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ADDENDA and CORRECTIONS

None

(ALL TIMES IN THIS BULLETIN ARE UTC)

INCIDENT

Aircraft Type and Registration:	Airbus A300 B4, TC-MND
No & Type of Engines:	2 CF6-50C2 turbofan engines
Year of Manufacture:	1982
Date & Time (UTC):	13 April 2007 at 2314 hrs
Location:	Manchester Airport
Type of Flight:	Commercial Air Transport (Cargo)
Persons on Board:	Crew - 3 Passengers - None
Injuries:	Crew - None Passengers – N/A
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	54 years
Commander's Flying Experience:	17,640 hours (of which 7,800 were on type) Last 90 days - 172 hours Last 28 days - 43 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

During its final approach to Runway 24L at Manchester, the aircraft descended below the minimum altitudes specified in the VOR/DME procedure for that runway.

History of the flight

The aircraft was cleared to descend in accordance with the Manchester (MCT) VOR/DME approach procedure for Runway 24L at Manchester Airport. The co-pilot contacted the Tower frequency at a range of approximately 10 nm from touchdown and the Tower controller confirmed that the aircraft was cleared for this approach. The commander calculated the Visual Descent Point[1] and at 6 nm commenced the final descent to the Minimum Descent Altitude (MDA)[2] of 660 ft.

The Tower controller observed on radar that the aircraft was 1 nm right of the published approach track. He advised the pilots of this and asked them to report when visual with the lights of Runway 24L. At 5 nm from the touchdown threshold, the Tower controller noticed that the aircraft appeared low on the approach and when this was confirmed by the Approach controller, instructed the aircraft to go around. The aircraft stopped descending and shortly afterwards reported that the runway was in sight. The Tower controller considered the aircraft now

Footnote

[1] The point at which a nominal 3° glide path to the touchdown point coincides with the published MDA.

Footnote

[2] The MDA is the altitude in a non-precision approach below which descent may not be made without the required visual reference.

to be at a suitable altitude and lined up with the correct runway and asked the crew if they were able to continue visually. The commander replied that they were and the aircraft landed without further incident.

Meteorological information

The weather reported at 2250 hrs was a wind of 2 kt with variable direction and a visibility of 4,800 m in haze. The temperature was 10ºC and the QNH was 1022 mb.

Aerodrome information

Manchester Airport has two parallel runways with a south-westerly alignment which at the time of the incident were designated 24L and 24R. A VOR/DME procedure was published for both runways. The final approach track for the Runway 24R procedure was offset 5º to the south of the runway heading, such that an aircraft following the published track would be south of the approach track to Runway 24L. The runway centrelines are 0.21 nm apart and the threshold of the left hand runway is 1.02 nm beyond the threshold of the right hand runway in the landing direction.

Approach procedure

The VOR/DME approach procedure for Runway 24L was published in the UK Aeronautical Information Package (AIP) and is shown in Figure 1. The pilots of TC-MND used a commercially available approach chart which contained information equivalent to that shown in the UK AIP.

According to the published procedure the aircraft was required to maintain an altitude of 2,400 ft until passing the Final Approach Fix (FAF) 6 nm from the MCT. When established on the published approach track the minimum altitude until passing the Step Down Fix at 5 nm from the MCT was 2,080 ft. Thereafter there were no further published altitude restrictions until the aircraft reached the MDA of 660 ft. The recommended vertical profile, given in the form of altitude versus distance from the MCT (and also, from the touchdown threshold) was shown in a table on the same page as the chart.

Recorded information

Due to a delay in notification of this incident the AAIB was unable to recover information from the cockpit voice recorder or the flight data recorder.

Radar recordings indicated the position and altitude of the aircraft as it approached Runway 24L. As it turned it crossed the final approach track and established a track parallel to the north of it. The table below shows the aircraft altitude relative to the profile recommended on the approach chart at intervals of one mile.

Distance to MCT VOR / nm	Recommended Altitude / ft	Aircraft Altitude / ft
6	2,400	1,800
5	2,080	1,300
4	1,770	800
3	1,450	800
2	1,130	800
1	820	800

This information indicates that the aircraft descended below the minimum procedure altitude of 2,400 ft before passing the FAF and below 2,080 ft before passing the associated SDF at 5 nm. As the aircraft passed within 5 nm of the threshold its track began to converge with the published approach track.

Recordings of the Manchester Approach and Tower frequencies indicated that the pilots had received and read back instructions correctly.

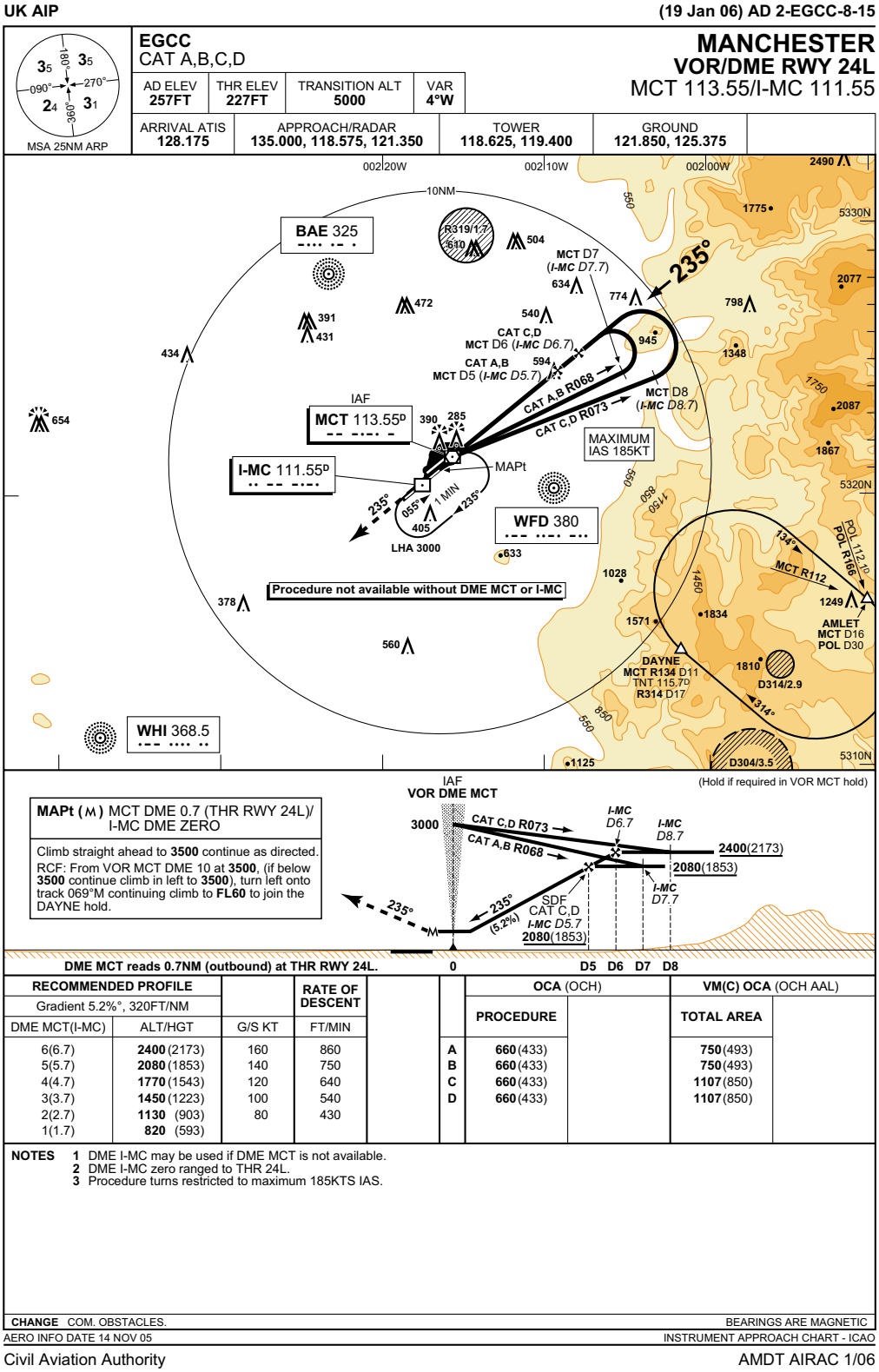


Figure 1

Manchester VOR/DME RWY 24L procedure

Approach techniques

Several studies by national aviation authorities and independent flight safety organisations have demonstrated that a stabilised approach technique is more desirable than a stepped descent from the FAF to the MDA. A stepped descent profile involves descending immediately to the lowest permissible altitude for a given sector of the approach, even if this means flying level for some distance at the MDA. A stabilised approach is conducted by descending at a constant angle, mimicking the profile that would result from following the glide slope of an instrument landing system. Such an approach can be flown without the need to change the configuration of gear and flap, resulting in fewer power changes and reduced pilot workload. The UK AIP and commercially available approach charts provide information to assist with determining the appropriate vertical profile.

ICAO Document 8168, PANS-OPS – *'Procedures for Air Navigation Services – Aircraft Operations'*, Volume I - *Flight Procedures*, describes operational procedures recommended for the guidance of flight operations personnel. The introduction to this document states, in relation to the construction of visual and instrument flight procedures, that it:

> *'illustrates the need for operational personnel including flight crew to adhere strictly to the published procedures in order to achieve and maintain an acceptable level of safety in operations.'*

In 2004 the progress report on the ICAO program for the prevention of controlled flight into terrain (CFIT) showed that, according to information available up to 2003, 67% of instances of CFIT occurred during the approach and landing phase of flight and indicated that of those, approximately 60% (or 40% of the total), occurred during non-precision approaches. The report highlighted the approval in 2001 of an amendment to PANS-OPS Volume I which contained:

> *'guidance for pilots to fly a constant approach descent gradient on non-precision approaches'.*

At the time of the occurrence to TC-MND, the relevant section of PANS-OPS contained the following statement:

> *'Operators may specify two types of approach procedures for non-precision approaches. The first is that described as: "descend immediately to not below the minimum stepdown fix altitude/ height or MDA/H as appropriate". This method is acceptable as long as the achieved descent gradient remains below 15 per cent and the missed approach is initiated at or before the MAPt (missed approach point). Alternatively, operators are encouraged to use a stabilised approach technique for non-precision approaches. This technique requires a continuous descent gradient to a point 15 m (50 ft) above threshold, taking due regard of the minimum crossing altitudes/heights specified for the FAF (final approach fix) and any prescribed stepdown fix.'*

Track error

The greatest track error shown by the recorded radar occurred at 5 nm from touchdown, when the aircraft was approximately 0.5nm north of the published final approach track. This is equivalent to a track error of 5.7º. The data processing accuracy of the radar itself, which is located on the aerodrome, is up to 0.07º. Accordingly, the aircraft could have been slightly less than 5.7º off track.

PANS-OPS states that the accuracy of a VOR, when used to define the final approach segment of an approach procedure, is considered to be ± 7.8º.

Altitude error

The altitude indicated on the radar record is derived from the aircraft transponder, which reports to the nearest 100 feet, such that an aircraft which reports its altitude as 1,300 ft could in fact be flying at 1,349 ft.

The radar makes 15 sweeps each minute, so the recorded position of a moving object at a particular time may be inaccurate by as much as the distance that the object can travel during one sweep. The average speed of TC-MND during the final approach was approximately 145 kt and the average rate of descent approximately 1,000 ft/min, resulting in lateral and vertical inaccuracies of up to 0.16 nm and 67 ft respectively. Consequently, whereas TC-MND was reported to be at 1,300 ft at the SDF, 5 nm from the MCT, it could have been at 1,349 ft at 4.84 nm from the MCT. Assuming a constant rate of descent the aircraft could then be assumed to have been at 1417 ft at the SDF.

If the pilots had misidentified the approach and descended the aircraft in accordance with the VOR/DME procedure for Runway 24R, they would have expected to be approximately 300 ft lower at a given distance from the MCT than was required for the approach to Runway 24L.

ATC instructions

Instructions to carry out a missed approach may be given to avert an unsafe situation. If instructed to go around, an aircraft on an instrument approach is expected to carry out the published missed approach procedure and an aircraft operating VFR is to continue into the normal traffic circuit unless instructions are issued to the contrary.

Conclusion

The radar record showed that the aircraft was north of the published approach track of the VOR/DME approach procedure for Runway 24L at Manchester. It was, however, within the prescribed final approach segment as defined by PANS-OPS. Nevertheless, the aircraft commenced its descent before the FAF and, at the SDF 5 nm from the MCT VOR, was below the minimum altitude required by the procedure, even when known inaccuracies are taken into account. It did not descend below the MDA, however, and having passed the SDF did not at any time thereafter operate outside the parameters of the published procedure.

Although their initial approach was north of track and more closely aligned with Runway 24R, it is unlikely that the pilots were following the approach procedure for Runway 24R. Neither pilot recalled any runway ambiguity and the more southerly final approach track of the procedure for Runway 24R does not correspond to the track followed by TC-MND.

The vertical profile followed by TC-MND indicates that the pilots did not intend to use a stabilised approach technique. Although this technique is widely regarded as more desirable than a stepped descent technique, under existing regulations the choice remains that of the operator and crew. Whichever technique is employed, an aircraft must not descend below the published minimum altitude relevant to each approach fix.

Safety action by the operator

As a result of this incident, the operator's Flight Safety Manager issued flight crew Notice 002/007 on 23 May 2007. This notice stated that:

'The Minimum Altitudes which are on approach charts or given by ATC have to be maintained during an Instrument Approach, even in VMC. As a precaution we have to;

- *Review altitude restrictions precisely during approach briefing,*
- *Maintain altitude which is given by ATC even if different from published altitudes,*
- *Request visual approach from ATC if VMC exists and visual approach is preferred by the crew.*
- *Follow ATC instructions strictly.'*

The operator's training department is also planning to review current instruction on non-precision approaches and perform more of these approaches during recurrent training.

ACCIDENT

Aircraft Type and Registration:	Airbus A321-231, G-OZBN
No & Type of Engines:	2 International Aero Engine V2533-A5 turbofan engines
Year of Manufacture:	2000
Date & Time (UTC):	28 August 2007 at 2120 hrs
Location:	Manchester Airport
Type of Flight:	Commercial Air Transport
Persons on Board:	Crew - 8 Passengers - 205
Injuries:	Crew - None Passengers - None
Nature of Damage:	No 2 tyre tread had been shed: damage to the left engine, the left flap and hydraulic lines in the left wheel well
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	53 years
Commander's Flying Experience:	13,400 hours (of which 5,000 were on type) Last 90 days - 241 hours Last 28 days - 71 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The No 2 tyre tread was shed during the landing; there was damage to the left engine, the left flap and hydraulic lines in the left wheel well.

History of the flight

The aircraft flew from Alicante to Manchester. The approach to Runway 23R at Manchester was normal, using full flap and with medium autobrake selected; full thrust reverse was used after touchdown. The estimated landing weight was 70,541 kg, the surface wind was from 300º at 4 kt and the runway surface was dry. After landing the crew noticed that the No 2 brake temperature, on the left landing gear, was higher than normal, at approximately 500º C, whilst all the other brake indications were normal. The aircraft was taxied onto stand using mainly the right brakes. After shutdown an engineer reported a hydraulic leak in the port wheel and that the No 2 tyre was damaged. Further investigation revealed that parts of the tread had struck the underside of the left wing and that there was damage to the left engine and some hydraulic lines in the left wheel well.

None of the crew had noticed anything unusual during either the takeoff or landing. A check of the runways at Alicante and Manchester revealed a small amount of tyre tread debris at Manchester

ACCIDENT

Aircraft Type and Registration:	Lockheed T-33 Silver Star Mk 3, G-TBRD
No & Type of Engines:	1 Rolls Royce Nene 10 turbojet engine
Year of Manufacture:	1953
Date & Time (UTC):	6 September 2006 at 1320 hrs
Location:	Duxford Aerodrome, Cambridgeshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Minor) Passenger - 1 (Serious)
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	59 years
Commander's Flying Experience:	22,000 hours (of which 14 were on type) Last 90 days - 158 hours Last 28 days - 78 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft was the lead of a pair of ex-military jet aircraft which were carrying out a stream takeoff. After it rotated, G-TBRD adopted a steep nose-up attitude; it remained airborne for approximately 200 m before stalling and crashing.

The Aircraft Operating Instructions and Training Manual advocated a lower pitch attitude and warned that excessive pitch rotation is hazardous.

