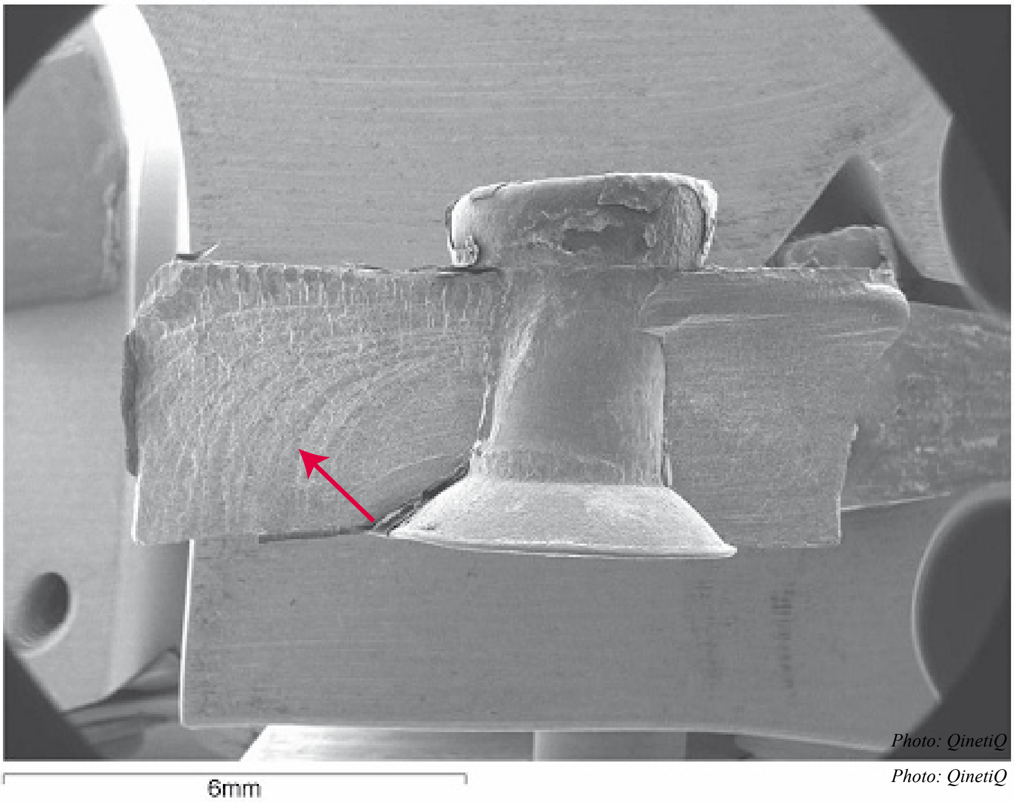
In both lower attachments there were fatigue origins in both the bolt and the rivet holes. The bores of all the holes were otherwise clean, with no significant features such as thread marks or corrosion pits. Figure 7 shows scanning electron microscope (SEM) photographs of a bolt hole and rivet hole, showing how the cracks initiated from the outboard edges of the bores. The cracks have then propagated away from the holes, at the same time extending through the thickness of the material to reach the inboard surface.

It was established that the first cracks to occur were those that passed through the holes, with the others being secondary. For example, in Figure 3, the 'yellow' crack in the top forward attachment can be seen branching off from the primary 'red' crack on the front face of the forging. Consideration of all the fractures led to the sequence of the attachment failures being established as: top aft, top forward, bottom aft and bottom forward.

The material specification was checked and found to conform to the grade of aluminium alloy specified by the manufacturer. Thus in the absence of features such as corrosion pits or mechanical damage sites, there was



Fatigue crack originating from edge at bolt hole on stabiliser side of top forward support



Fatigue crack originating from rivet hole on stabiliser side of bottom aft support

Figure 7

Scanning electron microscope photographs no obvious reason for the onset of fatigue. However, in the light of the low values of the breakout torque that were discovered on the fasteners following the accident, it was considered that insufficient torque may have been responsible. In support of this scenario, the metallurgical report contained the following comment:

'Specifying a torque setting for a mechanical fastening is a simple way to ensure that the joint is at a sufficient pre-load or clamping force (although not a particularly accurate way to measure it due to numerous variables in the torque-load relationship). It is known that increasing the clamping force increases the fatigue resistance of the bolt and mating surfaces of structure by establishing compressive stresses in critical areas. It also produces a more rigid structure thus reducing the likelihood of fatigue due to flexing.'

Also visible in Figures 3 to 6 are the remains of a paint finish on the outboard surfaces of the supports. Although most of the surfaces surrounding the bolt holes were bare metal, it was clear that originally, both yellow primer and dark blue gloss paint had been applied. Similarly, the shims on the fin inserts, against which the supports abutted, were also painted, although the paint had remained largely intact. Although no instruction to the contrary existed in the Maintenance Manual, it was considered unusual for the mating surfaces of a structural joint to be coated with gloss paint.

Maintenance information

The Helicopter Maintenance Schedule requires that the fin supports be inspected every 100 hours. This takes the form of a visual inspection only. A dye penetrant process would not normally be used; neither would the fin be removed. Thus a typical inspection would require the removal of the tail rotor gearbox fairing, allowing access to the inboard faces of the fin supports. These would then be cleaned and visually inspected for cracks. There is no requirement for a periodic inspection of the outboard faces, which would of course necessitate fin removal. Thus the fin is only removed for reasons other than inspection of the supports, such as repairs or re-sprays. Access to the supports with the fin removed is excellent and, as a consequence, a visual inspection of the inboard and outboard faces of the supports can be accomplished with ease.

In the case of G-WLLY, the fin was most recently removed in the summer of 2005 in order to facilitate the storage of major components whilst the fuselage was away being repaired. A qualified engineer, with 25 years experience of helicopter maintenance, and who was familiar with Bell and Agusta-Bell 206 helicopters, was employed by the maintenance organisation to take charge of the subsequent rebuild. The engineer stated that he and a colleague installed the fin in "about an hour", using the same nut/bolt/washer stack-ups that came off the helicopter; part of the process included checking that the stiff-nuts were fit for re-use. It should be noted that the Maintenance Manual details three slightly different procedures (in terms of the nut/bolt/washer stack-up) according to the serial number of the helicopter. The 'as-found' stack-up consisted of a plain aluminium washer under the bolt head and a radius washer next to the nut; this was appropriate to the helicopter serial number, but it was noted that the Manual took no account of the possibility that the tail boom might have been changed for one of an earlier or later production standard.

Although the maintenance company generated the work packs, the engineer instigated a process of dual inspections at various points during assembly. This included the fin installation, with the appropriate entry in the Duplicate Inspection Sheet calling up a "vital point inspection" in accordance with BCAR (British Civil Airworthiness Requirements) Section A6-2/B6-2. In fact the duplicate inspections described in these documents refer to flight, engine and propeller control systems, rather than structure. Vital points are defined in Section A5-3/B-5-3 and include aircraft structure; however, listings of vital points are not required for aircraft manufactured in accordance with a Type Certificate issued prior to 1 January 1986. In the event, the co-signatory checked the fastener stack-up, although he did not physically check the torque on the fin attachment bolts other than to confirm with the engineer as to the values he had used.

It was established that no re-painting occurred on any part of the helicopter during this reassembly. The most recent re-painting activity was carried out in December 2000, according to the log books, in which one of the certificates notes '*...vertical stabiliser removed for re-spray, refitted post re-spray*'. The helicopter had achieved 4,330 flight hours at this time, which was approximately 800 hours prior to the accident.

Previous occurrences

The manufacturer stated that they were aware of one fatal accident to a Bell 206 involving the in-flight detachment of the vertical fin. This occurred in April 1991; the helicopter crashed into the sea shortly after departing an offshore platform. The United States National Transportation Safety Board (NTSB) report noted that the fin supports had:

> *'...separated as a result of corrosion and corrosion pitting. The examination also revealed that the operator had attempted to combat the corrosion during a refurbishment of the airframe. All the fatigue fractures appeared old and one had paint in the fracture'.*

The United Kingdom CAA Safety Regulation Group database contained only one record on Bell 206 fin supports; this referred to a crack in a rear support that was found on a visual inspection and occurred in March 1977.

Transport Canada supplied a listing from a 'Service Difficulty Report Review', containing 12 records pertaining to the vertical fin. One of these, occurring in October 1980, involved the in-flight detachment of the fin and was the result of washers being omitted when complying with Service Letter 206-203. Over time, tension in the attachment bolts had pulled the fin-mounted inserts through the fin; thus this incident was apparently unconnected with the fin supports. Most of the other records were concerned with corrosion or cracks in the fin. There was one event in which, during an inspection, the top aft fin attachment bolt was found to be broken. The other three bolts were found to be below the minimum torque value.

Federal Aviation Administration Airworthiness Directives (FAA ADs)

During the service life of the Bell 206 the manufacturer has issued a number of Alert Service Bulletins (ASBs) concerning the vertical fin and its attachment to the tail boom. For the Agusta-Bell 206, there was invariably, for each ASB, a corresponding *Bolletino Tecnico* from the Italian company, although there were small differences in the content and issue dates.

The first relevant ASB was 206-26, dated 18 December 1972. This was superseded on 9 January 1973 by ASB No 206-01-73-1. Both of these required a repetitive inspection of the fin for cracks until Service Letter 206-203 was complied with (ie fitting a doubler). On 1 July 1973 the FAA made ASB 206-01-73-1 mandatory with the issue of AD No 73-12-01.

On 27 June 1973, Bell issued ASB No 206-01-73-5, which required inspection of the fin supports for cracks in the fin attachment bolt holes. Part I of the Bulletin called for the removal of the fin prior to conducting a dye penetrant inspection of the supports, which had to be replaced if cracks were found. In addition, the bolt holes had to be inspected for thread marks. Any marks had to be removed with a straight reamer, although this required prior removal of the nut plates on the inboard faces of the supports, into which the fin attachment bolts were located. If the nut plates had chafed into the radius of the forging, the marks had to be burnished. After cleaning up the holes the nut plates were replaced. The fin supports had to be replaced if any cracks were discovered; this was dealt with in Part II of the Bulletin. The replacement forgings were supplied without nut plates, the attachment bolts being secured with stiff-nuts. ASB No 206-01-73-5 was mandated on 15 November 1973 by FAA AD No 73-21-03.

On 28 June 1991 Bell issued ASB No 206-91-60 which applied to all 206A and B models with serial numbers between 4 and 1163 and which were equipped with a vertical fin assembly with a doubler installed on the inboard side. The reason for issue was that:

> *'[The manufacturer]has determined that installation of an external doubler on the fin may require spacing washers or shims between the fin and the tail boom to preclude unacceptable fatigue stresses on certain fin support forgings'.*

Part I of this Bulletin called for inspection of the supports in a similar manner to ASB 206-01-73-5, although the nut plates, if present, were not reinstalled; the nut plate attachment holes were filled with plug rivets. The supports were to be replaced in the event of any cracks being found. Part II called for inspection of the gaps between the fin-mounted inserts and the faces of the supports. Washers were used to fill any gaps so that the resulting stack was flush, -0 to +0.010 inches, with the surface of the external doubler. The washers were bonded in position. Both this ASB and 206-01-73-5 required that bare aluminium (ie on the supports) was to be coated with anti-corrosion primer. Gloss paint was not specified.

ASB No 206-91-60 was mandated on 29 June 1992 by FAA AD No 92-09-07. Operators were given 30 days or 100 flying hours, whichever occurred first, to accomplish this work.

With regard to G-WLLY, the Modification Statements in the log books show that all the above ASBs had been complied with. In addition, physical evidence, in the form of the plugged nut plate attachment holes and washers were found during the examination. It was not clear from the records when ASB 206-91-60 was embodied on the helicopter, although it is probable that it was accomplished during the second rebuild in Canada.

Examination of the components by the manufacturer

Following examination by the AAIB, the components were delivered to the manufacturer's facility at Fort Worth, Texas, where they conducted their own examination. Their findings were in broad agreement with those of the AAIB, with some additional comments concerning the washers that were used to fill the gaps between the fin supports and the inserts, as per ASB No 206-91-60. They noted that the washers appeared to be "homemade", in that they were out-of-round and that the holes were not centred; in addition some of them appeared ground down and had rough edges. However, they had been manufactured from the correct material.

On loosely assembling the components (with the exception of the bottom forward attachment, which was deformed), it was noted that the washer in the top aft attachment did not stand proud of the surface of the doubler and thus did not meet the ASB requirement. As, the washers were not disturbed during the disassembly and reassembly of summer 2005 they were likely to have been in this state for a while. It was noted that the washers had been bonded to the fin inserts on top of the finish paint, which, as it appeared to be same blue colour as the rest of the fin, suggested that they may have been reattached when the fin was re-sprayed in December 2000.

Analysis

Handling characteristics

The investigation established that the vertical fin had suffered an in-flight detachment from the helicopter. The manner of its departure was such that the lower part of the fin entered the tail rotor arc; the resulting contact removed the 'stinger' at the base of the fin and damaged the rotor blades. The tail rotor and its gearbox were torn from their mountings shortly after the loss of the fin. Apart from the effect on directional stability, there would have been the consequences of the loss of approximately 20 kg of mass from the rear of the helicopter.

The vertical stabiliser provides directional stability and also has an outboard inclined leading edge. The aerodynamic load that this generates reduces the tail rotor thrust required during forward flight. It would be at its most effective during high speed flight when it would be subjected to the greatest lateral loading. Although the Met Office aftercast noted the probability of turbulence in the area, this is not thought likely to have affected materially the loading on the fin.

The loss of the tail rotor, associated gearbox, vertical stabiliser and 'stinger' would have had a major effect on the helicopter's handling characteristics at any speed. It was calculated that the loss of these components shifted the centre of gravity forward to a point forward of the longitudinal centre of gravity limit. This would have occurred rapidly and is likely to have led to a loss of control even with full aft cyclic control applied. Handling difficulties would have been compounded by the loss of the lateral thrust from the tail rotor causing the helicopter to rotate to the right. It is probable that the pilot would have applied full aft cyclic control in an attempt to arrest the nose down pitch, resulting in the main rotor blades contacting the top of the tail boom. In fact this was confirmed by the presence of tail rotor drive shaft components early in the wreckage trail. What happened after this is conjecture, but it is possible that the blade contact on the tail boom resulted initially in the failure of at least one of the main rotor pitch control links. This could have resulted in a large increase in lift on one blade such that it tilted the rotor disc, causing a bending overload failure of the mast. The separated rotor disc then sliced off the nose of the helicopter.

Whilst mast failure is not necessarily an inevitable consequence of fin detachment (as illustrated by one of the Canadian incident reports), the loss of the tail rotor and gearbox in this case severely reduced any possibility of the crew surviving the accident.

History of the aircraft

The aircraft was constructed in 1969 and had experienced a chequered history, being involved in a number of incidents and two major rebuilds. At some stage it had gained a tail boom of uncertain provenance, which served to highlight a potentially confusing situation with the Maintenance Manual, in that the method used to attach the vertical fin varied according to the serial number of the airframe, as opposed to that of the tail boom.

The log books indicated that more than 5,100 flying hours had been achieved at the time of this accident, which is not exceptional for a helicopter of this age. However, it is questionable as to how much of the original airframe remained following the two rebuilds; the recorded figure is probably irrelevant. Despite this, the log books indicated that the helicopter had been maintained in accordance with its schedule and that all the necessary Airworthiness Directives relating to the fin and its attachment had been complied with. There was thus no evidence to suggest that the cause of the accident was rooted in the distant past. This view was reinforced by the fact that the fin supports were reportedly in good condition at the time the tail was reassembled in September 2005. As a thorough examination of the area is easily accomplished with the fin removed, a reasonable level of confidence can be placed in this assessment. It was therefore concluded that the fatigue cracks most probably initiated *after* September 2005, with the main issues being the cause of the crack initiations and the failure to detect them before they progressed to a critical condition.