Following the accident, the operator decided to use only pilots with a military background to operate their remaining F86 Sabre, and an experienced Qualified Flying Instructor (QFI) in the Royal Air Force, who was current on jet aircraft, was appointed as the operator's QFI. The operator also instigated a stricter regime of supervision for pilots who had been engaged on other flying duties prior to operating the F86.

History of the flight

The aircraft was departing on a flight to Jersey in company with an F86 Sabre. The two aircraft were carrying out a stream take-off from Runway 24, with G-TBRD as the lead aircraft. G-TBRD had taxied onto the runway and stopped on the left of the centre line, 100 m upwind of the start of the runway, thereby allowing space for the Sabre to line up astern and to the right of the centre line.

The pilot had little recollection of taxiing G-TBRD and

did not remember any of the ground roll other than that the windsock confirmed the surface wind of 270º/10 kt, as advised by the Flight Information Safety Officer (FISO) in the control tower. However, he subsequently recalled that at some point during the takeoff he saw 'treble figures' on the airspeed indicator, probably between 110 and 115 kt, and thought that the aircraft should be flying by now. He was also aware of the F86 aircraft behind him and that the end of the runway was approaching.

The passenger, in the rear seat, was an engineer from the company which maintained the aircraft. He stated that the engine start had been normal and that, after taxiing on to the runway, the aircraft's brakes were applied and engine power was increased to maximum rpm. He noted that the engine temperatures and pressures were normal and that there were no warnings, abnormal indications or noises. After the brakes were released, he could remember no unusual indications during the round roll – he had flown in G-TBRD about 10 times previously – and stated that the aircraft took off at about 110 kt.

Once airborne, the pilot remembered thinking that the aircraft was 'not going anywhere', and it occurred to him that full flap may have been selected instead of the normal takeoff setting of 32º of flap. He checked the gauge, which confirmed the 32º setting. He was also concerned that the airspeed was reducing and wondered if a thermal was involved. Having decided that the airspeed had indeed decayed, he moved the throttle lever fully forward, a movement of about one inch, to achieve maximum thrust. After that his attention was devoted to trying to stop the aircraft from sinking. He recalled some buffet and seeing a speed of 85 to 90 kt on the ASI, whereas he would normally have expected it to be more than 125 kt, and concluded that there was something clearly wrong with the aircraft. He therefore decided to carry out an emergency landing in the field beyond a line of trees 250 m from the end of the runway. However, it became apparent that the aircraft would not be able to climb over the trees and the pilot recalled that he may have attempted to turn left to fly through a gap in the trees. (Note: The aircraft's ejection seats were disarmed, so the procedure for an engine failure away from an airfield was to carry out a forced landing, with the landing gear retracted, after jettisoning the wing tip drop tanks.)

The engineer in the rear seat was recording the takeoff on a video camera. He recalled the aircraft rotating into a climb attitude at the end of the takeoff roll and then not accelerating, or only accelerating very slowly. The aircraft climbed to a height of a few feet, then descended and struck the runway whilst still in a nose-high attitude and he heard a 'heavy' metallic noise from beneath the fuselage. G-TBRD became airborne again and climbed, he thought, to a height of 50 to 80 ft agl. He stated that there were no other unusual noises or indications during this sequence of events. Then, from a climbing attitude, the aircraft pitched down and rolled left to an attitude of about 10º nose-down and 50º left wing low. As the aircraft was rolling left the engineer stopped the video recorder. He recalled the aircraft turning slightly to the left before the left wing tip struck the ground and the left wing separated from the airframe. The aircraft then cartwheeled through some trees; its nose struck the ground, followed by the right wing, and then there was an explosion. At the same time, witnesses on the airfield saw a fireball which rose about 300 ft into the air.

The engineer recalled one more cartwheel before coming to a stop. The cockpit filled with smoke and he sensed that there was a fire behind him. He could see that there was fire around the canopy but he was unable to see outside and could not be certain of the aircraft's

orientation. Consequently, he elected to use the canopy knife to break through the canopy glazing, rather than activate the canopy jettison mechanism. Before doing so, the engineer removed his helmet because the visor had been damaged in the crash and was further impairing his vision. Having difficulty breathing, he initially wielded the knife with his left hand, which was nearest to the knife stowage, but shortly transferred it to his stronger right hand, taking some 20 blows to make a sufficiently large hole through which he could escape. Meanwhile the pilot, who had briefly lost consciousness, was also aware of a fire and recalled trying to turn off switches in the cockpit and unlatching the canopy lock. He considered jettisoning the canopy but did not do so because the engineer was in the process of breaking his way through it.

Once outside the cockpit, the engineer successfully activated the external canopy jettison mechanism. The canopy shot approximately 50 ft into the air before landing about 10 ft from the forward section of the fuselage. The engineer then climbed on to the side of the cockpit to help the pilot, who appeared to be motionless in the front seat, and released the pilot's harness. The pilot came to and was assisted out of the cockpit. They both retreated about 30 m away from the wreckage to await assistance.

The Airfield Fire and Rescue Service (AFFS) arrived at 1323 hrs and proceeded to extinguish the fires in various parts of the wreckage. They also established that the occupants of the aircraft were clear of the aircraft and started to render first aid until paramedics arrived. The pilot, who had received various minor injuries, was taken to hospital by ambulance and was retained overnight. The engineer, who was apparently uninjured apart from a small cut and some bruising, was eventually given a lift back to his crew room. He was subsequently diagnosed with a broken rib and suffered mild concussion. The pilot sustained a lower back injury and mild concussion, in addition to lacerations to his legs and multiple bruising.

The F86 pilot was already committed to the takeoff when he saw G-TBRD in difficulty. He continued his takeoff and avoided the plume of smoke over the accident site by turning right. He subsequently diverted to Cambridge Airport.

Aircraft description

The Lockheed T-33 or 'T-Bird' is the world's first purpose-built jet trainer and evolved from the Lockheed P-80 Shooting Star jet fighter. Canadair signed an agreement to build the T-33 Mark 3 for the Royal Canadian Air Force and a total of 656 aircraft, called the 'Silver Star', were built under this agreement and fitted with the Rolls Royce Nene 10 turbojet engine. Aircraft Serial No 21261 was constructed in 1953 and came to the UK in 1974. The aircraft was restored in 2000 and was re-registered G-TBRD. In January 2005 a replacement ex-RCAF Nene 10 engine was fitted. At the time of the accident the total airframe hours were 2,963:45 hours, and total engine hours since overhaul 569:50 hours. The last annual check was carried out in February 2006 at 2,950:15 airframe hours.

G-TBRD had conventional flying controls. The elevators were operated via a system of push-pull rods and bell-cranks, and each elevator was equipped with a spring-loaded servo tab and a trim tab. The trim tabs were controlled by an electrically-driven actuator. Lateral control was effected by ailerons connected via torque tubes and control cables augmented by a hydraulic booster. The rudder pedal movement was transmitted to the rudder through a cable system. The split-type flaps were operated by an electrically-driven linear actuator.

Accident site and wreckage examination

The initial ground contact was from the tailpipe, at the rear of the aircraft, scraping on the runway surface, approximately 230 m from the end of the runway. Beyond the end of the paved surface there was a trail on the grass where it had been scorched by the jet blast. There were also marks from the left main landing gear running along the ground. The initial impact was from the left wing tip tank, which contacted the ground just in front of a high hedge, 250 m beyond the end of the paved surface. Photographic evidence showed the aircraft was in a left bank of over 45º at the time. Pieces from the left wing tip tank were found in the flattened hedge. The aircraft continued ahead for approximately 100 m before the nose impacted the ground. The aircraft then broke up into three main pieces; the front fuselage containing both occupants and the remaining section of the left wing, the rear fuselage including the engine and empennage, and the outer section of the right wing. Fuel, contained in tanks located in the fuselage, both wings and tip tanks, was released on impact, ignited and was consumed in a large fireball.

From examination of the wreckage it was found that the landing gear was down at impact and the position of the electrically driven linear actuator indicated that the flaps were at 32º which was the takeoff setting. This flap position was also confirmed, from the photographic evidence, as being set during the takeoff roll.

The fuselage structure had been disrupted in the impact, however continuity of the elevator, aileron and rudder control systems was confirmed and there was no evidence of any pre-impact failures. The elevator trim tab was in a neutral position.

A post-accident calibration was carried out on the front cockpit airspeed indicator; the maximum error was -7 kt at 250 kt. At airspeeds within the takeoff range, between 80 and 120 kt the error was between zero and -3 kt; this would result in the airspeed indicator under-reading.

Witness information

One witness, who was positioned to the north of the runway, recorded the takeoff on a series of photographs. He had set his camera to take a rapid sequence of still images, automatically, at a rate of 34 photographs every 15 seconds. The series of photographs started when G-TBRD was still in the early stages of its takeoff roll and provided good evidence of the subsequent chain of events and the pitch attitude that was achieved during the takeoff, which was approximately 15º nose-up (see Figure 1).

It was possible to estimate from this information the aircraft position at points during the takeoff run. At around 510 m before the end of the runway the nose of the aircraft began to lift off, and at around 440 m from the end of the runway the main wheels began to leave the runway. The aircraft became airborne briefly, but then descended and contacted the ground at around 230 m from the end of the runway; this was consistent with the scrape marks on the runway surface. When the aircraft crossed the end of the runway it was still in a nose-up attitude but was not climbing.

The photographs showed the aircraft maintaining the same level beyond the end of the runway as the ground dropped away, enabling it to become airborne for the second time, until the left wing dropped by about 50° and the aircraft disappeared from view. The photographs continued until after the aircraft had struck the ground.

The accident sequence and wreckage location is shown at Figure 2:

Figure 1

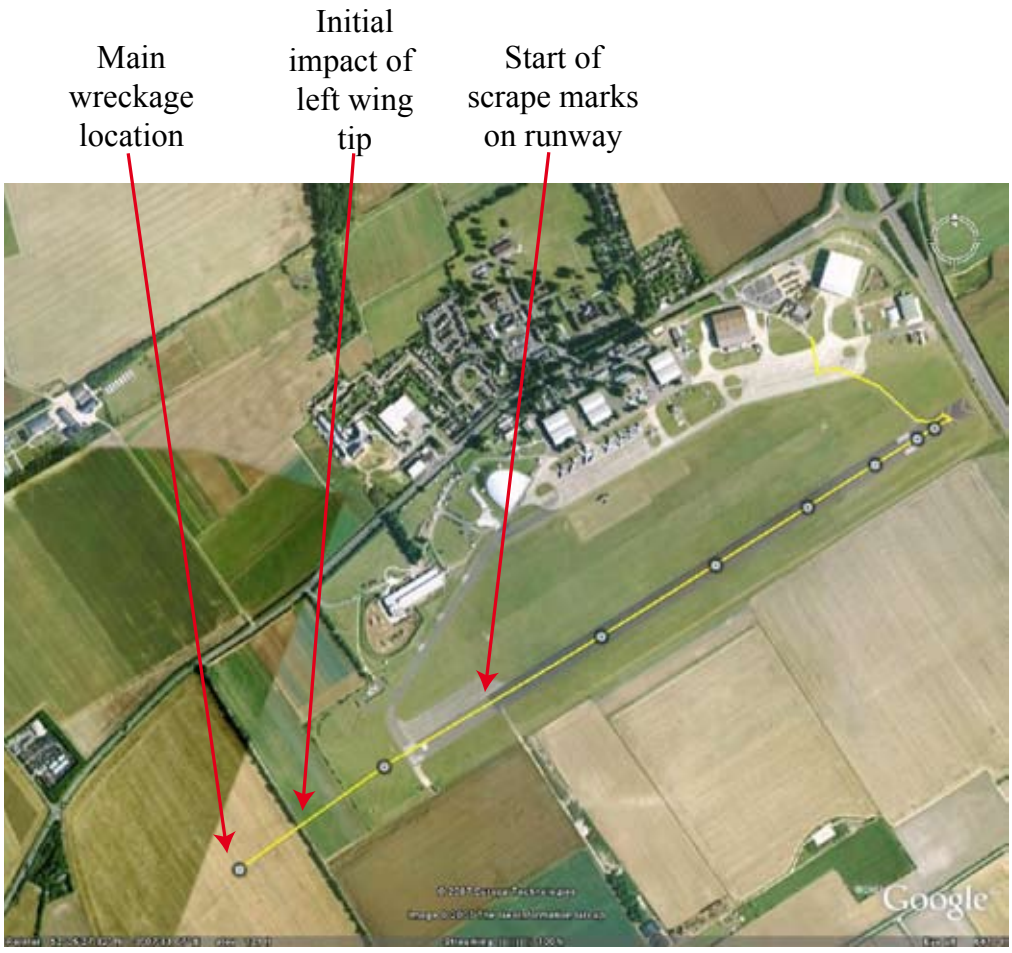


Figure 2

Recorded Information

The aircraft was fitted with a portable GPS which recorded a track log of G-TBRD's position. The engineer in the rear seat also recorded a video of the taxi-out and takeoff. Both of these devices survived the impact and were successfully downloaded.

GPS

On the 6 September the GPS track log started at 14:12:36 with a taxi to Runway 24. At the end of the runway, G-TBRD waited for around one minute before starting the takeoff roll. From this point, GPS position is logged every six to ten seconds and there are a total of six points detailing the aircraft position on the runway.

Takeoff began at 14:18:35 with the final GPS point on the runway at 14:19:22. Two further positions are recorded beyond the runway paved surface showing the aircraft track over the fields at the end of the runway. As there are only eight recorded GPS positions from the takeoff point, accurate aircraft speed cannot be ascertained.

Video

Video downloaded from the engineer's video camera allowed analysis of both the aircraft position and engine noise. The engine manufacturer supplied data concerning the number of impeller blades and guide vanes, along with expected takeoff rpm, which was then used to analyse the engine speed. The expected engine takeoff rpm was 12,500 ±100 rpm.

Spectral analysis of the video revealed that when G-TBRD was positioned at the end of Runway 24, the engine speed was around 11,708 rpm. This speed increased throughout the takeoff and at the point where the aircraft left the paved surface, the engine speed was calculated to be 12,374 rpm. This was the peak speed calculated from the analysis and was maintained for a further 4.4 seconds. For the final 532 milliseconds of video, the analysis shows a decay in engine speed from 12,374 rpm to 10,686 rpm. This corresponds to a rate of decay of 3,173 rpm / second. The video recording ceased just prior to impact as the engineer switched it off.

Personnel information

The pilot had accrued a large amount of flying experience in commercial aviation and had also flown a wide variety of ex-military jet and propeller-driven aircraft, as well as various general aviation light aircraft.

He started flying the T-33 in June 2003 and displayed G-TBRD that season. That initial training included dual instruction with the operator's Chief Pilot. He did not fly the aircraft in 2004 but renewed his Exemption[1] in 2005, again flying a dual 'check'. He displayed the G-TBRD three times that summer and flew the aircraft for the last time in 2005 on 11 November. He next completed a solo refresher flight, under the Chief Pilot's supervision, on 8 April 2006. Not having flown the aircraft since then, the pilot elected to carry out a solo practice display on 6 September, before departing on the accident flight. Furthermore, at his request, he briefed the pilot of the F86 aircraft, who was himself an experienced T-33 pilot, on the complete practice display: the flight, which lasted 15 minutes, was completed successfully. Following the accident the pilot acknowledged that he had been busy that day but did not feel fatigued or unfit in any way.

The pilot's last flight with an occupant in the rear seat of G-TBRD, before the accident, was in April 2005. His regular commercial employment was as a captain on Boeing 747-400 aircraft. He was in current flying

Footnote

[1] The Civil Aviation Authority had issued an Exemption to the Air Navigation Order to allow the pilot to fly the T-33 aeroplane.

practice on that type, as well as on various civilian and ex-military piston-engined aircraft.

Meteorology

The weather was good, with a surface wind from 250º at 10 kt, visibility in excess of 10 km and no cloud below 5,000 ft agl. There was no significant weather at or near the aerodrome, the temperature was 26ºC, the dew point was 15ºC and the QNH pressure setting was 1016 millibar.

Performance

The Maximum Total Weight Authorised for the aircraft is 16,800 lb. Its Take Off Weight (TOW) for the pilot's solo flight in the morning was 12,649 lb and the Take Off Distance Required (TODR), for the conditions at the time, was calculated to be 930 m. For the accident flight, when the weather was warmer and the TOW had increased to 14,161 lb, the TODR was calculated to be 1,326 m. At that weight, the stall speed, with takeoff flaps selected and the landing gear extended, was 101.5 kt.