The failure

The QinetiQ metallurgical examination of the supports noted that the fatigue cracks had originated in the attachment bolt holes and/or the nut plate rivet holes. More specifically, the initiation points were on the outboard edge of the bores (ie the interface with the inboard side of the fin). Bearing in mind the fin exerts an aerodynamically generated force to the right during the cruise, it follows that the resulting tension in the bolts tends to reduce the compression in the fin supports. It is possible that certain vibration modes of the fin could have a similar effect. The crack progression was therefore likely to have been along the outboard surfaces of the supports, at the same time propagating through the material to the inboard surface. The effect of this would be that at any one time, the cracks would be longer on the outboard surface of the supports than on the inboard. This would not have assisted the discovery of the cracks during the 100 hour inspection in November 2005 (assuming they had developed by that time), as the fin was not required to be removed. Also, the cracks would not have been visible on the forging inner faces until their length exceeded the diameter of the washers under the stiff-nuts. Finally, the visibility of the cracks, if present, would not have been aided in this case by the dark blue paint scheme of the aircraft.

The sequence of the attachment failures was established as: top aft, top forward, lower aft and lower forward. It is probable that the top aft attachment had completely failed some time before the accident, thus increasing the load on the remaining attachments and consequently accelerating the crack progression.

The lack of torque

The mating surfaces of a structural joint are normally held in compression by the fastener components. Compression is generally regarded as beneficial in conferring fatigue resistance, and in this case the support forgings would be clamped between the nut and washer on the inboard faces and the fin (or, to be more precise, the shim) on the outboard faces. On fins without doublers, the forging outer faces abut directly against the fin inserts and are therefore placed in compression when the bolts are tightened. The addition of the doubler (which has cut-outs to allow access to the inserts) thus creates a gap between the forging and the insert, and a consequent loss of compression in the area of the forging immediately surrounding the bolt hole. It seems probable that this was the cause of the in-service fatigue crack problems that led to the issue of ASB No 206-91-60 and FAA AD No 92-09-07 (which introduced the shims), although the likely fatigue mechanism was not actually explained in either publication. The fact that the washer in the top aft attachment did not stand proud of the doubler surface when the components were loosely reassembled would have served to reduce the compression applied around the fastener hole.

The cause of the crack initiation was not obvious. However in the absence of observable defects such as thread marks or corrosion pits, it is considered that insufficient assembly torque or an in-service torque loss may have been responsible. Corroborative evidence was provided by the low torque settings found on the fin attachment fasteners after the accident. The stiff-nuts were found to be in good condition and were not thought likely to have backed off in service. The fact that the fatigue cracks had progressed to failure of the attachments suggests that the loss of torque must have existed for a considerable time. It thus seems reasonable to suppose that this condition may have been present at the time of the last 100 hour inspection, irrespective of whether the cracks were present or visible. Whilst the fin may not have appeared physically 'loose' at this time (the lack of any obvious fretting damage suggested that this was the case), a torque check on the fasteners could have revealed the problem and hence potentially averted the accident. However, such a check was not required by the Maintenance Manual.

Regardless of the cause of the torque loss, the immediate consequence would be a loss of rigidity, or stiffness, of the structural joint, which could render it vulnerable to the effects of vibration. In particular, the 'stinger' and its associated alloy plate represented a significant mass concentration at the base of the fin, effectively on an approximately one metre moment arm from the attachment area. Whilst it is considered that this was not responsible for crack initiation (the 'stinger'/plate assembly is, after all, common to most float-equipped helicopters and has not resulted in any reported problems) it is possible that the vibration amplitude would increase with crack progression, which in turn could accelerate the process.

The 'stinger' assembly on this type of helicopter presents itself as an accessible 'handle' for such purposes as manoeuvring the helicopter in a hangar, or for the application of a downwards load in order to assist mounting the jockey wheels on the skids. Any aggressive ground handling could result in excessive lateral loads being applied to the fin, with the attendant possibility of causing strain in the structural joint. However, any loss of rigidity, or even cracks caused in this way, might be expected to affect the lower attachments, as they are closer to the applied load, whereas the complete failure of the top aft attachment suggested that this was where the first crack initiated.

Finally, there is the matter of the remains of the gloss paint on the faces of the support forgings. A corrosion inhibitor/primer is all that is specified in the manufacturer's ASBs and it is not standard practice to apply gloss paint to the mating surfaces of structural joints. Since no painting was carried out during the reassembly in September 2005, it is likely that the paint was applied in December 2000. Paint has a finite thickness, and in the event that the paint film deteriorated or disintegrated (perhaps as a result of excessive loads applied to the fin during ground handling) and was lost from the stack-up, there would be a corresponding loss of assembly torque. However, it was not possible to determine if the amount of paint found adhering to the support faces was different from that present at the time the fin was reattached to the aircraft. As a consequence, it was impossible to assess how much of a contribution, if any, the presence of the paint made to the cause of the lack of torque.

Summary and Safety Recommendations

This was the second fatal accident to a Bell 206 involving failure of the fin supports. Earlier concerns about their structural integrity had been addressed by a number of Alert Service Bulletins and Airworthiness Directives. This investigation did not reveal any defects in what is manifestly a mature design. The failure was attributed to a lack of assembly torque in the attachment of the fin to the support forgings. The fin became detached when the helicopter was within an hour of landing at its maintenance base for its planned 100 hour inspection, where the extensive cracks in the fin supports would certainly have been discovered.

Whilst the lack of assembly torque in the fin attachments could not be accounted for, there were a number of possible explanations. Regardless of the reasons for the lack of torque, a torque check on the fasteners could have revealed the condition and hence prevented the accident. No such check was required in any of the periodic inspections.

In March 2006 the AAIB published Special Bulletin S1/2006 in which Safety Recommendations 2006-039 and -040 were made to the United Kingdom Civil Aviation Authority (CAA), the European Aviation Safety Agency (EASA) and also, since the design authority and manufacture of the Bell 206 series is now based in Canada, to Transport Canada. The Recommendations are reproduced here:

Safety Recommendation 2006-039

It is recommended that the United Kingdom Civil Aviation Authority require a one-off inspection, within a reasonable timescale, of the vertical fin supports of all Bell and Agusta-Bell 206 series helicopters on the UK register. The inspection should be conducted with the fin removed in order to obtain adequate access.

Safety Recommendation 2006-040

It is recommended that Transport Canada, the European Aviation Safety Agency and the US Federal Aviation Administration each consider requiring a one-off inspection, within a reasonable timescale, of the vertical fin supports of all Bell and Agusta-Bell 206 series helicopters within their jurisdictions.

Subsequent safety action

On 6 June 2006, in response to these Safety Recommendations, the CAA issued a Letter to Operators (LTO) detailing an inspection to be completed at the next 100 hour maintenance input. However, the LTO left compliance with this inspection to the operator's discretion by requesting rather than requiring compliance.

On 26 April 2006 Bell Helicopter Textron (BHT) issued ASB 206-06-107, which called for an inspection of helicopters equipped with the older type of supports, together with a Maintenance Manual amendment that included, among other requirements, a recurrent torque check of the fasteners at each 100 hour/annual inspection. The ASB was mandated by Transport Canada on 5 June 2006 with the issue of Airworthiness Directive CF-2006-12.

In addition, the ASB called for an increase of the torque values to 75-95 in lbs. Reference was also made to BHT-ALL-SPM (Standard Practices Manual), which provides guidance on paint finish applied to faying surfaces, which are defined as 'face-to-face areas of adjoining (contacting) parts'. However the ASB did not require the fin to be removed unless low torque values were recorded, paint was found on mating surfaces, or if cracks were suspected following an external examination. The text of ASB 206-06-107 was extensively amended at Revision A on 15 June 2006, but there was still no requirement to remove the fin unless some anomaly existed.

In addition to the ASB, on 17 April 2006, BHT also issued Operations Safety Notice (OSN) GEN-06-36, which reminded owners/operators to adhere to the original paint finishes, especially in the area of faying surfaces.

In Europe, on 5 July 2006, Agusta issued Bollettino Tecnico No 206-240, in respect of Agusta-Bell 206 series helicopters. This is a shorter, simpler version of ASB 206-06-07 which, significantly, does require removal of the vertical fin in order to inspect the supports. On 20 July 2006 the European Aviation Safety Agency (EASA) issued a Proposed Airworthiness Directive (PAD) No 06-192, in preparation for mandating the Bollettino Tecnico.