The Take Off Distance Available (TODA) for Runway 24, as published in the Duxford Airfield Manual, is 1,603 m.

The aircraft's Centre of Gravity (CG) on the accident flight was calculated to be 236.3 inches aft of the datum, towards the aft end of the allowable range from 230.4 inches to 237.7 inches aft of the datum. The CG on the pilot's previous solo flight was further aft because of the lack of a rear seat passenger and the absence of baggage and equipment in the nose compartment.

Procedures

The operator used the Aircraft Operating Instructions for the Silver Star, as issued in 1996 by the Canadian Department of National Defence. Under *Take-Off Procedures* the instructions state:

> *'As elevator control becomes effective at about 70 KIAS, apply a gradual back pressure on the control column until, at about 80 to 90 KIAS, the nose-wheel is just off the ground. In this attitude the total drag is at a minimum and acceleration will be most rapid. Maintaining this attitude, the aircraft will become airborne at 105 to 115 KIAS, depending on fuel load and air temperature.'*

Advice is also given in the same authority's Manual of Flying Training for the Silver Star, issued in 1984. Under *Air Handling,* it states:

> *'Use the proper technique during the initial and final stages of the take-off. Typical errors, such as premature or excessive pitch rotation ... are incorrect and hazardous.'*

A further *Caution* in the Royal Canadian Air Force's Pilots Operating Instructions for the T-33 Mk 3, issued in 1957, states:

> *'...taking off at too slow an airspeed may cause the aircraft to settle back onto the ground.'*

Having lifted off the runway, a typical pitch attitude during the initial climb is 5-6º nose up.

The recommended pitch attitude to achieve during a takeoff in a Boeing 747-400, as detailed in the Boeing Flight Crew Training Manual for the type, is 15º nose up, using an average pitch rate of approximately 2.5º per second, initiated at V_R.

Operational procedures

The aircraft was being operated under the auspices of Civil Aviation Publication (CAP) 632, entitled *Operation of 'Permit-to-fly' Ex-military Aircraft on the UK Register*. In accordance with this publication, the operator's operational procedures are contained in an Organisational Control Manual (OCM) which has been approved by the CAA. These procedures detailed the training required when one of the operator's pilots was new to type or had not flown on type for more than six months. This training included, amongst other comprehensive briefings, ground instruction and flying practice, a supervised solo flight, which could include a 'dual check' at the Chief Pilot's discretion.

Discussion

The technique used by the pilot during the takeoff produced an excessive nose-up pitch attitude of about 15º shortly after rotation. This differed from the advice given in the T-33 Operating Instructions and Training manuals held by the operator, in which the nosewheel should be lifted just off the ground during the latter stages of the takeoff roll, and that attitude maintained as the aircraft becomes airborne. Following lift off, a typical pitch attitude during the initial climb is 5-6º nose up.

As a result of the excessive rotation, the aircraft did not accelerate as normal and subsequently descended, sufficient for the tail pipe to make brief contact with the surface. As the ground beyond the runway dropped away, the aircraft maintained level flight before stalling and dropping its left wing, then striking the ground. During the ensuing impact the aircraft cartwheeled, broke into three main pieces and caught fire. The section containing the cockpit came to rest in an upright attitude and the rear seat occupant, an engineer, managed to exit through the fire damaged canopy using the canopy knife. Once outside the cockpit, he activated the canopy jettison mechanism using the external handle. The canopy landed clear of the aircraft and he then helped the pilot, who had lost consciousness for a period during the impact, to make an exit from the front seat.

The engineer showed remarkable presence of mind during the accident, and his subsequent recall of events was a significant help during the investigation.

From the wreckage analysis and the photographic and video evidence there appeared to be no technical fault with the aircraft. Spectrum analysis of the on-board video recording confirmed that the engine was developing takeoff power.

The pilot had extensive flying experience as a commercial pilot and a wealth of experience on a wide variety of ex-military jet aircraft and single and twin piston-engine aircraft. G-TBRD was the only ex-military jet aircraft that he was current on but with limited flying hours, particularly during the previous 10 months. The pitch attitude which was seen during the takeoff appears to have been more akin to that associated with the Boeing 747-400, which was the aircraft type he flew most frequently, and was not appropriate for the T-33. By all accounts, this was most uncharacteristic of this widely experienced display pilot who had completed a successful flight in G-TBRD, lasting 15 minutes, earlier that day.

The pilot was not aware of any fatigue but did acknowledge being busy before the accident. He was the leader for the formation flight to Jersey and, as the lead aircraft during the stream takeoff, he was aware that the F86 Sabre was taking off astern of him, and that was an added pressure. Whilst he would have

encountered busy periods previously during his long flying career, this was the first time for 17 months that he had flown the aircraft with an occupant in the rear seat, his last training flight having been supervised from the ground five months earlier. The increased TOW and warmer temperature meant that the aircraft's performance during the takeoff on the accident flight was significantly different from that on his earlier solo flight that day, the TODR being increased by 43% in the latter case. Conversely, the CG was further forward on the accident flight, encouraging less of a pitch-up moment.

Action by the operator

Following the accident, the operator decided only to use pilots with a military background to operate their remaining F86 Sabre, and an experienced QFI in the Royal Air Force, current on jet aircraft, has been appointed as the operator's QFI. At the time of this report, all their pilots were experienced fast jet pilots with a display background. The operator also instigated a stricter regime of supervision for pilots who had been engaged on other flying duties prior to operating the F86.

ACCIDENT

Aircraft Type and Registration:	Agusta A109A, G-DNHI
No & Type of Engines:	2 Allison 250-C20B turboshaft engines
Year of Manufacture:	1979
Date & Time (UTC):	9 October 2006 at 1431 hrs
Location:	2 nm west of Biggin Hill Airport, Kent
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Tail rotor assembly separated from helicopter, severe damage to both vertical stabilisers and aft tailboom
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	52 years
Commander's Flying Experience:	8,465 hours (of which 1,836 were on type) Last 90 days - 68 hours Last 28 days - 16 hours
Information Source:	AAIB Field Investigation

Synopsis

During cruise flight, an engine exhaust duct separated from the helicopter and struck the tail rotor assembly, causing the tail rotor gearbox to separate. After an initial yaw to the right, the pilot regained limited control. However, a further sudden yaw, possibly associated with a partial structural failure of the upper vertical stabiliser, prompted an immediate autorotative descent, which culminated in a successful forced landing. The investigation established that a clamp attaching an exhaust duct to the left engine had failed, due to stress corrosion cracking, allowing the duct to disconnect from the engine. Two Safety Recommendations are made.

History of the flight

The helicopter was being flown by the operating company's Chief Pilot from Redhill Aerodrome to Biggin Hill Airport to collect two passengers and fly them to Battersea Heliport. Prior to the flight, he carried out a pre-flight check of G-DNHI which revealed no anomalies or defects; there were no outstanding defects recorded in the technical log. The helicopter was fuelled to full main tanks and was within centre of gravity (CG) and overall mass limits for the proposed flight.

After a refreshment break, the pilot departed for the short flight to Biggin Hill, 10 nm away. The weather there was fine, with a surface wind from 210º at 8 kt, good visibility and scattered cloud cover at 1,600 ft aal.

The surface temperature was +18ºC. He made contact with Biggin Hill ATC and was instructed to fly to a right-hand downwind position for Runway 21. At this time the helicopter was flying at 1,500 ft amsl and with a cruise power setting of approximately 90% torque, giving an airspeed of 120 kt to 140 kt.

Without warning, the helicopter suddenly yawed to the right, and the pilot thought later that this may have been accompanied by a "bang". He instinctively applied full left anti-torque pedal and left cyclic control, and the helicopter appeared to stabilise with about a 30º angle of bank to the right. Although the pilot was visual with Biggin Hill, he was unable to stop the helicopter from turning away from the airport. Aware that there had been a serious malfunction of the tail rotor, the pilot attempted to regain directional control of the helicopter by reducing the collective setting, and thus the torque being applied to the main rotor. A person on the ground in the area heard the helicopter approaching and then heard two "pops", before seeing the helicopter pass overhead in the direction of Biggin Hill, with what sounded like an altered engine note.

The pilot was aware of a reducing airspeed, possibly to around 100 kt. He reported that having flown the helicopter through about 360º of turn, he was able to fly toward Biggin Hill for a mile or so with crossed controls. There was then was a violent yawing and pitching motion which he described as "wrenching" which he sensed as a significant pitch-up and yaw to the right. It was probably this event that was seen by another witness on the ground who described seeing the helicopter yaw a full 180º (although described as a yaw to the left) before pitching nose-down and yawing back in the direction of flight.

The pilot immediately lowered the collective lever to remove all torque from the main rotor system. He then reduced engine power to idle, lowered the landing gear and the helicopter settled into an autorotative attitude. The pilot sensed that it still wanted to turn to the right and recalled that he was concentrating on maintaining a satisfactory airspeed and main rotor speed, but that he had limited influence on the helicopter's direction of travel. He saw a field ahead of the helicopter which appeared suitable for landing. Being reluctant to flare too harshly, the pilot made a shallow flare before 'cushioning' the touchdown with increasing collective. Consequently, the landing was faster than it would otherwise have been. The pilot lowered the collective lever gently, and the helicopter decelerated satisfactorily without the need to use wheel brakes, and remained upright.

The pilot shut down the engines and attempted to call Biggin Hill or another aircraft on the radio. This was unsuccessful, so the pilot made an 'all-stations' broadcast to inform anyone who might receive his transmission of the situation and his safe landing; this transmission was not acknowledged. The pilot switched off electrical power and vacated the helicopter. He then alerted the emergency services by telephone and ensured that ATC at Biggin Hill were informed of his safe landing. Subsequently, the pilot could neither recall any vibration at any stage of the emergency, nor recall seeing any warning lights or abnormal cockpit indications.

CG determination

The manufacturer made a conservative estimate of the effect on the helicopter's CG position after the tail rotor assembly departed. Making the assumption that only 25 kg of fuel was on-board (although it had been refuelled to full tanks prior to flight, fuel weight has a small effect on CG position), that the pilot weighed 80 kg and that the tail rotor assembly weighed 19 kg,

they calculated that the CG position remained well inside normal limits.

Recorded information

The majority of the helicopter's flight was captured by radar heads at London Heathrow Airport and Pease Pottage in Sussex. Radio communications between G-DNHI and Biggin Hill ATC were also recorded and available for analysis. A plot showing the helicopter's radar-derived track and other relevant information is at Figure 1.

Radio telephony

The pilot contacted Biggin Hill Approach Control (129.400 MHz) and reported that he was over the M23/M25 motorway junction at 1,400 ft amsl. Two minutes later he transmitted "MAYDAY MAYDAY (CALLSIGN TWICE) TAIL ROTOR FAILURE JUST WEST OF BIGGIN", and this was acknowledged by the approach controller. The pilot then said "… IN A RIGHT TURN AT FIFTEEN HUNDRED FEET, FIELD IN SIGHT, UNABLE TO MAKE LEFT TURN AT THE MOMENT, AM TRYING TO GET TOWARDS YOUR AIRFIELD". In response the controller cleared the pilot for a landing on any available surface at

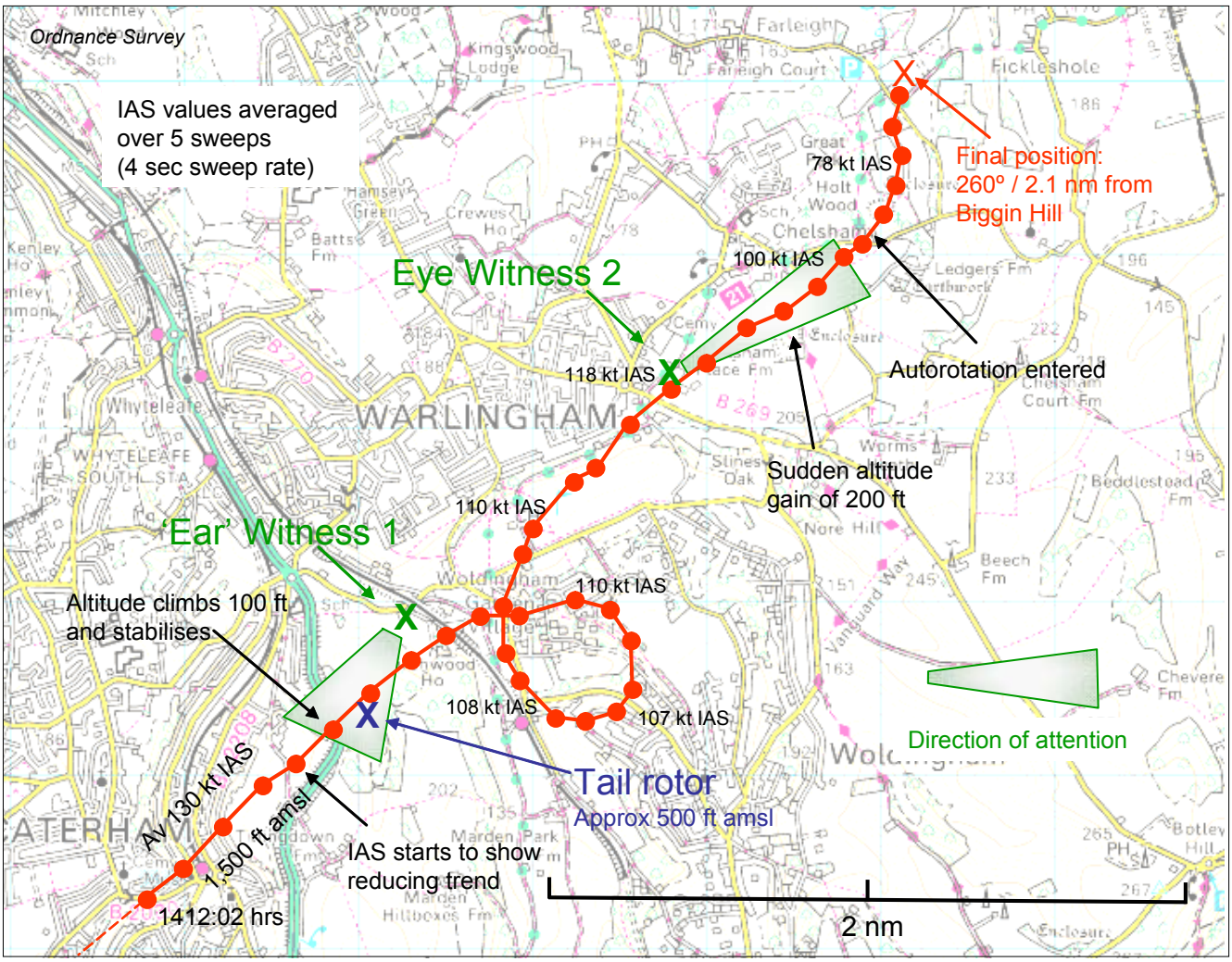


Figure 1

Diagram illustrating G-DNHI's track for the last part of the flight, and the location of witnesses

the airport. Seventy seconds after his first 'MAYDAY' call, the pilot transmitted that that he was carrying out a forced landing into a field three miles west of the airport. There were further weak and broken transmissions, which were probably from G-DNHI, but which were not readable. An attempt by ATC to use another airborne helicopter to contact G-DNHI was unsuccessful but, by this time, ATC had been informed by telephone that the helicopter had landed safely.

Radar

Radar altitude and groundspeed information confirmed the pilot's reported altitude and estimated IAS, based on a south-westerly airflow of 10 kt to 12 kt. When the helicopter was in the vicinity of the first witness, its altitude began to vary, to a maximum of +200 ft /-0 ft. At the same point the instantaneous and averaged IAS began to decay from about 130 kt. Radar returns then showed an orbit to the right before the helicopter resumed its original track. During this time, the IAS continued to decay, until it stabilised between 100 kt and 110 kt. The orbit was flown with an average rate of turn of 6º/sec, although the actual turn rate was highest mid-way through the orbit. The radius of the orbit was approximately 335 m.

The helicopter resumed a track towards Biggin Hill, maintaining a steady altitude and with a reduced IAS, which then began to increase gradually. About 25 seconds after regaining track, the altitude return showed a sudden increase of 200 ft and the IAS began to decay again. About 12 seconds after this event, the altitude information indicated that the helicopter had entered autorotation, with an IAS between 85 kt and 95 kt and an average rate of descent of 2,100 fpm. The last recorded radar position was within 80 m of the landing site, with a calculated height of 300 ft agl.

Examination of the accident site

The accident site was a large field that had been unused for sometime which had become overgrown with weeds. Crop furrows formed undulations in the surface. The field was generally surrounded by large areas of woodland interspersed with a few residential buildings and unmade roads. To the east of the field, the ground sloped downwards into a narrow valley that ran in a north-south direction.

Surface marks indicated that the helicopter had initially contacted the ground with its left main wheel, whilst yawed slightly to the right, on a heading of approximately 035º, and with a forward speed in the region of 60 kt. About 2.5 m after the initial contact, the right main wheel contacted the ground; this was quickly followed by the nosewheel. The helicopter, which remained upright, rapidly came to a halt, slewed to the right by about 55º.

Examination of the helicopter

Initial examination of the helicopter revealed that the tail rotor assembly, including the gearbox, and left engine outboard exhaust duct were missing, Figure 2. One of the main rotor blades had a deep indentation on its under surface at, approximately, the half-span point. The upper vertical stabiliser was inclined about 25º to the right and its fixture to the tailboom was severely disrupted. The lower vertical stabiliser had suffered severe damage to its trailing edge consistent with being struck by the tail rotor blades.

Damage to the helicopter

The tail rotor and its gearbox were found some time after the accident, in the vicinity of the first uncommanded yaw event; the exhaust duct has not been found to date.

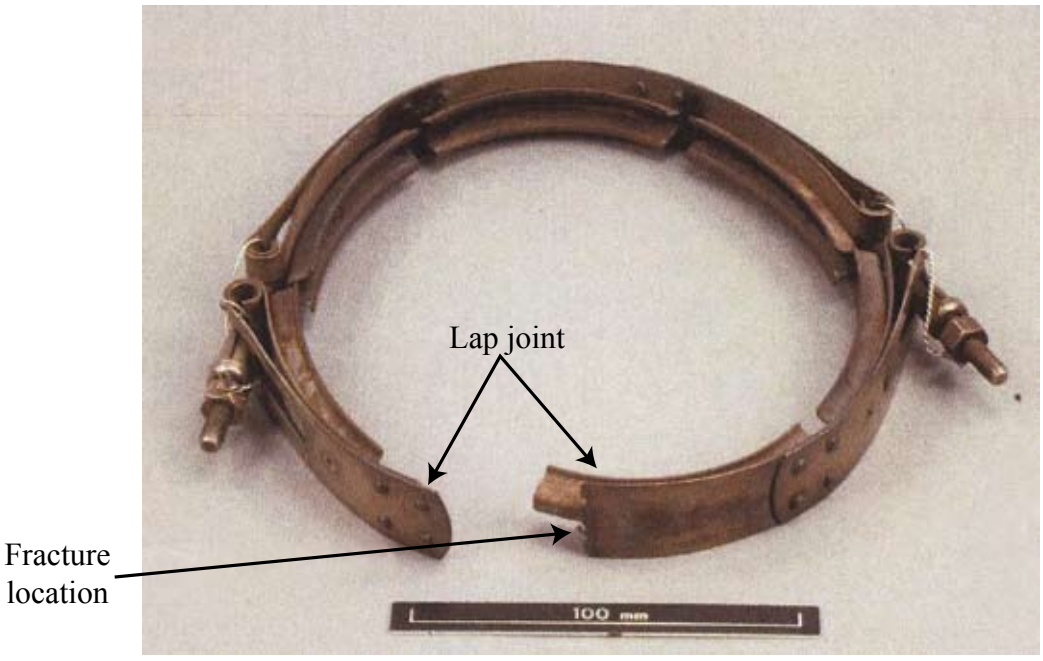
When the left engine cowl was opened, a two-piece

Mormon[1] clamp (part number 4606AC), that had been used to attach the outboard exhaust duct to the left engine, was found loose in the engine bay. This had failed at a position approximately one third of the way around the circumference of one of the two halves of the clamp, Figure 3.

Examination of the inside of the left engine cowl, in the area of the aperture through which the exhaust duct would normally protrude, showed very good evidence that a safety tang on the rear of the duct had very recently been in heavy contact with the cowl, to the extent that it had cut a slot-shaped hole through the metal skin.

Examination of the tail rotor gearbox showed all failures to be consistent with high out-of-balance forces from the tail rotor having induced excessive loads on the gearbox-to-tailboom mounting points, causing these to fail.

Figure 2



Picture courtesy of QinetiQ

Figure 3

Failed exhaust-duct-to-engine Mormon clamp

Footnote

[1] See paragraph titled Mormon clamp description.

Exhaust duct description

The exhaust duct is a stainless steel ovalated tube curved through 45°, 26 cm in length, and with a lip formed at the engine casing interface end, Figure 4. This lip corresponds to a lip on the engine casing which facilitates the use of a Mormon clamp to join the two. A total of four clamps are used to attach two exhaust ducts to each of the engines.

At around the time that the prototype Agusta 109 was being tested, it came to the manufacturer's attention that there had been an event to another helicopter type where a Mormon clamp had failed. This allowed an exhaust duct to separate, which resulted in damage to the helicopter. Following this event, the manufacturer produced a modification whereby two 4 cm long metal tangs were riveted to the lip end of the exhaust duct, to prevent the duct from exiting through the aperture in the engine cowl in the event of a clamp failure, Figure 4. This modification has been applied to all production models of the Agusta 109 helicopter.

Mormon clamp description

Mormon clamp is a term applied to a clamp installed around a cylindrical object to connect two halves together. The clamp usually has U or V sections that fit over lips or flanges on the objects to be joined, and serves to pull the two halves together as the clamp is tightened in place. Because the clamp is required to pull the two sections together, it is undersized and, in cases where the sections to be joined are oval, the clamp is not an exact match with the profile of the flanges. This is achieved as the clamp is tightened. The clamp has no position

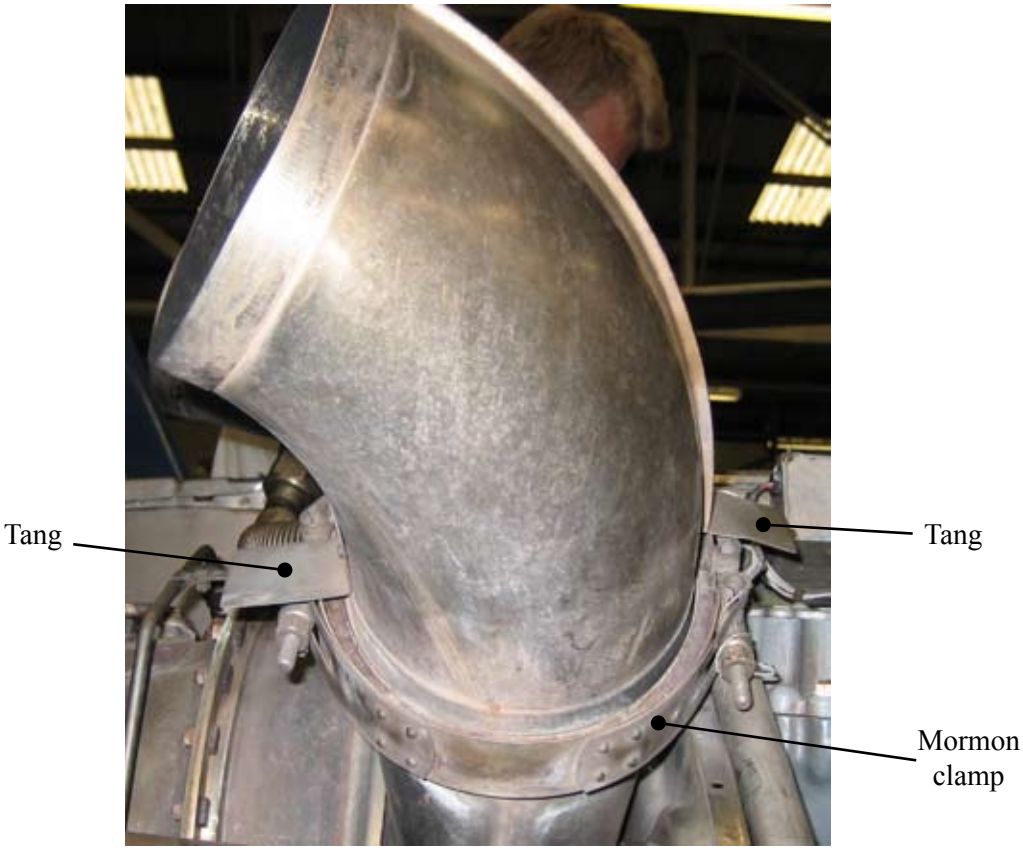


Figure 4

Exhaust Duct arrangement

keyways or orientation markings, but the manufactured shape of the clamps used on G-DNHI approximated to the oval profile of the exhaust ducts.

The inner U section of the clamps used on G-DNHI, comprise six individual sections, three being spot welded to each half section of the clamp. Each half section consists of one strap folded back onto itself at each end, and secured there by four rivets, as illustrated in Figure 3 and 4. The loops formed by the fold-back facilitate the location of T-bolts used to tighten the clamp assembly. The clamps used on G-DNHI, fabricated in the USA by the National Utilities Company (NUCO), are made from AMS 5595 corrosion resistant steel and identified by the manufacturer as 'V-band clamps'.

Clamps examination

It was evident that a failure of the strap had occurred on one half of the subject clamp, beneath where it was overlapped by one of its folded back ends. Detailed examination revealed that a crack had formed and that this had initiated in the strap's central region. The crack had then propagated towards the strap's outer edges, running through two rivet holes, before the remaining material failed in overload, Figure 5. Metallurgical examination of the fracture faces indicated that the nature of the crack was consistent with chloride-driven stress corrosion cracking.

The location of the crack on the strap was effectively hidden by the overlap of its end section. This would not have allowed early detection by visual examination or non-destructive testing by, for example, fluorescent dye-penetrant, unless the clamp had been removed. Another area on the failed clamp associated with the strap overlap was found to have surface-breaking cracks which, on further examination, also exhibited characteristics of stress corrosion cracking.

Close examination of the remaining three Mormon clamps from G-DNHI, both visually and by fluorescent dye-penetrant inspection, revealed no evidence of cracking and these appeared to be serviceable.

Use of Mormon clamps

The design and manufacture of the exhaust duct and its method of attachment to the engine casing exhaust aperture flange, are the responsibility of the airframe, not the engine, manufacturer. Rolls Royce Allison, one of the main manufacturers of small turbine engines installed in many helicopters and some fixed wing types, provide a flange at the exhaust end of the casing to facilitate the use of a Mormon clamp to attach exhaust ducts. However, the type and manufacturer of these clamps vary between airframe manufacturers. Mormon clamps do not have serial numbers or declared service lives, and are reusable.

In-service history of the Agusta AB206 and A109 fleets

The AB206 fleet of about 740 helicopters (first delivery in 1967) and the A109 fleet of about 400 helicopters (first delivery in 1975) use Mormon clamps to attach exhaust ducts, a total of some 3,080 installed clamps. Of these, six are known to have failed in-flight, resulting in the release of only one duct, the event which occurred to G-DNHI.

Previous occurrences of Mormon clamp failure, UK data

A search of the UK CAA Occurrence database revealed eight previous recorded incidences of Mormon clamp failure (Table 1), six of which resulted in the exhaust duct departing from the helicopter, including one where the duct struck the tail rotor. All these events involved the Rolls Royce Allison 250 series engine fitted to either the Bell/Agusta Bell 206B, or Bolkow 105 helicopters.

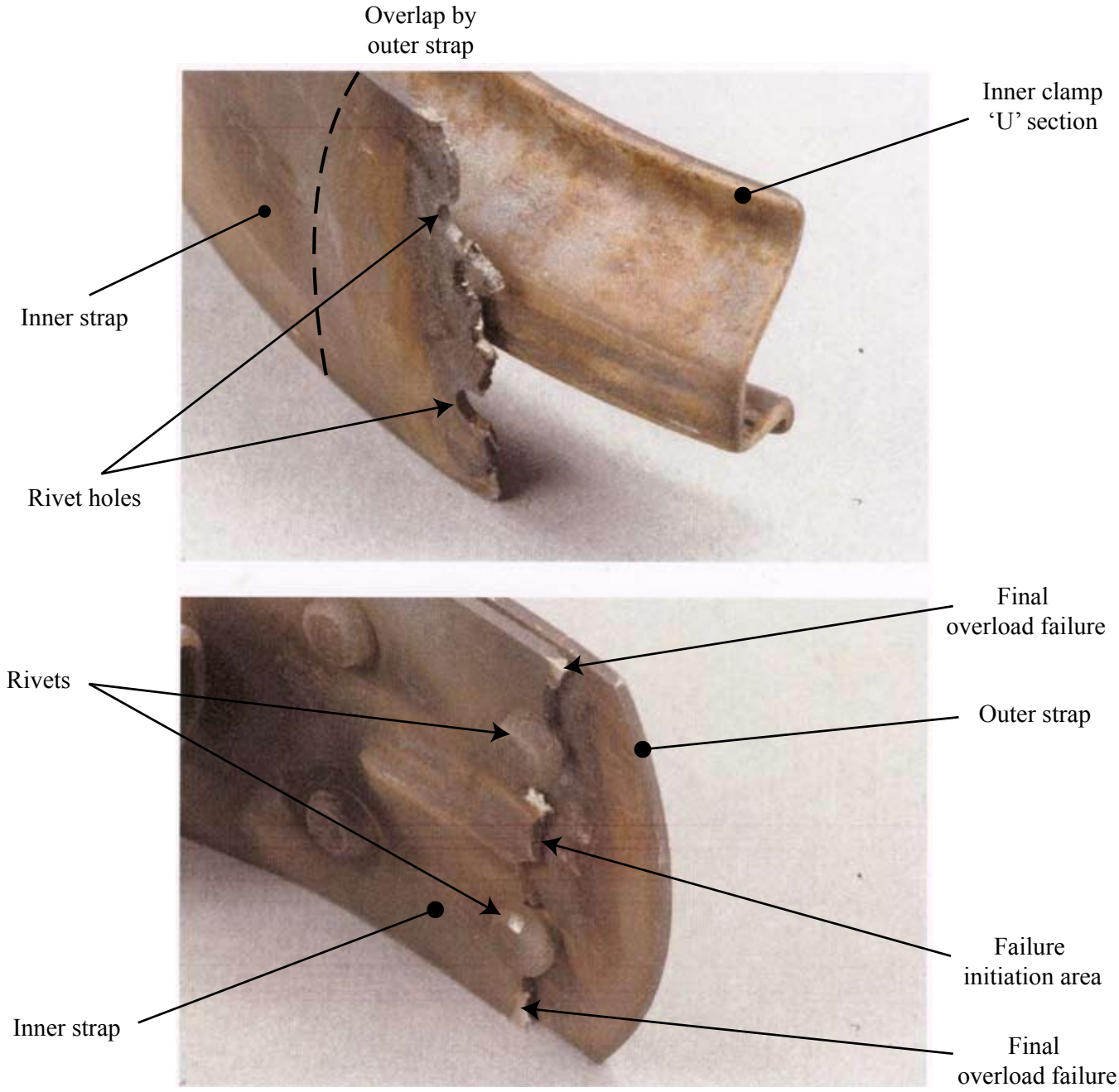


Figure 5

The two halves of the fracture of the failed clamp

Date	Helicopter Type	Engine Type	Details of event
Oct 1978	Bell 206 B	Allison 250	Mormon clamp failure allowing exhaust duct to separate and strike tail rotor
Feb 1983	Bell 206 B	Allison 250	Post flight inspection revealed exhaust duct missing due to Mormon clamp failure
Mar 1990	Bell 206 B	Allison 250	Mormon clamp failure across width where band is folded back and riveted. Found on pre-flight
Jul 1995	Bolkow 105	Allison 250	After shutdown exhaust duct found to be missing
Apr 1996	Bolkow 105	Allison 250	Nr 2 engine outboard exhaust duct separated from helicopter during final approach
Apr 2000	Bolkow 105	Allison 250	During post-flight inspection RH outboard exhaust duct missing - Mormon clamp cracked through at stud sleeve attachment
Apr 2000	Bolkow 105	Allison 250	RH outboard exhaust duct detached due to Mormon clamp failure
Sep 2000	Agusta Bell 206 B	Allison 250	During post-flight inspection LH exhaust duct Mormon clamp found failed in fatigue across two rivet holes

Table 1

Previous known occurrences of exhaust duct Mormon clamp failures

UK in-service history of Mormon clamps

The main UK EASA Part 145 maintenance organisation for Agusta helicopters is frequently required to replace Mormon clamps, Pt No 4606AC, on helicopters fitted with Rolls Royce Allison 250 series turbine engines, due to the presence of cracks in the strap material between the rivets. Thirteen clamps were replaced in 2005, 19 in the first nine months of 2006. Approximately 25% of the cracked clamps are repaired and returned to service, the remaining 75% are scrapped.