Finally, although this investigation has been concerned with a helicopter equipped with an older type of tail boom, ie on which the tail rotor gearbox platform was of a fabricated sheet metal construction, there is no suggestion that the one-piece fittings on later helicopters would be any less vulnerable to the effects of low torque. Thus the Safety Recommendations 2006-039 and 2006-040 contained in the Special Bulletin were intended to apply to all Bell and Agusta-Bell 206 helicopters, and the AAIB notes that while ASB 206-06-107 applies only to the older type of tail boom, the BHT Maintenance Manual amendment also applies to the later design.

ACCIDENT

Aircraft Type and Registration:	Jabiru UL-450, G-TYKE
No & type of Engines:	1 Jabiru 2200A piston engine
Year of Manufacture:	2002
Date & Time (UTC):	23 September 2006 at 1408 hrs
Location:	Glenforsa, Isle of Mull
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Minor damage to nose, right landing gear, wing tip and propeller
Commander's Licence:	Private Pilot's Licence
Commander's Age:	62 years
Commander's Flying Experience:	928 hours (of which 680 were on type) Last 90 days - 3 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

On landing, the aircraft skidded on the wet grass runway surface and was damaged as it entered an area of rough ground to the side of the runway.

History of the flight

After carrying out an aerial assessment of the 730 m grass runway at Glenforsa, the pilot carried out an uneventful approach and landing on Runway 25. When braking was applied, the aircraft skidded to the left and the pilot was unable to regain control before it entered and area of rough ground to the side of the runway. As the aircraft crossed this ground, the right wing tip and propeller struck the surface, causing damage to the nose, right landing gear and right wing tip. Both occupants were uninjured and vacated the aircraft in the normal manner. The pilot attributed the accident to the condition of the runway surface which, despite looking suitable from the air, was, upon inspection, found to be wet from rain the previous day and, as a consequence, was very slippery.

ACCIDENT

Aircraft Type and Registration:	Medway Eclipser, G-CCGA
No & type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	2003
Date & Time (UTC):	2 July 2006 at 1530 hrs
Location:	Wells-next-the-Sea, Norfolk
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Monopole and hanging bracket bent, aircraft swamped during recovery
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	43 years
Commander's Flying Experience:	268 hours (of which 66 were on type) Last 90 days - 19 hours Last 28 days - 11 hours
Information Source:	Aircraft Accident Reporting Form submitted by the pilot

Synopsis

The pilot attempted unsuccessfully to land on a deserted beach because he considered that he had an engine problem. A lack of climb performance lead to this belief. He subsequently considered that wind conditions encountered at low level accounted for the lack of performance.

History of the flight

The pilot reported that he was taking his daughter to view a seal colony just off the coast at Blakeney. He continued west and flew at low level over some seals but with no boats or people in the vicinity. He then turned through 180º to head towards Cromer, along the shoreline. At this point he was below 100 ft amsl. He applied power to climb back to a normal altitude for the leg to Cromer. He then became aware that his machine was not climbing normally. Suspecting an engine problem, he decided to land on the beach and check the fuel filters and plug leads. The beach was approximately five miles long and one mile wide and the pilot was conscious that the area was suitable for a precautionary landing, and was a more favourable landing site than the terrain on the route back to Cromer, should total engine failure occur.

The pilot carried out a normal landing into wind. The landing run at first appeared to be as on grass, but the drag of the rear wheels then increased dramatically and the front wheel was pulled down quite firmly. As the front wheel touched, the trike rapidly decelerated, and realising he was in soft sand, the pilot pushed the bar fully forward whilst applying full power. The machine nonetheless rapidly came to a halt, rolling onto its nosewheel and right mainwheel and coming to rest on the right wingtip. The pilot turned off the engine and master switch and both occupants left the aircraft without injury.

The pilot then located a suitable landing area on foot and alerted a colleague who had been flying nearby and was now overhead. The other pilot landed and helped right the overturned machine. Both pilots then dragged it to firmer sand. The pilot of G-CCGA examined the fuel filters and found them to be clean. He tried to taxi the machine towards the shore. Unfortunately, soft sand was again encountered and the aircraft became stuck.

The colleague then flew the pilot's daughter back to Cromer. The pilot was assisted by the RNLI to de-rig and tow the aircraft to their boathouse. Notwithstanding great effort to locate a 'dry' route, the machine was swamped as they passed through the shallowest point of a sea channel.

Pilot's comment

The pilot subsequently noted that, following the accident, the wind was swinging from 100º to 40º and occasionally gusting. He subsequently felt that low level wind conditions explained the lack of climb performance. The engine was reaching full power during his attempt to taxi to the land and its indicated temperatures were normal.

ACCIDENT

Aircraft Type and Registration:	Raj Hamsa X'Air 133(1), G-CDHO
No & type of Engines:	1 Verner 133M piston engine
Year of Manufacture:	2005
Date & Time (UTC):	17 June 2006 at 1500 hrs
Location:	Near Tilbury Docks, Essex
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Engine magneto failure and damage to propeller
Commander's Licence:	Private Pilot's Licence
Commander's Age:	37 years
Commander's Flying Experience:	275 hours (of which 33 were on type) Last 90 days - 21 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and follow-up AAIB investigation

Synopsis

When close to Tilbury Docks, during a training flight, the magneto rotor separated from the engine, damaging the propeller and causing the engine to stop. The instructor carried out an uneventful forced landing in a field adjacent to the River Thames. The magneto separation was due to the failure of the crankshaft stub shaft, from crack propagation due to a torsional fatigue mechanism. Damage to the magneto coil formers indicated that the rotor had been operating out of alignment, increasing the torsional loads within the shaft. The cause of the misalignment was probably due to an impact on the magneto rotor, during engine handling, at some point between a workshop visit in July 2005 and re-installation of the engine.

History of the flight

The aircraft was being used for an instructional flight, with the owner under the tuition of a qualified instructor. It was operating in an area close to the north bank of the River Thames, near Tilbury Docks. With the aircraft at a high angle of attack and the engine at maximum speed, the magneto rotor separated from the engine and passed through the rotating propeller, severely damaging both blades. The instructor manoeuvred the aircraft into the gliding attitude and carried out an uneventful forced landing in a large field adjacent to the river. With the exception of the engine and propeller, the aircraft was undamaged and neither occupant was injured. After recovery, the fuselage was taken to the AAIB to allow the engine to be removed and stripped for investigation; the magneto rotor was not recovered.

Engine examination

The aircraft, a Raj Hamsa X'Air microlight, was constructed in 2004 and purchased by the present owner in February 2006. It was powered by a Verner 133M two-cylinder, horizontally opposed engine, manufactured in the Czech Republic and mounted above and ahead of the cockpit. At the time of the incident, the airframe and engine had a total time of approximately 43 hours.

Engine history

A review of the engine and airframe log book showed that the engine had been installed in January 2005 and had completed its post installation runs satisfactorily. In July 2005, with no further recorded operation, it was then removed and returned to the manufacturer for the crankshaft (including the stub shaft) to be replaced. This was because the manufacturer had identified this engine as one of a batch where the crankshafts had been produced from steel of a higher than normal sulphur content. Subsequently, after a total of 20 hours of operation, two cylinder head studs pulled from the crankcase, which required their replacement. Twenty-one hours after that event, several other cylinder studs pulled out which also required replacement. The engine manufacturer's UK agent confirmed that, on both occasions, the cylinder head studs were replaced without removing the engine from the airframe. The engine then operated for approximately two hours prior to the failure of the magneto rotor.

Magneto description

The magneto on the Verner 133M engine is located on the front of the engine, immediately below the propeller shaft. It consists of eight primary and two secondary coils secured to the front of the gearbox casing (Figure 1). Magnets are secured to the inside of a rotating casing which covers the entire assembly. The casing is bolted to a steel stub shaft, pressed into the forward end of the crankshaft, which passes through the centre of the coils, (Figure 2).