There are a number of manufacturers of turbine engines fitted to light helicopters, but only the Rolls Royce Allison engine requires the use of Mormon clamps to attach exhaust ducts, with the exception of early Turbomeca Astazou engines. Other manufacturers generally utilise a nut and bolt attachment method. This type of clamp is also used in some Lycoming and Continental piston engine turbocharger installations and, according to one maintenance organisation, clamp failures are known to occur.

Relevant Service Bulletins

In June 1969, the Bell Helicopter Company issued a Service Letter (SL) that introduced tangs on the engine exhaust ducts of model 206A helicopters to retain the exhaust duct in the event of failure of Mormon clamp Pt No 4656AA. In August 1969, Agusta issued a mandatory Service Bulletin (SB), in response to the Bell Service Letter, requiring tangs to be fitted to the engine exhaust ducts of Agusta/Bell 206A helicopters.

In November 2000, Eurocopter issued an Alert Service Bulletin (ASB) applicable to all Bolkow 105 helicopters,

titled '*Power Plant – Coupling Clamp – Inspection for Corrosion and Cracking in the Area of the Latches'*. This resulted from the discovery that stress corrosion cracking had occurred in the latches of a Mormon clamp, Pt No 4606AH, resulting in its failure.

In August 2006, Eurocopter issued an ASB titled *'Assembly of the Exhaust Clamps',* again applicable to Bolkow 105 helicopters. This was issued as a result of a reported incident where an exhaust clamp failed during flight. Eurocopter advised that the exhaust clamps must not be secured with wire, as shown in Figure 4, as the lockwire may damage the clamps, due to vibration, causing them to break. Only self-locking nuts should be used to secure the two halves of the clamp.

Analysis

Operational aspects

From the location of the tail rotor/gearbox on the ground, and information from witness who heard unusual noises, it is likely that the tail rotor assembly separated from the helicopter very soon after being struck by the exhaust duct. The sudden consequent reduction in anti-torque capability, together with a relatively high power setting, caused the helicopter to yaw to the right. When the pilot reduced power, the helicopter's directional stability, aided by the vertical stabiliser, was sufficient to allow a measure of directional control to be regained. The loss of a significant mass so far aft would have moved the CG of the helicopter forward. However, the estimation of the 'new' CG position by the manufacturer indicated that it probably remained within the helicopter's limits, thereby allowing the pilot to retain control in pitch and effect a 'run-on' landing.

The second event, which the pilot described as a "wrench", entailed a further, sudden yaw to the right and a nose-up pitching moment. It is possible that these events involved the failure of the already weakened upper vertical stabiliser at its attachment point to the rear tailboom, in that the stabiliser force vector would have changed, should it have adopted an unusual attitude by canting over to the right. The reduced anti-torque moment was probably only countered by the pilot's immediate reaction of lowering the collective control and reducing engine power to idle.

The terrain beneath the helicopter's flight path, as it descended in autorotation, presented limited opportunities for a safe landing, being quite heavily wooded and undulating. Nevertheless, with limited control available and no other options, the pilot was able to execute a successful run-on forced landing without injury to himself or further damage to the helicopter.

Engineering aspects

The failure, due to stress-corrosion cracking, of the Mormon clamp that attached the outboard exhaust duct to the left engine, appeared to have allowed the duct to become loose at the rear of its mounting. With the engine running, forces induced by gasses exhausting from the duct were likely to have pitched the duct forward, until the rear tang contacted the underside of the engine cowl. After a period of time, during which damage was caused to the cowl by the rear tang, the duct fully disconnected from the engine, exited the cowl and, after being struck by a main rotor blade, defected into the tail rotor. In the absence of the duct, it has not been possible to ascertain the process by which the duct was released from the cowling, but the possibility that the safety tang(s) may have deformed or failed cannot be dismissed.

The resulting damage to one or both tail rotor blades was sufficient to induce a severe imbalance within the tail rotor assembly. This precipitated failure of the tail rotor gearbox mounting structure, and partial failure of

the vertical stabiliser attachment frames in the rear of the tailboom, allowing the tail rotor gearbox and the rear section of the tailboom structure to depart the airframe.

Safety action

As a result of the accident to G-DNHI, Agusta has issued two SBs, 109-123 and 206-242, whose status they regard as mandatory, titled *'Inspection to grooved clamps P/n 4656AA or P/n 4606AC that attach the engine exhaust ducts'*. These SBs apply to Agusta A109A, A109A11 and A109C helicopters (issued 16 November 2006) and Agusta-Bell AB206A/B helicopters (Issued 18 December 2006). They require that a detailed visual inspection for cracks and corrosion of the clamps after removal, using a 10x magnifying glass, within 50 operating hours of the SB's issue date. After this initial inspection, repetitive inspections are required every 200 hours/annually for the A109 fleet and 100 hours/annually for the AB109 fleet. EASA have issued an Airworthiness Directive which mandates these SBs. This inspection regime is regarded as reducing the probability of an in-flight catastrophic clamp failure to an acceptable level.

Safety Recommendations

The direct cause of the accident to this helicopter may be attributed to the failure of a Mormon clamp used to secure the outboard engine exhaust duct to the left engine, in combination with the failure of the duct retention system. The clamp failed due to a crack which had developed over a period of time in one of its strap segments. The location of this crack was effectively hidden by the overlap of the strap end section, and would not have allowed detection by visual or non-destructive testing with the clamp installed. The clamps used on G-DNHI, in common with other types of Mormon clamps, were not subject to any proscribed inspection/ maintenance regime. Therefore, no documented history of the failed clamp, or any others with identified cracks, was available. However, safety action has already been taken by EASA and Agusta to address the problem with the A109 and AB206 helicopters, the inspection regime being considered appropriate for the early detection of the stress corrosion failure mode.

Since 1978, eight failures of Mormon clamps used to secure exhaust ducts on UK registered Agusta A109, Bell 206 and Bolkow 105 helicopters, are known to have occurred, and it is relatively common for maintenance crews to find that in-service clamps contain cracks. However, although visual inspections of these clamps whenever they are removed from a variety of installations, would seem to identify clamps with developing cracks, the SBs issued by Agusta, and mandated by EASA only relate to their products. Due to different installations on other helicopter types and the nature of these cracks, their early detection would not seem assured on all helicopters which use this method of duct attachment.

Despite the presence of two tangs on the engine exhaust ducts on G-DNHI, designed to retain a duct within the engine cowl in the event of it becoming loose, the left engine outboard duct departed the helicopter following the clamp failure.

The following Safety Recommendations are therefore made:

Safety Recommendation 2007-114

It is recommended that the European Aviation Safety Agency require all helicopter manufacturers for whom they have airworthiness responsibility to institute similar Mormon clamp inspection regimes to those detailed in Agusta Service Bulletin Nos 109-123 and 206-242, where they are used to secure exhaust duct components to the turbine engines of helicopters.

Safety Recommendation 2007-085

It is recommended that the European Aviation Safety Agency require all helicopter manufacturers for whom they have airworthiness responsibility, to review the design of engine exhaust duct attachment and retention systems, to ensure that no part of the ducting will be released from the helicopter in the event of a failure of the attachment.

ACCIDENT

Aircraft Type and Registration:	Cessna 152, G-BNKS
No & Type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1979
Date & Time (UTC):	12 September 2007 at 1415 hrs
Location:	Sleap Airfield, Shropshire
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to propeller, engine shock-loaded
Commander's Licence:	Student pilot
Commander's Age:	19 years
Commander's Flying Experience:	24 hours (of which all were on type)
Information Source:	Aircraft Accident Report Form submitted by the instructor

Synopsis

The solo student landed the aircraft in a flat attitude and it bounced. A series of bounces developed during which the propeller struck the ground. The aircraft was brought to a stop on the runway.

History of the flight

The student pilot was carrying out a circuit training detail on Runway 36 at Sleap Airfield. This asphalt runway is 775 m long and 18 m wide. The surface wind was from 350° at 10 kt. The exercise began with an instructor on board and a number of circuits and landings were completed successfully by the student pilot. The instructor then assessed that the student pilot was ready to fly solo and monitored the subsequent flight.

The first two solo circuits, with 'touch-and-go' landings, were completed and the instructor assessed them to be satisfactory. On the third landing the flare was late and the aircraft touched down in a level attitude and bounced. A series of bounces developed during which the propeller struck the runway. The aircraft came to a stop on the runway and the student pilot, who was uninjured, shut down the engine.

ACCIDENT

Aircraft Type and Registration:	Cessna 172S Skyhawk, G-GFMT
No & Type of Engines:	1 Lycoming IO-360-L2A piston engine
Year of Manufacture:	1999
Date & Time (UTC):	20 August 2007 at 1659 hrs
Location:	Runway 09R, Manchester (Barton) Aerodrome
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 3
Injuries:	Crew - None Passengers - None
Nature of Damage:	Nose leg detached, propeller damaged, engine shock-loaded and engine firewall damaged
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	26 years
Commander's Flying Experience:	589 hours (of which 43 were on type) Last 90 days - 190 hours Last 28 days - 55 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Shortly after the landing on Runway 09R at Barton, the nose leg collapsed.

History of the flight

Following a local flight, the aircraft was positioned for a 'touch-and-go' landing on the grass Runway 09R at Barton. The wind was reported as from 020° at 10 kt, varying between 360° and 050° . The pilot described his approach and landing as being normal and he maintained 'back pressure' on the controls following the touchdown. However, after the application of engine power for the 'touch-and-go', and whilst retracting the flaps to 10°, the nose leg collapsed and detached. The pilot immediately shut off the engine and then shut down the rest of the aircraft systems, after which he and the passengers exited the aircraft normally, having not sustained any injuries.

There had been no prior indication, in the aircraft, that the nose leg would collapse nor was there a bounce or porpoise on landing that could have precipitated it. The collapse had occurred approximately 20 metres from the threshold of Runway 09R and the aircraft travelled approximately 100 metres before coming to rest. The pilot also noted that there was a slight rise across the runway at the point at which the nose leg first collapsed.

Examination of the aircraft revealed overload failures of the structure to which the nose landing gear was attached. There were no signs of fatigue or of any pre-existing failure of the nose leg that could have led to the collapse.

ACCIDENT

Aircraft Type and Registration:	Cessna 210 Centurian, N761JU
No & Type of Engines:	1 Lycoming TSIO 520 R piston engine
Year of Manufacture:	1977
Date & Time (UTC):	7 August 2007 at 1610 hrs
Location:	Wycombe Air Park (Booker), Bucks
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to the engine and propeller and possible damage to the fuselage
Commander's Licence:	Private Pilot's Licence
Commander's Age:	42 years
Commander's Flying Experience:	810 hours (of which 202 were on type) Last 90 days - 20 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft landed with the undercarriage UP. The pilot did not recall any warnings from the undercarriage aural warning system, which he had tested during his checks before flight.

History of the flight

The pilot reported that the flight from Wellsbourne to Wycombe proceeded without incident, and the aircraft joined downwind for Runway 35 at Wycombe Air Park. The pilot completed his landing checks and believed that he had selected the undercarriage DOWN. He recalled checking that whilst on finals he had the green lights illuminated, which indicate that the undercarriage is DOWN and locked. As the aircraft landed the propeller struck the ground and it became apparent that the undercarriage was still retracted. The aircraft was shut down and the pilot and his passenger, who were both uninjured, vacated via the normal exits.

Upon inspection after the accident, the undercarriage selector was found to be in the UP position. The pilot did not recall any warnings from the undercarriage aural warning system, which he had tested during his checks before flight.

The pilot believes the accident was caused by his failure to lower the undercarriage before landing. He considers contributory factors include a possible failure of the

undercarriage aural warning system and the brightness of the sun during his landing checks. However, an examination of the undercarriage aural warning system shortly after the accident confirmed that it was serviceable.

ACCIDENT

Aircraft Type and Registration:	Cessna A150L Aerobat, G-BOYU
No & Type of Engines:	1 Continental Motors Corp O-200-A piston engine
Year of Manufacture:	1974
Date & Time (UTC):	15 September 2007 at 1732 hrs
Location:	Runway 27L at Barton (Manchester) Airfield
Type of Flight:	Training
Persons on Board:	Crew -1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to nosewheel assembly
Commander's Licence:	Student
Commander's Age:	42 years
Commander's Flying Experience:	105 hours (of which 105 were on type) Last 90 days - 14 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Whilst attempting to land with the sun directly in his eyes the student pilot's seat moved back slightly and he inadvertently applied excessive aft elevator. During the ensuing bounce, he attempted to level the aircraft but had difficulty in assessing the aircraft pitch attitude. The aircraft nose landing gear struck the ground and collapsed.

History of the flight

The student flew the aircraft back to Barton, Manchester, at the end of his qualifying solo navigation exercise, and completed an overhead join for Runway 27L. The surface wind was from 270º at 7 kt. The student reports that the approach was normal, but the sun was low on the horizon and the aircraft had no sun visor. As the student commenced the flare for landing the seat moved back slightly. The student was still holding the control yoke and so applied excessive aft elevator, which in turn caused the aircraft to bounce. The student attempted to level the aircraft by moving the control yoke forward, but with the sun in his eyes he had difficulty in assessing the aircraft pitch attitude. The aircraft nose landing gear struck the ground and collapsed. The student switched off the fuel and electrics and vacated the aircraft normally.

Comment

At Barton there are several runways that would have had been acceptable in the prevailing wind conditions. With the sun causing the student such problems

with visibility he could have asked for one of these alternative runways. This accident also highlights the need to ensure that all seats are securely locked in place during all stages of flight.

ACCIDENT

Aircraft Type and Registration:	Denney Kitfox Mk2 Kitfox, G-KAWA
No & Type of Engines:	1 Rotax 582 piston engine
Year of Manufacture:	1994
Date & Time (UTC):	8 September 2007 at 1730 hrs
Location:	Holmbeck Farm, near Wing, Aylesbury, Bucks
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Minor damage to left wing, fuselage badly distorted with bent and broken free tubes, landing gear collapsed, propeller and tailwheel broken
Commander's Licence:	Private Pilot's Licence
Commander's Age:	57 years
Commander's Flying Experience:	713 hours (of which 22 were on type) Last 90 days - 3:05 hours Last 28 days - 0:45 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

As the aircraft landed in a light crosswind from the right, the pilot could not level the wings as he began the flare. Use of rudder in an attempt to do so resulted in the aircraft 'crabbing' and drifting towards some hay bales on the left side of the runway. The engine responded to the application of full power but failed to climb away and the left wing struck a bale. A broken link in the aileron circuit was found after the accident, but was assessed to have resulted from overload.

History of the flight

On completion of a local flight to evaluate the aircraft prior to an impending inspection for the renewal of its permit to fly, the pilot set up an approach to Runway 33 at Holmbeck Farm. This runway is normally used as an emergency runway. The flight had included an assessment of the aircraft's general handling throughout the speed range, as well as stalls, with and without flap. The wind was 340°/07 kt, and the approach proceeded normally. However, the pilot decided not to land on Runway 33 and, after carrying out an uneventful go-around, flew a normal circuit for a flapless landing on Runway 29. This requires a 'dog-leg' turn to the left to line up for a short final approach.

The approach to Runway 29 was flown at 60 mph, and the pilot reported that everything felt normal until shortly before the flare, at which point he considered the

ailerons felt 'slightly mushy'. As he started to flare the aircraft, it rolled gently left. He tried to level the wings with aileron, but was unable to do so, and the stick 'felt very light'. He did succeed in levelling the wings using rudder, but finished up crabbing sideways across the ground towards some hay bales. The pilot applied full power, intending to go around, but although the engine responded, the aircraft failed to climb. Consequently, the left wing struck one of the hay bales, yawing the aircraft violently left, as it slid across the runway intersection. It came to rest just beyond the intersection facing in the opposite direction. The pilot was able to exit the aircraft via the left cabin door, having suffered minor injuries.