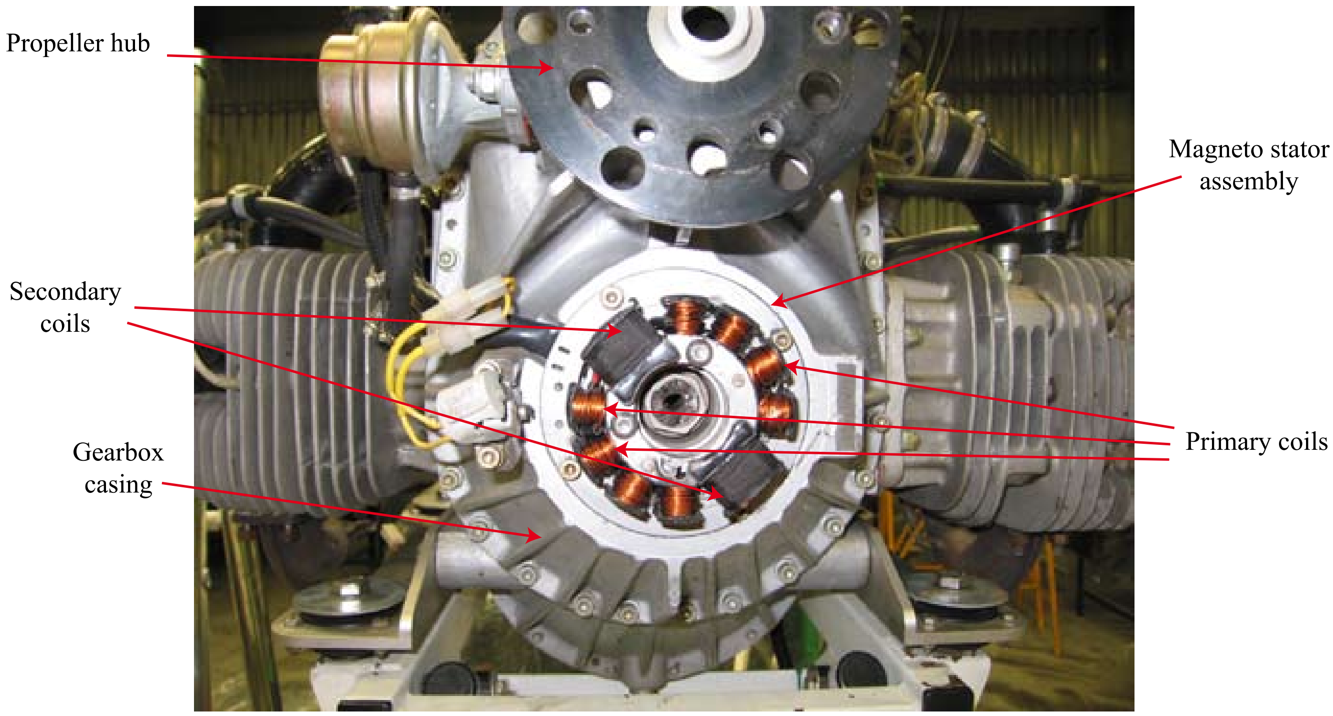


Figure 1

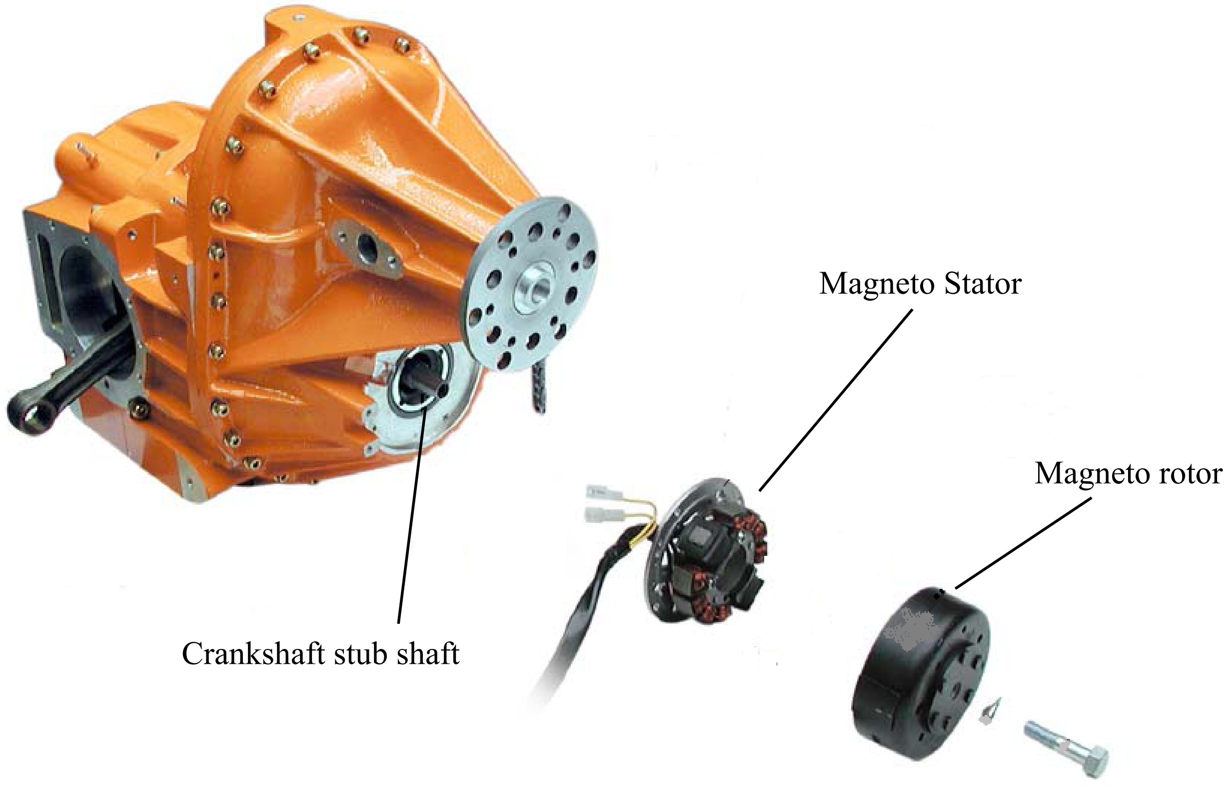


Figure 2

Stub shaft examination

Examination of the engine identified that the release of the magneto rotor resulted from the failure of the stub shaft. The magneto coils showed evidence of uneven and heavy rubbing to the end of the coil formers, indicating that the magneto rotor had been operating out-of-alignment prior to the failure, (Figure 3). Metallurgical examination of the stub shaft fracture surface revealed the presence of a pre-existing crack, which had propagated by a torsional fatigue mechanism, across 65% of its cross-sectional area, before failing in overload. Mechanical damage to the fracture surface precluded an estimation of the number of stress cycles experienced prior to failure, or positive identification of crack initiation site(s). No material abnormalities or inclusions were identified in the fracture surface.

Engine examination

Examination of the engine prior to removal, showed evidence of impact damage to a stiffening rib on the gearbox casing, at the 6 o'clock position (Figure 4). The condition of the rib indicated that it had been damaged for some time and was unlikely to have been caused when the magneto rotor separated from the engine. When placed on a work surface, the balance of the engine caused it to tip forward, where it came to rest on the damaged stiffening rib. Measurements confirmed that, had the magneto rotor been in place, it would have made contact with the work surface before the stiffening rib.

Analysis

In normal operation, the torsional loading of the stub shaft is low and would be unlikely to be of sufficient

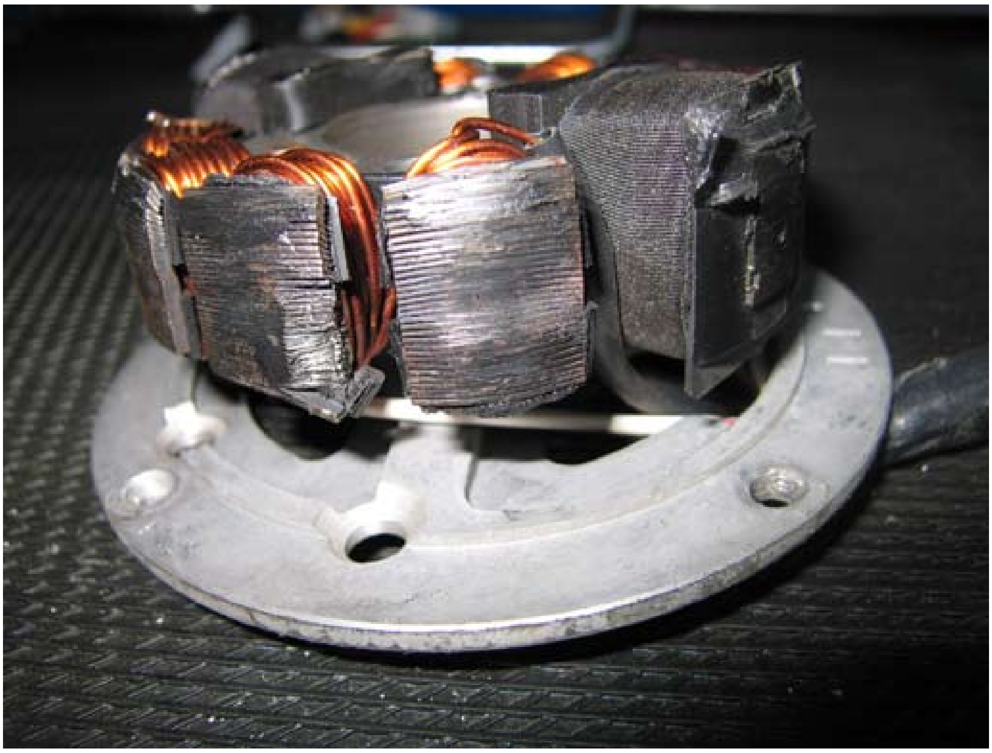


Figure 3 (left)