Aircraft examination

Upon dismantling the aircraft, the pilot noticed that a 'ball-link' rod-end connector in the aileron circuit at the base of the control column was broken, and that the fracture surfaces were dark in colour. This raised a question in his mind as to whether the fracture might have occurred prior to the impact. He also commented that, after the accident, the ailerons were 'jammed left up/right down', and believed that if they had been in this condition prior to touchdown, they could apparently offer an explanation for the aircraft's abnormal behaviour.

Detailed examination of the failed component by the AAIB showed that it had fractured through the threaded section of the fitting, adjacent to the backing nut, as a result of bending instability caused by a compression overload. The dark colour of the fracture was due to the granular nature of the surface, and was of no particular significance. The fracture faces displayed no evidence of fatigue or any other form of progressive failure. Gross plastic deformation of the fitting adjacent to the fracture, extending over much of the exposed threaded section, confirmed that the component was not in a weakened state when fracture occurred. Whilst it was not possible to determine when the overload fracture occurred, the characteristics of the failure were typical of accident-induced damage seen on this type of component.

ACCIDENT

Aircraft Type and Registration:	DHC-1 Chipmunk 22A, G-AORW (PA-28R-180 Arrow, G-AVWV, parked)
No & Type of Engines:	1 De Havilland Gipsy Major 10 MK.2 piston engine
Year of Manufacture:	1950
Date & Time (UTC):	22 September 2007 at 1515 hrs
Location:	Apron P1, Prestwick Airport
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Chipmunk: Damage to the left wing, wing root fairings and attachments Arrow: Damage to the right wing
Commander's Licence:	Private Pilot's Licence
Commander's Age:	37 years
Commander's Flying Experience:	394 hours (of which 59 were on type) Last 90 days - 1.5 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft had returned to Prestwick from a local flight and was taxiing at slow speed towards the apron when its left wing struck the right wing of a parked Piper PA-28. The pilot attributed the accident to his misjudgement of the clearance between the two aircraft, brought about by glare from the low sun directly in front of him, restricting his forward visibility.

History of the flight

The aircraft had returned from a local flight and, whilst returning to the apron along a narrow taxiway, the pilot observed a PA-28 parked at the edge of the apron. As the aircraft approached the PA-28, glare from the sun, which was low on the horizon and directly in front of the aircraft, severely restricted the pilot's visibility. The pilot slowed the aircraft to walking pace but misjudged the clearance between the PA-28 and his aircraft as he turned to the right. This resulted in his aircraft's left wing striking the right wing of the PA-28. The pilot, who was uninjured, brought the aircraft to a halt on the taxiway and shut it down.

ACCIDENT

Aircraft Type and Registration:	DHC-2 Mk.III Turbo-Beaver, OY-JRR
No & Type of Engines:	1 Pratt & Whitney PT6A-34 turboprop engine
Year of Manufacture:	1966
Date & Time (UTC):	11 March 2007 at 1615 hrs
Location:	Headcorn Airfield, Kent
Type of Flight:	Aerial work
Persons on Board:	Crew - 1 Passengers - 8
Injuries:	Crew - 1 (Fatal) Passengers - 1 (Minor)
Nature of Damage:	Substantial damage to the aircraft
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	36 years
Commander's Flying Experience:	932 hours (of which 27 were on type) Last 90 days - 36 hours Last 28 days - 22 hours
Information Source:	AAIB Field Investigation

Synopsis

The pilot commenced a takeoff on Runway 21 at Headcorn Airfield with eight parachutists on board. The flaps were not selected and the aircraft failed to get airborne in the available distance. The pilot aborted the takeoff but was unable to prevent a collision with a parked aircraft. The pilot received fatal injuries as a result of the collision.

History of the flight

The pilot was conducting flights for the purpose of parachute operations; these flights are known colloquially as 'lifts'. On the previous day, he had conducted 13 lifts, of which eleven were to an altitude of 12,000 ft and two to an altitude of 5,500 ft or less.

On the day of the accident the pilot recorded that he took off for the first lift at 0927 hrs. The aircraft, with nine parachutists aboard, climbed to 12,000 ft and landed at 0946 hrs. There followed three flights of an average 18 minute duration, between each of which the aircraft was on the ground for no more than 7 minutes. The last of these flights landed at 1100 hrs, after which the aircraft uplifted 230 ltr of Jet A1 fuel. The aircraft utilised the main runway, Runway 29, for each of these flights.

The surface wind had freshened from the south and the pilot requested the use of the shorter Runway 21. The air/ground radio operator refused this request because he believed that the pilot had not been checked out to use this runway, as required by the Headcorn Aerodrome Manual. Accordingly, the pilot approached a nominated

check pilot who agreed to observe his next flight. The check pilot briefed the pilot of OY-JRR on the procedures for using the short runway, emphasising the need to make an early decision to abort the takeoff if necessary. The check pilot stated that the pilot of OY-JRR performed a thorough pre-takeoff check using the full checklist available in the cockpit and that the subsequent flight was entirely satisfactory.

Following the check flight the aircraft took off again at 1148 hrs and flew a further five flights, each separated by periods that ranged between 7 and 36 minutes. The check pilot observed several of these flights, all of which were from Runway 21, and most appeared to proceed normally. He and another witness noticed that on one occasion the climb gradient after takeoff appeared shallower than normal, but they believed that the wind speed had decreased at this time. The pilot recorded that the aircraft was refuelled again after landing at 1443 hrs, this time uplifting 266 ltr of fuel. The next takeoff was at 1447 hrs and having climbed to 12,000 ft again the aircraft landed at 1521 hrs.

The accident occurred on the pilot's eleventh flight of the day. Prior to the flight the aircraft was refuelled with a further 100 ltr at 1555 hrs. Shortly before 1605 hrs the aircraft taxied to Runway 21. It appeared to accelerate normally but at no time was the tail seen to rise in its usual manner prior to becoming airborne. Onboard, the experienced jump-master noticed that the aircraft was passing the aerodrome refuelling installation and several aircraft parked close to the runway, beyond the intersection of Runway 21 with Runway 29. He was aware that the aircraft had now passed the point where it would normally become airborne. Almost simultaneously, he heard the pilot shout "Abort". One of the parachutists shouted to the other occupants "Brace - Brace, everyone on the floor". The aircraft stopped abruptly when its left wing and cockpit collided with a camouflaged F100 fighter aircraft which was parked as a museum exhibit to the left of the southern edge of Runway 21.

The occupants of the cabin were able to vacate the aircraft with mutual assistance. Members of the aerodrome fire service extinguished a small fire, which had started in the area of the engine, and other witnesses helped the occupants to move away from the aircraft. The pilot, however, remained unconscious in the cockpit. He was attended subsequently by paramedics and taken to hospital, where he succumbed to his injuries.

Medical and pathological information

Post-mortem examination conducted by an aviation pathologist revealed that the pilot died of multiple injuries, consistent with those sustained at the time of the impact with the parked aircraft. The post-mortem showed no evidence of natural disease which could have caused or contributed to the accident and toxicology was negative.

The aviation pathologist considered that this was potentially a survivable accident, as evidenced by the very few injuries sustained by the eight parachutists on board. Impact of the cockpit with the nose of the parked aircraft had caused the fatal injuries sustained by the pilot and no alternative or additional safety equipment would have altered the fatal outcome.

Personnel information

The pilot possessed a Commercial Pilot's Licence, issued by the CAA, which included a DHC-2 Turbo-Beaver rating issued on 7 February 2007 and valid until 6 February 2009. He also possessed a valid Flight Instructor rating and an Instrument Rating valid for single and multi-engine single pilot aircraft. His unrestricted Class One Medical certificate was valid until

28 March 2007. He also possessed a Commercial Pilot's Licence issued by the United States Federal Aviation Administration, valid for single and multi-engine aircraft, which included a Flight Instructor rating.

Members of the parachute school who saw him on the day of the accident commented that he seemed happy, excited and keen to go flying.

Pilot fatigue

Guidance produced by the British Parachuting Association (BPA) in relation to pilot fatigue stated that a pilot who is engaged on parachuting operations should not fly more than four hours without a thirty minute break away from the aircraft and should not fly more than eight hours in any one day. The pilot's record of flights indicates that he had operated in accordance with this guidance.

Meteorological information

Several pilots who witnessed the accident reported a surface wind of approximately 10 kt from the south. Witnesses described the runway surface as slightly wet but not unduly soft or boggy. The temperature at the time of the accident was approximately 13ºC.

Aerodrome information

Headcorn Airfield is a grass aerodrome with two landing strips. Runway 11/29 is licensed with a declared takeoff distance of 840 m. Runway 21/03 is unlicensed, which means that it does not necessarily comply with the provisions of CAP 168 – *'Licensing of Aerodromes'*, a document that describes the minimum standards necessary to meet licensing requirements, including the provision of runway markings and freedom from obstacles. The Headcorn Aerodrome Manual stated that the length of Runway 21/03 was 312 m, being the distance between the marked northern threshold of Runway 21 and its intersection with Runway 29/11. The distance from this threshold to the position of the parked F100 fighter aircraft was approximately 570 m.

The UK Aeronautical Information Package (AIP) contains information about individual licensed aerodromes. The edition of the AIP current at the time of the accident concurred with the declared length of Runway 11/29 but did not report the length of the unlicensed Runway 21/03 (see Figure 1). One of the commercially available aerodrome guides noted that Runway 21/03 was unlicensed but had a length of 312 m. Another such guide, whilst also referring to this runway as unlicensed, gave its length as 549 m. The publishers of both guides commented that in respect of unlicensed runways they rely on information provided by the aerodrome operator except where graphical representation of the aerodrome shows an obvious geometric error.

A diagram on the Headcorn Aerodrome website depicted the runway layout. It showed Runway 21/03 extending south beyond the location shown in the Headcorn Aerodrome Manual so that it resembled the depiction in the aerodrome guide which quoted its length as 549 m.

The aerodrome operator commented that historically Runway 21/03 was considered to be 549 m long. More recently, whilst applying to license this runway, the aerodrome operator reduced its nominal length to 312 m in order to comply with the provisions of CAP 168 in relation to obstacles. The operator considered, however, that the provision of threshold markings, in accordance with CAP 168, would have been confusing visually. Consequently, these markings were not provided and the runway remained unlicensed, albeit at the reduced published length of 312 m.

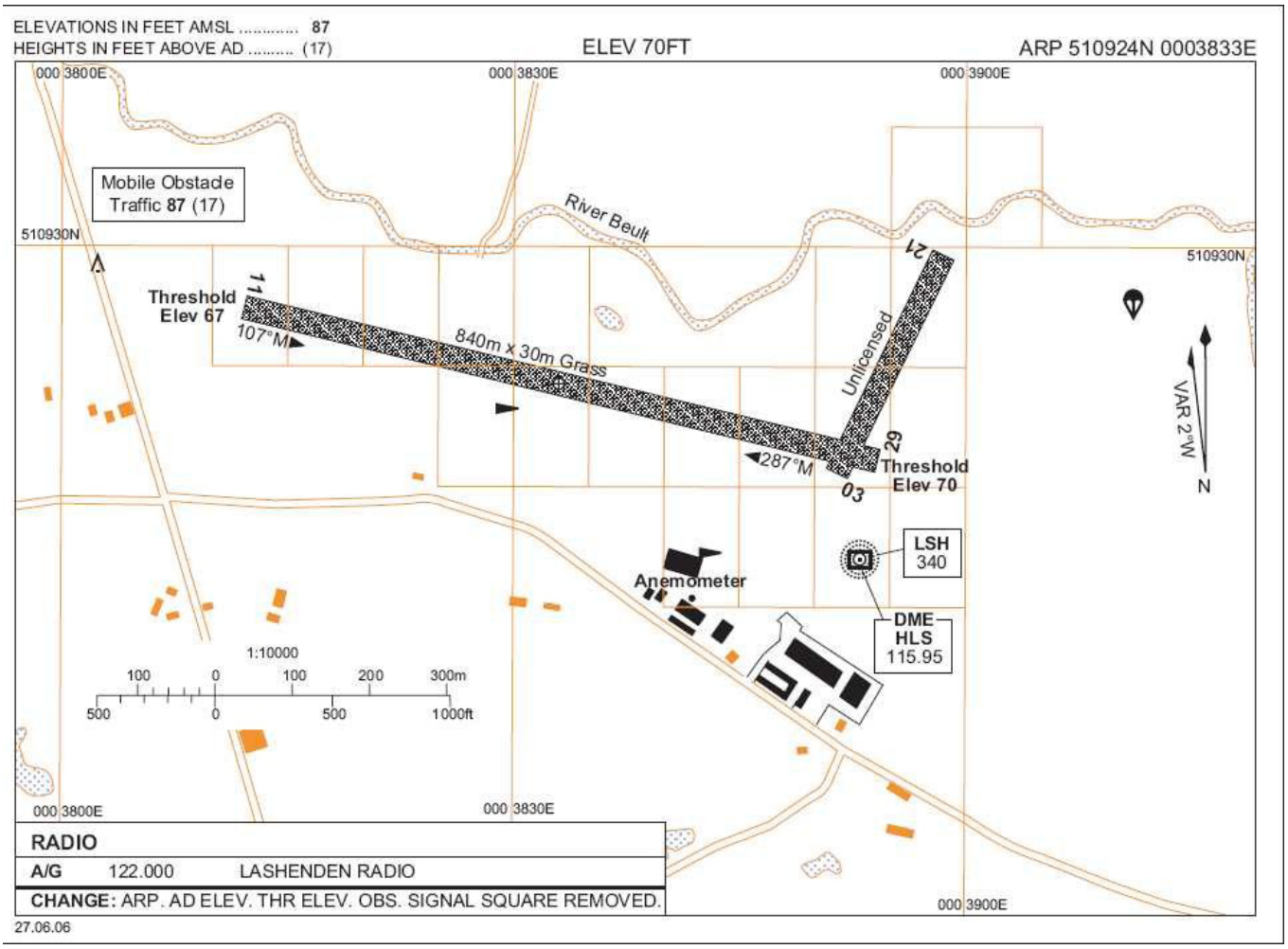


Figure 1

Aerodrome chart, UK AIP

The Operational Procedures section of the Headcorn Aerodrome Manual, current at the time of the accident, contained information about operation of Runway 21/03. It stated that this runway could only be used by pilots who were based at the aerodrome and had been checked by an instructor or nominated check pilot. The nature of this check was not specified but was understood to involve the candidate pilot being observed to operate safely in the context of that runway's characteristics. In addition, the air/ground radio operator had the right to refuse the use of the short runway.

A museum, occupying an area adjacent to the south-eastern boundary of the aerodrome, included as exhibits several non-airworthy parked aircraft, one of which was the F100 aircraft. This 1960s jet fighter aircraft wore faded green and brown camouflage paintwork that was difficult to distinguish from the skyline beyond it when viewed from the start of Runway 21.

Impact sequence

The left side of the Beaver struck the nose of the F100 static display aircraft, tearing open the left side of the forward fuselage and cockpit, until its left wing contacted the right side of the F100's fuselage. Thereafter, the Beaver's momentum drove the front end of the F100 sideways a distance of some 3.5 m (measured at the nose

wheel), pivoting it about its main wheels, before finally coming to rest. The disruption of the Beaver cockpit's left side and windscreen pillar weakened the forward fuselage to extent that the surviving structure could no longer support the weight of engine and propeller, and the whole of the aircraft's nose section collapsed downwards, bending about the lower fuselage skins and the remnants of cockpit floor structure just aft of the instrument panel, until the propeller rested on the ground.

The speed at impact could not be determined with any degree of precision from the evidence available at the scene, but the damage was consistent with a speed of at least 30 kt.

Wreckage examination

Flaps

System description

The wing flaps on the Beaver family of aircraft are linked to the aileron control circuit, so as to provide aileron droop when the flaps are deployed. A single hydraulic actuating cylinder, located in the wing centre section, drives the system by operating a torque tube which extends laterally to each wing root. The rotational movement of the torque tube is transferred to the individual flap via lever arms on the ends of the torque tube and short push rods connected directly to the flap surfaces. Hydraulic fluid is directed to the appropriate side of the actuating cylinder by means of a flap selector valve controlled by a lever located just to the right of the pilot's seat. The system is pressurised by means of a hand pump operated by a lever, also positioned to the right side of the pilot's seat.

The actuating cylinder incorporates a mechanism which prevents it from being back-driven when the system is not being actively pressurised via the hand pump, and holds the actuator at the position to which it was last moved. Therefore, the position of the flap selector valve lever does not provide a reliable indication of the last flap selection made by the pilot. For example, the flaps could be pumped DOWN, and the flap selector valve then returned to the UP position in readiness for a subsequent retraction; the flaps would then remain in the DOWN position until such time as the hand pump is operated.