Damage to stator formers

Figure 4 (right)

Damaged stiffening rib

magnitude to cause crack initiation or progression in the shaft. The damage to the magneto coil formers indicated that the rotor had been sufficiently out of alignment, prior to the failure, to make contact with the formers whilst rotating. This would have significantly increased the torsional loads within the shaft and, most likely, both precipitated and propagated the crack.

When installed in the X'Air, the engine is approximately six feet above the ground and the magneto rotor is partially shielded by the propeller, which should protect it from inadvertent damage. However, whenever the engine is removed, the position of the magneto rotor makes it vulnerable to handling damage. Any impact on the magneto rotor has the potential to distort the stub shaft and allow the rotor to make contact with the coil formers.

Conclusions

The magneto rotor was released as a result of failure of the crankshaft stub shaft, which had failed due to crack progression from a torsional fatigue mechanism. The torsional loading on the shaft was likely to have been increased as a result of the magneto rotor being sufficiently out of alignment to make contact, when operating, with the coil formers. The damage to the gearbox stiffening rib indicated that the engine had probably been allowed to tip forward at some point when being handled 'off-wing', possibly causing a slight distortion to the stub shaft. As a new crankshaft, including the stub shaft, had been installed by the manufacturer in July 2005, and the engine had not been removed again until this incident, it is likely that the stub shaft became damaged at some time between the workshop visit and completion of the re-installation process.

Follow up action

The manufacturer has stated that they are aware of one previous loss of a magneto rotor, which they confirmed to be the result of an engine being allowed to tip forward during handling, distorting the stub shaft. They have since introduced a modification to fit a guard to protect the magneto from such damage.

BULLETIN CORRECTION

AAIB File:	**EW/G2006/06/14**
Aircraft Type and Registration:	EV-97 TeamEurostar UK, G-IHOT
Date & Time (UTC):	16 June 2006 at 1800 hrs
Location:	Barling farmers strip, Essex
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

AAIB Bulletin No 11/2006, page 135 refers

In the 'Nature of Damage' section of this report it was stated that the engine had been shockloaded. In fact, the engine had not yet been examined for shockloading and, in the opinion of the engineer repairing the aircraft, the minor damage to the propeller tips would probably not have caused the engine to suffer from shockloading damage.

BULLETIN CORRECTION

AAIB File:	**EW/C2004/10/03**
Aircraft Type and Registration:	Mooney M20J, G-EKMW
Date & Time (UTC):	16 October 2004 at 0648 hrs
Location:	Jersey Airport, Channel Islands
Information Source:	AAIB Field Investigation

AAIB Bulletin No 11/2006, page 92 refers

Safety Recommendation 2006-029 was made to the CAA in the report on the accident to Mooney M20J, G-EKMW, as follows:

'It is recommended that the Civil Aviation Authority review their quality audit programmes, which underpin its EASA Part 145 approvals of maintenance organisations, to ensure that such audits include adequate sampling and objective scrutiny of the physical engineering activities'

The CAA has stated that it is fully supportive of [safety] recommendations that enable improvements to be made to its regulatory oversight and surveillance methods, and believes that this was the intent of SR 2006-029. However, they could not accept this recommendation as worded because it would require the implementation of a quality audit programme, with all that this implies, as it is for the approved organisation to implement.

In order to more reflect correctly the role of the Regulator, Safety Recommendation 2006-029 has been re-issued as follows:

Safety Recommendation 2006-134

It is recommended that the Civil Aviation Authority review their regulatory oversight methods, which underpin its EASA Part 145 approvals of maintenance organisations, to ensure they include adequate sampling and objective scrutiny of the physical engineering activities.

AIRCRAFT ACCIDENT REPORT No 2/2006

This report was published on 10 November 2006 and is available on the AAIB Website www.aaib.gov.uk

REPORT ON THE ACCIDENT TO PILATUS BRITTEN-NORMAN BN2B-26 ISLANDER, G-BOMG WEST-NORTH-WEST OF CAMPBELTOWN AIRPORT, SCOTLAND ON 15 MARCH 2005

Registered Owner and Operator:	Loganair Limited
Aircraft Type:	Pilatus Britten-Norman BN2B-26 Islander
Nationality:	British
Registration:	G-BOMG
Place of Accident:	7.7 nm west-north-west of Campbeltown Airport, Argyll, Scotland Latitude: 55º 29.2' N Longitude: 005º 53.7' W
Date and Time:	15 March 2005 at 0018 hrs All times in this report are UTC

Synopsis

The watch supervisor at the Scottish and Oceanic Area Control Centre notified the accident to the Air Accidents Investigation Branch (AAIB) at 0115 hrs on 15 March 2005.

The Glasgow based Islander aircraft was engaged on an air ambulance task for the Scottish Ambulance Service when the accident occurred. The pilot allocated to the flight had not flown for 32 days; he was therefore required to complete a short flight at Glasgow to regain currency before landing to collect a paramedic for the flight to Campbeltown Airport on the Kintyre Peninsula.

Poor weather at Campbeltown Airport necessitated an instrument approach. There was neither radar nor Air Traffic Control Service at the airport, so the pilot was receiving a Flight Information Service from a Flight Information Service Officer in accordance with authorised procedures. After arriving overhead Campbeltown Airport, the aircraft flew outbound on the approach procedure for Runway 11 and began a descent. The pilot next transmitted that he had completed the 'base turn', indicating that he was inbound to the airport and commencing an approach.

Nothing more was seen or heard of the aircraft and further attempts at radio contact were unsuccessful. The emergency services were alerted and an extensive search operation was mounted in an area based on the pilot's last transmission. The aircraft wreckage was subsequently located on the sea bed 7.7 nm west-north-west of the airport; there were no survivors.

The investigation identified the following causal factors:

1. The pilot allowed the aircraft to descend below the minimum altitude for the aircraft's position on the approach procedure, and this descent probably continued unchecked until the aircraft flew into the sea.

2. A combination of fatigue, workload and lack of recent flying practise probably contributed to the pilot's reduced performance.

3. The pilot may have been subject to an undetermined influence such as disorientation, distraction or a subtle incapacitation, which affected his ability to safely control the aircraft's flightpath.

Three safety recommendations have been made.

Findings

3.1.1 The aircraft

1. The aircraft was certified, equipped and maintained in accordance with existing regulations and approved procedures. With the exception of a single non-airworthiness item, concerning the stretcher assembly, the aircraft was free of recorded defects.

2. The aircraft's weight and centre of gravity were within limits during the accident flight.

3. The aircraft had been refuelled to full on the evening of 14 March 2005, and the aircraft's wing fuel tanks contained a substantial amount of fuel at the time of the accident.

4. There was no evidence of pre-impact failure in any of the aircraft's systems and the aircraft was intact when it hit the sea.

5. The aircraft's elevator trim setting would have resulted in a hands-off trim speed of 110 to 120 KCAS using an approach or cruise power setting.

6. Fuselage and wing sections showed damage consistent with the aircraft having struck the sea in a controlled flight attitude, at a typical operating speed and with symmetric engine power.