Post-accident state

The flap selector valve in the cockpit was positioned to port fluid to the flaps up side of the actuator. However, it was not possible to determine whether the lever had been disturbed during the post-impact rescue activities.

The flap actuating system of OY-JRR comprising the actuator, torque tube and push rods, was in the fully retracted position. Both flap surfaces were fully UP, and neither aileron was drooped. The left wing root trailing edge was driven into engagement with the fuselage side when the left wing struck the side of the F100's fuselage; the flap surface was in the fully UP position at that time.

Engine and propeller

The engine and propeller controls in the cockpit were largely undamaged, but their associated operating cables had been stretched when the nose section dropped to the ground. Consequently it was not possible to determine their pre-impact settings.

The engine casing exhibited no deformation indicative of a sudden stoppage under power, and there was no compelling evidence on the propeller blades indicative of a high power setting at the instant of contact with the F100 aircraft. A section was broken out from the leading edge of one propeller blade near its tip, as a result of it striking the F100's nose intake structure, but there were no deep or clearly delineated circumferential scores on the faces of this, or any other blade. Numerous nicks

and small, localised areas of breakout, also caused by contact with the F100's nose structure, were present on the other two blades. These were possibly indicative of their having been in reverse pitch at the time of the collision but this could not be confirmed. The mechanical interlock between the power lever and propeller pitch mechanisms was functional and would have prevented the power from being increased in the event of the blades failing to achieve reverse pitch.

Taken overall, the evidence at the scene suggested that the engine was not under high power at the time OY-JRR struck the F100 aircraft.

Cabin integrity

Except for the penetration of the cockpit by the F100's nose structure, and the associated collapse of the nose section, the fuselage of the Beaver suffered relatively minor damage and the passenger cabin had remained intact.

Two elements of the thin-wall tubular steel space-frame supporting the forward-facing bench seat at the rear of the cabin had failed. The remaining framework had twisted as a result of inertial forces transferred to it via the seat belts, which were anchored directly to the seat. However, the seat itself had not become detached. One of the tube failures, close to the top of the tube forming the front right seat leg, was a pre-existing fracture at a welded joint. This was indicated by corrosion and bruising of the fracture faces, which in some regions exhibited features indicative of fatigue crack propagation. The design of the seat support frame was asymmetric due to a requirement for it to provide clearance for the curtain-type cabin door to slide around in its tracks, following a curved path behind the right rear corner of the seat. The distribution of the anchorage points securing the seat to the cabin floor structure was also asymmetric, for similar reasons. The attachment points were biased towards the left side and with just a foot resting on the cabin floor, with no attachment to the structure supporting the rear right corner of the seat. The remaining seats in the cabin were intact.

The sliding curtain-style cabin door was found in the fully open position, occupying the section of door track which curved around behind the rear cabin seat. Despite the deformation and partial separation of this seat from its mountings, and its close proximity to the door tracks, it had obstructed neither the tracks nor the door itself.

Survival aspects

It is unlikely that an impact of the sort encountered on contact with the F100 was envisaged during the original design of the DHC-2. Consequently, no specific provision would have been made for protection of the pilot in these circumstances.

Although the forward-facing passenger seat was provided with lap restraints the seated occupants had, immediately prior to impact, decided to lie on the floor. All of the parachutists were essentially unrestrained. The jump master commented that the issue of restraint had been discussed throughout the parachuting community. Additionally, this issue was the subject of three Safety Recommendations arising out of the investigation into the fatal accident to G-BGED. In its response to these recommendations the BPA stated that it considered the dangers arising from becoming entangled in restraining devices during a jump outweighed the theoretical benefits of being restrained in the event of an occurrence on the ground.

GPS data

Track log data covering both the accident takeoff and the previous takeoffs flown by the same pilot earlier in

the day, was downloaded from a GPS unit recovered from the aircraft. The frequency with which these data were logged by the unit was dynamically controlled by algorithms in the unit's controlling software, based on rates of change of height, track, and ground speed. From the data obtained, it was possible to make estimates of the average speed of the aircraft during four consecutive segments of the final take off. This data suggested that during the failed takeoff, the aircraft's average speed during the first 85 m segment had been approximately 5 kt; 17 kt during the following 105 m segment; 51 kt over next 170 m segment; and 50 kt over the final 185 m segment.

Data for the previous, successful, takeoff suggested the average speeds over broadly comparable segments of the take off were: 5 kt, 10 kt, 46 kt (with the aircraft airborne, at around 30 ft agl), and 57 kt (when the aircraft was climbing away).

Runway marks

A number of tyre tracks were visible in the grass at the threshold end of the runway, consistent with a Beaver's main wheel track and tail wheel tyre profile, evidently made by OY-JRR as it was manoeuvred onto the runway and lined-up prior to takeoff. However, it was not possible to identify which of these sets of marks was made during its final takeoff.

Sets of both main and tail wheel tracks from OY-JRR were also visible on the grass runway, but during the early stages of the takeoff roll the marks from the final takeoff could not be differentiated from those made during previous takeoffs by the aircraft that day. Further up the runway, however, one set of tyre tracks began to display differing characteristics from all the others. These distinctions became increasingly apparent as the takeoff progressed, and it was possible to follow these marks right up to where OY-JRR had come to rest. Working forward from the start of the takeoff to the impact with the F100 aircraft, the marks displayed the following changes of character, as the attempted takeoff progressed. (Distances are quoted to the nearest 5 m from the Runway 21 numbers.)

- At 135 m, the tail wheel track started to become more clearly defined; the main wheel tracks remained substantially unchanged.
- Beyond 140 m, the tail wheel track became progressively more pronounced and by 200 m had developed into a deep and clearly defined depression reflecting the characteristic profile of the Beaver's edge-ribbed tyre. The main wheel tracks remained substantially unchanged initially during the period, but then started to lighten perceptibly as the tail wheel track deepened.
- At 205 m, the main wheel tracks became intermittent, and had disappeared completely by 255 m; the tail wheel track remained consistently deep throughout.
- Between 255 m and 380 m no main wheel tracks were present except for a brief contact at 320 m, made by the left main wheel tyre with brake applied. The tail wheel track remained consistently deep throughout.
- At 380 m, the tail wheel track disappeared abruptly, and was replaced by a series of intermittent marks from by both main wheel tyres, made with the brakes applied. These intermittent braked main wheel marks continued to 400 m, with no tail wheel track visible.

- From 400 m onwards, the intermittent (braked) main wheel tracks became continuous, with evidence of wheel-locking at 430 m; they remained locked thereafter until impact with the F100, which occurred approximately 550 m from the start of the takeoff roll. No tail wheel mark was present at any stage during this period except at the point of impact with the F100 aircraft, when it dropped back into contact with the ground.

- Until very shortly before impact with the F100, OY-JRR followed a substantially straight track directly towards the centre of the F100. Some 40 m before impact the tracks start to deviate to the right and thereafter continued in a tightening curve to the right, up to the point of impact.

- At the point of initial contact with the F100 aircraft, there was a clearly defined imprint, and a subsequent skid laterally to the right, made by the tail wheel as it dropped to the ground and was dragged sideways during the impact sequence. The geometry of these marks showed that when it collided with the F100, OY-JRR had been yawed some 10º to right of its track over the ground track, sideslipping 10º left.

Photographic evidence

Photographs taken by a witness who saw the aircraft during the initial stage of its takeoff roll showed the aircraft's flaps in the retracted position.

Aircraft operation

The Airplane Flight Manual (AFM) for OY-JRR contained normal and abnormal operating procedures. The *'Normal Operating Procedures'* section contained a statement that, before takeoff, the flaps should be set to the TAKE-OFF position. It did not contain any information regarding takeoff performance with any other flap setting. The *'Performance Information'* section of the AFM contained a chart showing the takeoff performance of the aircraft according to weight and environmental factors which noted, as an 'associated condition', that the flaps should be set at TAKE-OFF (35°). The distance required to stop the aircraft following an aborted takeoff was not shown.

A checklist found in the cockpit, entitled *'OY-JRR DHC-Mk3 Turbo Beaver Check list'*, contained abbreviated normal and emergency procedures. The section entitled *'Taxi'*, which would have been the last such check accomplished prior to a normal takeoff, contained the item:

'Flap……Set for T/O'

indicating that the flaps should be set to the TAKE-OFF position prior to commencing the takeoff run.

Some aircraft are fitted with a system which, independently of the flap position indicator, will provide a warning that the aircraft is not in the correct configuration for takeoff. The warning is usual aural and may be accompanied by a warning light. No such system is fitted to the Turbo-Beaver.

The organisation holding design authority for this type was unable to provide information regarding performance during takeoff with the flaps in the UP position, commenting that this configuration was "outside the normal flight envelope", and that it was not considered for the development of performance charts or normal procedures for insertion in the Flight Manual.

Pilot training

The pilot was trained by the owner of the aircraft. The training syllabus included familiarisation with the aircraft and its systems and consideration of normal and abnormal operating procedures. A takeoff with the flaps in the UP position was not included in the syllabus and was not demonstrated to the pilot. The owner had made several takeoffs from long hard surface runways with cruise flap set and noted that, whereas the aircraft was "extremely short field capable" with takeoff flap set, it was "very difficult to get airborne" without it.

Operation from unlicensed runways

Article 126 of the Air Navigation Order (ANO) is applicable to operation of the Turbo-Beaver and states that:

> *'aircraft flown for public transport shall takeoff and land at a licensed aerodrome'*

Article 157 of the ANO states that:

> *an aircraft shall be deemed to fly for the purposes of public transport if valuable consideration is given or promised for the carriage of passengers or cargo in the aircraft on that flight.*

Such valuable consideration was given or promised for the carriage of several of the occupants of OY-JRR, in the sense that they had paid to conduct the parachuting operations that necessarily involved their carriage in this aircraft. However, Article 163 *'Public transport and aerial work – exceptions- parachuting'* states that:

> *'A flight shall be deemed to be for the purpose of aerial work if it is a flight in respect of which valuable consideration has been given or promised for the carriage of passengers and which is for the purpose of:*
>
> *(a) the dropping of persons by parachute and which is made under and in accordance with the terms of a parachuting permission granted by the CAA under article 67.'*

There is no requirement for aerial work to be conducted from a licensed aerodrome. Consequently, operation of this flight from an unlicensed runway was in accordance with the provisions of the ANO.

CAP 428 – *'Safety standards at unlicensed aerodromes'*, published by the CAA, is a guidance document for the operation of unlicensed aerodromes. Its contents are not mandatory. It states, in relation to the following topics:

> *'Runway markings*
>
> *The usable parts of hard runways (if all of the hard area cannot be used) and of grass runways may be edged with white rectangular paint markings or marker boards, flush with the runway surface, each 3 metres long and 1 metre wide, at intervals of not more than 90 metres. Alternatively, suitable elevated frangible markers, such as traffic cones at the same spacing may be used. The ends of the usable runway may be indicated with similar paint or markers at right angles to, and adjoining the end lateral markers.*
>
> *Where operations are not confined to marked, paved or unpaved runways, the limits of the usable area may be marked in a similar way, i.e. 3 metre by 1 metre markers spaced at intervals of not more than 90 metres around the perimeter.'*
>
> *Obstacles*
>
> *'Anything that, because of its height or position, could be a hazard to an aeroplane landing or*

taking off, and which cannot be removed, should be conspicuous and marked if necessary.'

Aircraft parking

If designated parking areas are provided:

a) They should not be sited under aircraft flight paths or within the runway strip, and should have barriers and notices warning against unauthorized entry.

b) Suitable fire extinguishers should be available in areas where aircraft engines are started.

Aircraft performance

'Pilots must also check that the runway surface is suitable for use by their aircraft type, and that there is sufficient distance for the takeoff or landing and to abort the takeoff if necessary.'

Analysis

Engineering aspects

Both the wreckage and photographic evidence indicate that the takeoff was initiated with the flaps fully retracted, and that they remained so throughout. There was no evidence to suggest that there had been any malfunction or failure of the engine or the propeller. Indeed, the GPS data shows that the aircraft accelerated normally and had achieved a velocity somewhat in excess of that achieved at a comparable stage during the previous takeoff, at which stage it was climbing through about 30 ft. The changing character of the tyre marks left on the runway suggests that as the expected lift off point was approached, the pilot had been increasingly trying to pull the aircraft off the ground, and indeed that the aircraft had almost lifted off. The evidence for this is the deeply imprinted tail wheel track and ultimately, briefly, the absence of main wheel tracks.

However, when the aircraft failed to lift off cleanly the pilot apparently decided to abort the takeoff. During the abort phase, the tail was up and the wheel brakes applied heavily – sufficiently to lock the wheels for much of the time. There was no evidence available from which either the propeller pitch or engine power settings used prior to impact could be determined, but a study of the acceleration and abort profiles illustrated by the graphic at Figure 2 suggests that it would not have been possible to stop the aircraft before reaching the airfield boundary.

Figure 2 shows a range of speed profiles broadly compatible with the average acceleration segment speeds from the GPS data, giving a range of terminal speeds (at impact with the F100 aircraft). Those profiles having terminated at a high impact speed with the F100 also fit well with the average segment speeds for both acceleration and abort phases. Those profiles giving an impact speed below about 35 kt do not make for a very convincing fit with the final average speed block, suggesting that the maximum speed obtained was more likely to have been 52 - 53 kt than the 60 kt which lower impact speed profile would imply. An abort speed of 52 - 53 kt is also consistent with the tyre track evidence, which suggest that the aircraft was marginally wing-borne at that stage. (No lift off speed is given by the manufacturer for a takeoff without flap, but the flaps-up stall speed of 52 kt would equate to a ground speed, in this case, of the order of 51 kt.) It is also the case that the principal decelerative forces acting on the aircraft comprising the combination of main wheel braking and, if used, reverse thrust, would not have been capable of slowing the aircraft significantly, and certainly not below 25 kt at impact.

The initial application of brakes during the early stages of the abort in particular, and indeed subsequently,

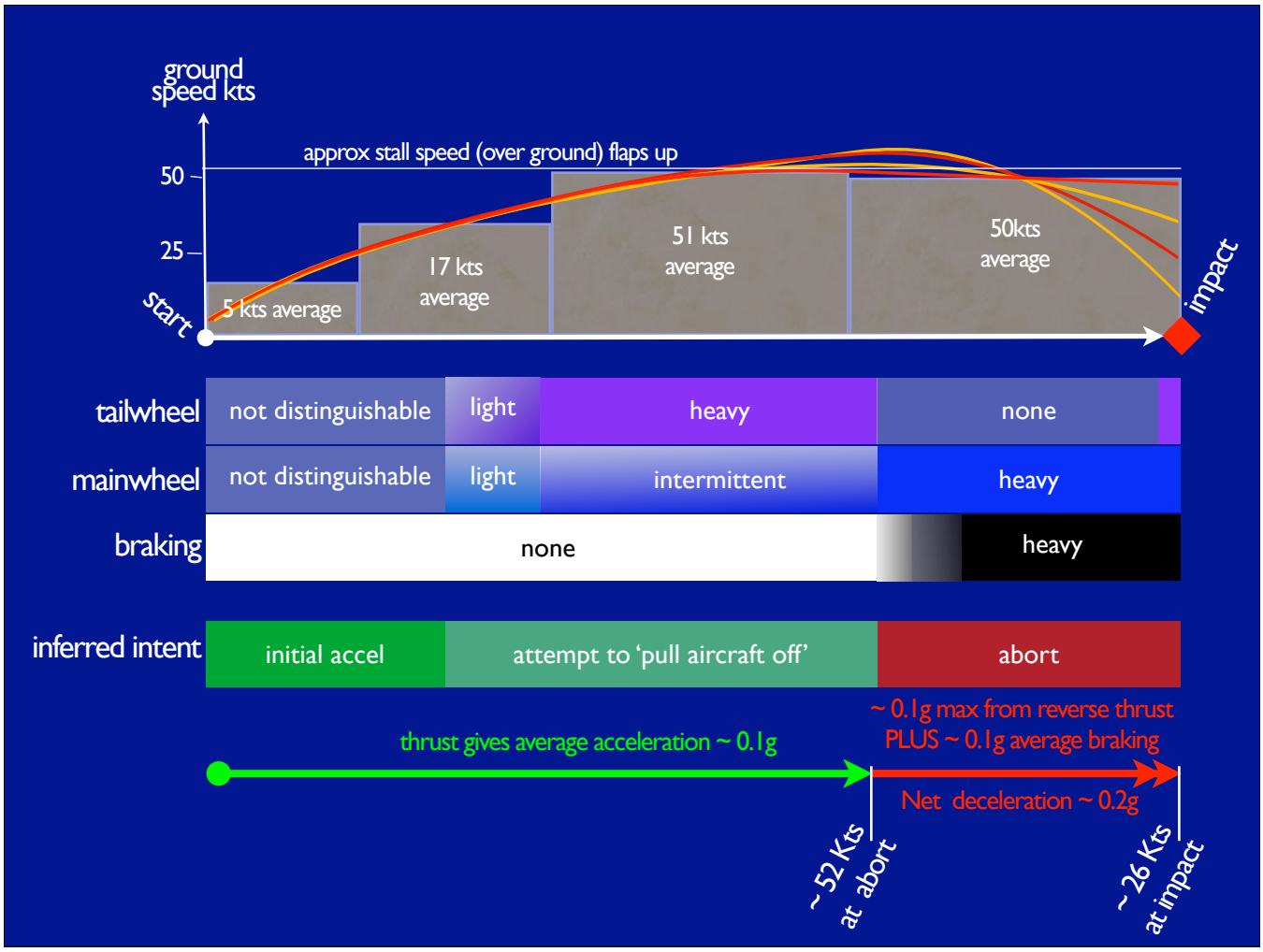


Figure 2

Possible speed profiles

would have had very little effect because with the aircraft almost wing-borne very little weight would have acted on the main wheels. The retardation force acting on the aircraft derives from the slip resistance (friction) developed between the tyre and the ground, and is directly proportional to the weight borne by that wheel. If the aircraft was 90% wing-borne, therefore, the braking force available to slow the aircraft will be only 10% of that available with no lift being developed by the wings. Even with no lift and the whole of the aircraft's weight being carried by the main wheels, the braking coefficient on grass is not likely to have exceeded 0.2 (giving approximately 0.2g deceleration).