7. No evidence of a technical fault was found that might have contributed to the accident.

9. The HSI and OBI settings were not consistent with the aircraft's position in the approach procedure.

10. The altimeters were set to within 1 hPa of the reported QNH, corresponding to a maximum display error of about 28 ft.

11. The primary attitude indicator was probably capable of displaying reliable attitude information at the time of the accident.

3.1.2 Flight operations

1 The air ambulance task by SAS was legitimate and conformed to standard procedures detailed in the operator's operations manual. The operator was responsible for operational control of the flight.

2. For the purpose of air ambulance work, the operator had permission from the CAA and HIAL to operate non-scheduled public transport flights outside published aerodrome operating hours.

3. It is probable that when the pilot left the operations room for the flight he had seen only limited weather information for Glasgow and Prestwick.

4. The flight met the requirements for the provision of meteorological information.

5. Although the pilot had declared his intention to route to the west after takeoff rather than direct to Campbeltown, the actual route flown was unusually long, given the nature of the task.

6. Reliable VOR and NDB signal from Campbeltown would probably have been received as the aircraft passed ROBBO, and for the remainder of the flight.

7. The pilot appears to have been unaware of his precise position in relation to the 'MAC' when his route was queried by ATC.

8. At some stage prior to arriving at Campbeltown, the pilot had probably seen the 2320 hrs weather report, taken to the aircraft by the paramedic.

9. The pilot's stated intention was to fly the VOR/DME procedure to Runway 11, and then to circle to land on Runway 29.

10. The weather information available to the pilot indicated that the cloud base would very probably prevent a circling manoeuvre to Runway 29, and that even a landing on Runway 11 may not be possible. However, the pilot was permitted to commence an approach in the weather conditions that prevailed.

11. Visibilities were at or above the minimum required for landing on either runway.

12. Glasgow and Prestwick remained suitable as diversion airports, and the aircraft had sufficient fuel to divert to either if it was unable to land at Campbeltown.

13. The pilot descended the aircraft to 3,000 ft before reaching the 'MAC' VOR/DME, which was below SSA and contrary to procedures.

14. The 'MAC' VOR/DME was operating to specification at the time of the accident. The associated procedure was approved by the CAA for use by the operator, including outside of normal airport operating hours.

15. The aircraft established correctly on the 307º outbound radial, and the observed speed and rate of descent on the outbound leg were consistent with normal flight profiles.

16. The aircraft descended below the minimum outbound altitude of 1,540 ft with a steady rate of descent of about 1,000 ft/min. At the last recorded radar position it was 200 ft below the minimum altitude and still descending.

17. The autopilot was probably not in use in the final stages of the flight.

18. Had the aircraft simply 'dipped' below 1,540 ft and then climbed back up, it is probable that further radar returns would have been received.

19. The cloud base in the accident area was probably as low as 200 ft and the visibility approximately 2,000 m. There would have been few environmental cues to alert the pilot to the aircraft's very low altitude.

20. The location and orientation of the wreckage trail was consistent with the aircraft having descended at a more or less constant rate after it disappeared from radar, and having turned at the 9 DME point directly on to a heading to intercept the inbound course.

21. The presence of a second pilot may have prevented the accident.

22. Had the aircraft been equipped with a radio altimeter, or other electronic low height warning device, which was correctly set to warn of a low height situation, the accident may not have occurred.

3.1.3 Personnel

1. The pilot was correctly licenced and qualified to operate the flight.

2. The pilot was in compliance with the applicable flight and duty time limitations.

3. The pilot held an appropriate medical certificate. No psychological factors were likely to have played a part in the accident.

4. The pilot had undergone formal training in stress and fatigue issues as part of the company's recurrent training programme.

5. Although the pilot had flown a short currency flight on the night of the accident, he had not previously flown for 32 days and therefore lacked recent flying practise.

6. The pilot met the minimum requirements regarding currency in instrument approaches, but it is probable that he had flown comparatively few of these on the Islander.

7. It is probable that the pilot was suffering, at least to some extent, from the affects of fatigue.

8. The pilot may have been operating under high workload, or even overload, conditions in the latter stages of the flight, which may have degraded his situational awareness.

9. The paramedic was experienced as a passenger in the Islander aircraft, and had received appropriate training in safety procedures and equipment.

3.1.4 Survivability

1. The pilot's body showed no obvious external injuries and no internal injuries or fractures. A survivable space was preserved in the cockpit area and it is probable that the pilot survived the impact.

2. The paramedic was probably rendered unconscious in the impact when his head hit the pilot's seat in front due to the lack of upper torso restraint.

3. There was no operational or certification requirement for the aircraft to be fitted with shoulder harnesses on the passenger seats and, under the certification standards applicable to G-BOMG, there was no requirement relating to passenger head injury protection.

4. It was not normal practise for the pilot or paramedic to wear immersion protection or a lifejacket during such flights.

5. Average survival time in the sea, at a temperature of 9ºC, would have been no more than one hour.

Safety Recommendations

The following safety recommendations were made:

Safety Recommendation 2006-101

The European Aviation Safety Agency and Joint Aviation Authorities should review the UK Civil Aviation Authority's proposal to mandate the fitment of Upper Torso Restraints on all seats of existing Transport Category (Passenger) aeroplanes below 5,700 kg being operated for public transport, and consider creating regulation to implement the intent of the proposal.

Safety Recommendation 2006-102

Considering the unique circumstances of air ambulance flights, the Civil Aviation Authority, in conjunction with the Joint Aviation Authorities should review the circumstances in which a second pilot is required for public transport flights operating air ambulance services.

Safety Recommendation 2006-103

The Civil Aviation Authority, in conjunction with the Joint Aviation Authorities, should consider mandating the carriage of a radio altimeter, or other independent low height warning device, for public transport IFR flights operating with a single pilot.

AIRCRAFT ACCIDENT REPORT No 3/2006

This report was published on 8 December 2006 and is available on the AAIB Website www.aaib.gov.uk

REPORT ON THE SERIOUS INCIDENT TO BOEING 737-86N, G-XLAG AT MANCHESTER AIRPORT ON 16 JULY 2003

Registered owner and operator:	Excel Airways Limited
Aircraft Type and Model:	Boeing 737-86N
Registration:	G-XLAG
Location:	Runway 06 Left, Manchester Airport
Date and Time:	16 July 2003 at 1408 hrs All times in this report are UTC (equivalent to local time minus one hour) unless otherwise stated

Synopsis

G-XLAG, a Boeing 737-86N, with seven crew and 190 passengers on board, was undertaking a flight from Manchester Airport to Kos, Greece. Runway 06L was in use but the flight crew were not aware that this runway was being operated at reduced length. This was due to work-in-progress to remove rubber deposits at the far end of the runway, which was out of sight from the 06L threshold end as the runway is built over a slight rise in the ground. Due to a difference in interpretation of information passed between Air Traffic Control (ATC) and the flight crew, the aircraft entered the runway from holding point AG, rather than the expected holding point A, and the takeoff was conducted using a reduced thrust setting calculated for the assumed normal runway length. As the aircraft passed the crest of the runway, the flight crew became aware of vehicles at its far end but, as they were now close to their rotation speed, they continued and carried out a normal takeoff. The aircraft passed within 56 ft of a 14 ft high vehicle.

This serious incident was notified to the AAIB at 1724 hrs on 23 July 2003, seven days after it had occurred. The subsequent investigation revealed further incidents had occurred during the course of the work, the most significant being on the night of 15 July 2003. On this occasion ATC had instructed three commercial passenger aircraft to go-around after they had knowingly positioned them to land on the reduced length runway. The crews of all three aircraft were unaware of the reduced length available and, when informed, stated that it was insufficient for them to be able to land. The closest of the aircraft, a Tristar, was at a range of 2.5 nm when instructed to go-around.

The actions of Manchester Airport plc (MA plc) and National Air Traffic Services (NATS) Manchester, whilst not directly contributing to the event involving G-XLAG, raised additional concerns. In light of this, the scope of the investigation was extended to include the manner in which MA plc and NATS had planned and managed the rubber-removal operation.

The operator, MA plc and NATS have now taken considerable steps to address most of the issues raised in this report.

Six safety recommendations are made.

Causal factors

The crew of G-XLAG did not realise that Runway 06L was operating at reduced length due to work-in-progress at its far end, until their aircraft had accelerated to a speed approaching the rotate speed (V_R), despite:

- Being in possession of a NOTAM concerning the work-in-progress
- The ATIS broadcast relating to the work-in-progress
- ATC passing information on the takeoff distance available

At this point, the aircraft was approaching seven vehicles on the runway and was at a position which precluded an abort within the useable runway length remaining.

Findings

1 A classification survey carried out on 25 and 26 June 2003 identified friction levels on portions of Runway 24R touchdown zone exceeding 100 m in length, that were below Minimum Friction Level.

2 No NOTAM was published to advise that Runway 06L/24R was slippery when wet whilst portions of the runway were below Minimum Friction Level.

3 The airport operator contracted the rubber-removal operator on 2 July 2003.

4 The airport operator held the first planning meeting for the rubber-removal operation on 9 July 2003.

5 Hazard analysis conducted by the airport operator dated 14 July 2003 did not include all hazards associated with the rubber-removal operation.

6 No documented hazard analysis was conducted by Manchester ATC.

7 Operational Advice Notice 08/03, relating to the rubber removal operation and published on the morning of 14 July 2003, contained only limited briefing information.

8 Manchester ATC did not publish a Temporary Operating Instruction relating to the rubber-removal work.

9 The request for NOTAM action was applied for by the airport operator approximately three hours prior to the commencement of the rubber-removal operation on 14 July 2003.

10 The CAA confirmed the correct reduced runway distances had been calculated when contacted by the airport operator on the morning of 14 July 2003.

11 Rubber-removal operations commenced at 1430 hrs on 14 July 2003 and were completed by 2053 hrs on 17 July 2003.

12 No evidence was found that the NOTAM detailing the work had been cancelled by the airport operator when the work had been completed ahead of schedule.

13 There were no markings to delineate the extent of the Take Off Climb Surface whilst Runway 06L was operating at reduced length.

14 Commencement of reduced runway operations coincided with the ATC shift change.

15 There was no blanking of runway lighting in the work-in-progress area of Runway 06L during reduced runway operations.

16 There was confusion between Manchester ATC and the airport operator operations staff over the planning restrictions in force limiting the operating time permitted for Runway 06R/24L.

17 There was no access to the planning restrictions in force on the use of Runway 06R/24L in any documents available to Manchester ATC or the airport operator at an operational level.

18 On 15 July three aircraft were lined up on the approach to land on Runway 06L by Manchester ATC whilst it was operating at reduced length, a length insufficient for them in which to land.

19 Work was in progress at the time of the incident at the end of Runway 06L.

20 The work-in-progress was promulgated by NOTAM and transmitted on the ATIS to which the two pilots had access.

21 The co-pilot listened to the ATIS broadcast, which contained details about the weather, bird activity and the work-in-progress, but only copied down details about the weather.

22 Manchester ATC advised the pilots of the reduced runway distance available for takeoff.

23 The pilots were properly licensed to conduct the flight.

24 The pilots did not read the NOTAMs relating to Manchester Airport prior to the aircraft's departure.

25 The pilots correctly determined the aircraft's takeoff performance for a takeoff from Runway 06L had it been at full length, but this was incorrect at its reduced length.

26 The pilots had no means of determining takeoff performance for the aircraft from Runway 06L at reduced length.

27 The aircraft was more than nine tonnes over-weight to conduct a reduced thrust takeoff from the reduced runway length available.

28 The taxi instructions issued to the flight crew by Manchester ATC did not include a specific holding point.

29 The version of MATS Part 1 current at the time of the incident did not require a specific holding point to be included in taxiing instructions.

30 The captain was handling pilot during the taxi.

31 Radio communications between Manchester ATC and the flight crew regarding the lining up point on Runway 06L were misinterpreted by both parties.

32 The aircraft was lined up on Runway 06L via holding point AG using a non-standard technique.

33 The co-pilot was the handling pilot during take off.

34 The pilots used a non-standard technique to set takeoff power at the commencement of the takeoff roll.

35 Seven vehicles associated with the work-in-progress were on Runway 06L at the time of takeoff; closest to the aircraft's point of rotation was a rubber removal vehicle 14 ft high.

36 The pilots only became aware of the presence of vehicles as they crested the rise in the runway just prior to the aircraft attaining rotation speed, V_R.

37 The aircraft was rotated at the pilots' calculated V_R speed.

38 After becoming airborne, the aircraft passed within 56 feet of the vehicle.

39 The pilots did not believe they had been involved in a serious incident and so did not make a report to their company, the CAA or the AAIB.

40 Both MA plc and Manchester ATC senior management were made aware of the incident on the day of its occurrence, but did not necessarily appreciate its true significance at the time.

41 The incident was witnessed by some ATC and airport operations staff.

42 No report was made by any members of MA plc or Manchester ATC immediately following the incident.

43 The incident was reported seven days after its occurrence to the AAIB by NATS on receipt of a report by Manchester ATC.

Safety Recommendations

The serious incident which triggered this investigation resulted from a non-adherence to established procedures by the flight crew, rather than a failing in the procedures themselves. The operator took early and appropriate action to prevent a reoccurrence by the crew involved.

In investigating the event involving G-XLAG, the planning and management of the rubber removal operation by MA plc and NATS Manchester raised additional concerns. They too, largely centre on non-adherence to established procedures. Since the event, both these organisations have taken considerable action and, as a result, the majority of the issues identified in this report have now been resolved.

The following safety recommendations are made where it is believed further action by these, and other parties, remains necessary.

Safety Recommendation 2006-07

It is recommended that the Civil Aviation Authority review the measures required to protect runway safety surfaces during reduced length runway operations.

Safety Recommendation 2006-08

It is recommended that National Air Traffic Services consider the exclusion of operational staff in direct commercial negotiations where there is the potential for this to result in a conflict of interest between operational best practice and commercial considerations.

Safety Recommendation 2006-11

It is recommended that the Civil Aviation Authority, in conjunction with National Air Traffic Services and other air traffic service providers, jointly review the current risk analysis associated with operations from runways when at reduced length, to ensure that it remains valid.

Safety Recommendation 2006-12

It is recommended that Manchester Airport plc include appropriate guidance in the Airport Operations Manual on the local authority planning agreements governing the use of Runway 06R/24L.

Safety Recommendation 2006-13

It is recommended that National Air Traffic Services incorporate appropriate guidance in the Manchester Airport Manual of Air Traffic Services (Part 2) on the local authority planning agreements governing the use of Runway 06R/24L.

Safety Recommendation 2006-14

It is recommended that Manchester Airport plc introduce a system which requires the timely dissemination and acknowledgement of any instruction issued containing operational information with safety implications, such as Operations Advice Notices.

FORMAL AIRCRAFT ACCIDENT REPORTS ISSUED BY THE AIR ACCIDENTS INVESTIGATION BRANCH

2004

2/2004 Sikorsky S-61, G-BBHM at Poole, Dorset on 15 July 2002.

Published April 2004.

3/2004 AS332L Super Puma, G-BKZE on-board the West Navion Drilling Ship, 80 nm to the west of the Shetland Isles on 12 November 2001.

Published June 2004.

4/2004 Fokker F27 Mk 500 Friendship, G-CEXF at Jersey Airport, Channel Islands on 5 June 2001.

Published July 2004.

5/2004 Bombardier CL600-2B16 Series 604, N90AG at Birmingham International Airport on 4 January 2002.

Published August 2004.

2005

1/2005 Sikorsky S-76A+, G-BJVX near the Leman 49/26 Foxtrot Platform in the North Sea on 16 July 2002.

Published February 2005.

2/2005 Pegasus Quik, G-STYX at Eastchurch, Isle of Sheppey, Kent on 21 August 2004.

Published November 2005.

3/2005 Boeing 757-236, G-CPER on 7 September 2003.

Published December 2005.

2006

1/2006 Fairey Britten Norman BN2A Mk III-2 Trislander, G-BEVT at Guernsey Airport, Channel Islands on 23 July 2004.

Published January 2006.

2/2006 Pilatus Britten-Norman BN2B-26 Islander, G-BOMG, West-north-west of Campbeltown Airport, Scotland on 15 March 2005.

Published November 2006.

3/2006 Boeing 737-86N, G-XLAG at Manchester Airport on 16 July 2003

Published December 2006.

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