Reverse thrust would, if used, have contributed to the aircraft's deceleration. The GPS data suggests that the net forward thrust prior to the abort gave an acceleration of approximately 0.1g, and it therefore follows that at best (had the reverse pitch propeller efficiency been comparable to that during forward thrust, which it certainly would not have been), reverse thrust could not have contributed more than 0.1g to the aircraft's overall deceleration. Following an abort at 52 kt, deceleration of 0.1g from braking and 0.1g from reverse thrust, both significantly optimistic assumptions in the circumstances, would give an impact speed of the order of 26 kt.

In summary, the evidence shows that if the flaps had been set correctly for takeoff, the aircraft could have lifted off and climbed away safely, as it had done during the previous flights that day. Because the flaps were not set correctly, the aircraft did not become airborne as expected, and this was evidently the trigger for the pilot's decision to abort. From that position on the runway, ie the abort point, there was insufficient distance, by a significant margin, to permit the aircraft to be brought to rest before over-running the airfield boundary or colliding with the static museum aircraft parked adjacent to it. In relation to these static aircraft, it was notable that, viewed from a distance on the runway, they visually merged into the background and were very difficult to pick out until at close range. This was probably the reason for the very late attempt by the pilot to take avoiding action, by jinking to the right shortly before impact.

Operational aspects

The pilot's training was probably adequate for the normal and abnormal circumstances envisaged by his instructor. However, the pilot was not familiar with the handling or performance characteristics of the aircraft during takeoff with the flaps in the UP position and consequently he may not have identified that the aircraft was in the wrong configuration for takeoff. The design authority for this type considered that this configuration was "outside the normal flight envelope" and had produced no performance charts or procedures for its use. In such circumstances, it is essential that the pilot follows the published procedures and positively ensures that the aircraft is correctly configured for takeoff.

Impact with the F100 aircraft occurred approximately 550 m from the start of the takeoff roll. This coincided roughly with the end of the runway as depicted in one of the commercially available aerodrome guides, but was beyond what the aerodrome operator considered to be the end of the runway. The use of an unlicensed runway for this operation was in accordance with the ANO in force at the time of the accident. The fact that the aircraft had operated regularly from Runway 21, without incident, indicated that it was possible to do so safely. The dimensions of an unlicensed runway are not necessarily defined. In the case of Runway 21 at Headcorn the presence of parked aircraft in what might otherwise have been an overrun area made it difficult to judge the actual distance available for each takeoff. Furthermore, the lack of markings to define the southern end of the runway made it difficult for aircraft parking or manoeuvring adjacent to the runway to ensure that they did not enter it. The presence of runway end markings such as those suggested in CAP 428 would assist in both cases. Therefore, the following Safety Recommendation was made.

Safety Recommendation 2007–098

It is recommended that Headcorn Aerodrome should install markings that indicate the southern end of Runway 21.

Aircraft involved in parachuting regularly operate from unlicensed runways and there is no evidence to suggest that to do so is inherently more dangerous than operating from licensed runways. Any requirement to conduct parachute operations from licensed runways could therefore restrict the sport without any commensurate improvement in safety. In relation to runway edge and obstacle markings, the guidance contained in CAP 428 emulates the requirements of CAP 168 in respect of licensing of runways, the physical characteristics of which afford additional protection to public transport operations. However, Headcorn Airfield would not necessarily consult CAP 428, as Headcorn is a licensed aerodrome, albeit one that also operates an unlicensed

runway. Whereas the operation undertaken by OY-JRR was defined as aerial work, and may therefore operate from unlicensed runways, it is reasonable to expect some level of protection for members of the public for whose carriage valuable consideration has been given. Moreover, it is possible that had the pilot seen the F100 aircraft earlier in the aborted takeoff he may have been able to avoid striking it with the cockpit of his aircraft. Accordingly, the following Safety Recommendation was made.

Safety Recommendation 2007–099

It is recommended that the Civil Aviation Authority should review the requirement to provide runway edge and obstacle markings for unlicensed runways from which aerial work operations are conducted.

Aircraft are often manoeuvred or taxied in the area south of what the aerodrome operator considered to be the southern end of Runway 21. The absence of such aircraft immediately in the path of the Turbo-Beaver was entirely fortuitous because their presence in that area was not expressly forbidden during operation of Runway 21. Therefore, the following Safety Recommendation was made.

Safety Recommendation 2007–100

It is recommended that Headcorn Aerodrome should amend the Operating Procedures section of the Headcorn Aerodrome Manual to prevent any aircraft entering Runway 21 or its overrun when an aircraft is taking off or landing on Runway 21.

ACCIDENT

Aircraft Type and Registration:	Pierre Robin DR400/180 Regent, G-FCSP
No & Type of Engines:	1 Lycoming O-360-A3A piston engine
Year of Manufacture:	1990
Date & Time (UTC):	11 August 2007 at 1215 hrs
Location:	Rothesay, Isle of Bute
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Nose landing gear detached, propeller and right wing damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	74 years
Commander's Flying Experience:	2,708 hours (of which 2,517 were on type) Last 90 days - 30 hours Last 28 days - 13 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and subsequent AAIB enquiries

Synopsis

The aircraft overran the damp, short grass runway, having touched down 150 m into the 480 m strip.

History of the flight

The pilot reported that he flew from Biggin Hill towards the Isle of Bute, to take part in a commemorative event which he was keen to attend and about which he was somewhat pre-occupied. Crossing the mainland coast, he descended to 600 ft amsl to remain clear of cloud. Arriving at the Isle of Bute he overflew the airfield, noting that the windsock was showing a slight southerly wind and established the aircraft in a teardrop turn onto a final approach for Runway 27. This runway has a short grass surface and recent rain had left the surface damp.

The approach was flown at 56 kt (slower than the 'normal' approach speed of 65 kt) and the aircraft touched down approximately 150 m beyond the beginning of the runway. The aircraft rolled along the remaining length of runway, ran through a fence and over a ditch. It came to rest on its main landing gear and engine cowling, the nose landing gear having become detached. The pilot evacuated the aircraft normally without difficulty and there was no fire.

The pilot recalled that he may not have set the flaps for landing, attributing this to the short time available in the teardrop turn to complete the pre-landing checks, although photographs of the aircraft at rest after the

accident showed the flaps in the landing position. He commented that although he was experienced on type, he seldom landed on short grass runways.

After the accident, the pilot assessed that the wind was from the south-east at 5 kt. This would have given a slight tailwind on Runway 27.

Additional information

The Aircraft Flight Manual suggested that with the conditions at the time of the accident, the landing distance required on a '*dried and plane concrete runway'* would be 451 m, and the landing ground roll would be 201 m; the runway at Bute is 480 m long. The CAA's Safety Sense Leaflet 7c, entitled *'Aeroplane Performance'* suggests safety factors to be added to performance figures. For landing on short wet grass up to 20 cm long, a factor of 35% of the landing distance is suggested, and the Leaflet notes that:

> *'Very short grass may be slippery, distances may increase by up to 60%'.*

The leaflet also suggests that a safety factor of 43% should be incorporated into landing performance calculations, and states that all factors are cumulative. Applying the short wet grass factor would increase the landing roll to 271 m and adding the safety factor of 43% would increase the distances to 387 m. The presence of a slight tailwind would further increase this distance.

It was noted in the Aircraft Flight Manual that the landing ground roll data was presented as *'landing distance'* and the landing distance information was headed *'landing ground roll (over 15 m barrier)'* and this may have caused some confusion to the pilot.

The pilot commented that his keenness and concern to get to the commemorative event had led him to fly when he was not as "cool, calm, and collected" as he should have been.

ACCIDENT

Aircraft Type and Registration:	Piper PA-25-235 Pawnee, G-BLDG
No & Type of Engines:	1 Lycoming O-540-B2C5 piston engine
Year of Manufacture:	1968
Date & Time (UTC):	3 September 2007 at 1430 hrs
Location:	Rufforth Aerodrome, Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to right wing
Commander's Licence:	Private Pilot's Licence
Commander's Age:	53 years
Commander's Flying Experience:	648 hours (of which 1 was on type) Last 90 days - 6 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

During his second familiarisation flight on the aircraft, the pilot allowed the airspeed to decay excessively on the approach to land and rounded out too high, causing the aircraft to stall. The right wing contacted the ground and the aircraft landed heavily, slewing round to the right and coming to rest facing in the direction of approach. The pilot, who was wearing a full harness, was uninjured.

History of the flight

The pilot was conducting familiarisation flights in the single seat aircraft in preparation for performing glider towing duties. He was familiar with grass Runway 36, which was in use at the time of the accident, having flown from it recently. On the morning of the accident, the pilot was given an extensive briefing on the aircraft by the tugmaster of the gliding club, and he studied the Pilot's Operating Handbook. He then taxied the aircraft around the airfield for a while to become familiar with its ground handling characteristics. Having gained sufficient confidence, he made his first flight in the aircraft and explored its handling characteristics. Whilst practising stalls he noted that, with full flap selected, the aircraft tended to drop the right wing. He returned to the airfield and performed a number of circuits and landings, without incident.

He conducted a second familiarisation flight in the afternoon and performed three successful circuits and landings; the fourth circuit was tighter than the previous three. The approach was initially satisfactory but the

pilot believed that he inadvertently allowed the airspeed to decay excessively, over the airfield boundary, and rounded out too high. This caused the aircraft to lose flying speed and the right wing to drop. The pilot immediately applied full power but was unable to prevent the right wing from contacting the grass surface of the runway. The aircraft then landed heavily and slewed round to the right, entering the parallel and adjacent asphalt runway, where it came to rest facing in the direction of approach. The pilot, who was wearing a full harness, was uninjured.

In the pilot's opinion, the accident was caused by allowing the speed to decay below safe limits on the approach and a late attempt at taking corrective action.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28-140 Cherokee, G-AVGD
No & Type of Engines:	1 Lycoming O-320-E2A piston engine
Year of Manufacture:	1967
Date & Time (UTC):	16 September 2007 at 1040 hrs
Location:	1.75 miles west of Deanland Airfield, Sussex
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Minor) Passengers - 1 (Minor)
Nature of Damage:	Wings separated from fuselage
Commander's Licence:	Private Pilot's Licence
Commander's Age:	66 years
Commander's Flying Experience:	1,150 hours (of which N/K were on type) Last 90 days - 42 hours Last 28 days - 15 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

After turning onto the base leg at Deanland, the engine failed to respond to throttle inputs despite the use of carburettor heat. The aircraft made a forced landing in a field, losing its wings as it passed through a hedge. The probable cause of the incident was thought to be carburettor icing. After a recent cable replacement, the carburettor heat control protruded from the instrument panel by more than 25 mm in the cold position. This probably prevented the air valve from reaching its fully hot position before the control reached its maximum travel, thus limiting its ability to prevent the formation or removal of ice within the carburettor.

History of the flight

The aircraft had recently been repaired following an accident in September 2006. The commander, a qualified instructor, had planned to carry out a flight with a recently requalified pilot to familiarise him with the use of the aircraft's navigaion equipment.

The aircraft had flown from Cranfield to Deanland, and joined the circuit. After turning onto base leg, the pilot attempted to increase the engine power in order to control the rate of descent, but there was no response to the throttle movement. The instructor then took control of the aircraft, switched fuel tanks, confirmed that the electric fuel pump had been switched on and that the carburettor heat had been selected to hot, but the engine remained unresponsive. The instructor transmitted a

'MAYDAY' and carried out a forced landing in a field approximately 750 metres to the north east of the runway. During the landing, the aircraft passed through a hedge where the wings separated from the fuselage. Both of the occupants received minor injuries but were able to leave the aircraft unaided prior to the arrival of the airfield fire service vehicle and a police helicopter.

The commander reported that, in his opinion, the most probable cause of the incident was carburettor icing. Established carburettor icing charts (CAA General Aviation Safety Sense leaflet No 14, '*Piston Engine Icing*') indicated that the reported weather conditions at the time of the accident of temperature +15ºC and a dew point of +11ºC, were conducive to the formation of carburettor icing at cruise and descent power settings.

The carburettor heat control cable had been replaced during the aircraft's rebuild. However, this control protruded more than 25 mm from the instrument panel when in the cold position. This had been brought to the attention of the engineering organisation but had not been rectified at the time of the accident. When rigged in this manner, it may have been possible for the carburettor heat control to reach its maximum travel before the air valve reached the fully hot position, limiting its ability to prevent the formation or removal of, ice within the carburettor.

Safety Sense Leaflet 14 contains the following advice about carburettor icing:

> ***'Recognition and General Practices……***
>
> *f) Always use **full** heat whenever the carb heat is applied: partial hot air should only be used if an intake temperature gauge is fitted and only then if specifically recommended in the approved Flight Manual or Pilots Operating Handbook.*
>
> ***Pilot Procedures***
>
> *a) Maintenance*
>
> *Periodically check the carb heating system and controls for proper condition and operation…….'*

ACCIDENT

Aircraft Type and Registration:	Piper PA-28-140 Cherokee, G-BBBK
No & Type of Engines:	1 Lycoming O-320-E3D piston engine
Year of Manufacture:	1967
Date & Time (UTC):	3 February 2007 at 1713 hrs
Location:	In the sea close to Blackpool Beach, Lancashire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Fatal) Passengers - 1 (Fatal)
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	26 years
Commander's Flying Experience:	110 hours (of which 105 were on type) Last 90 days - 4 hours (flown on the day of the accident) Last 28 days - 4 hours (flown on the day of the accident)
Information Source:	AAIB Field Investigation

Synopsis

The aircraft was returning to Blackpool Airport following a VFR flight from Exeter Airport. The weather conditions at Blackpool were poor, with low cloud and limited visibility. The pilot was unable to locate the airfield visually and, while descending through cloud with a base of around 100 ft, at twilight, the aircraft flew into the sea. It sank in shallow water; neither of the two persons on board survived.

Background to the flight

The pilot had originally planned to go to Blackpool Airport on the day of the accident, to carry out refresher training in the circuit with an instructor from a Flying Training Organisation (FTO) based there. According to his logbook, he had not flown in the preceding three months. However, on the morning of the day of the accident he was telephoned by the Chief Flying Instructor[1] (CFI) of the FTO who left a message with a proposal for a flight.

The proposal was for him to fly a Piper PA-28-140 Cherokee, G-BBBK, from Blackpool to Exeter and back, taking two passengers who were to pick up another aircraft and fly it to Blackpool. The financial terms for the use of the aircraft would be the same as had been arranged on some previous occasions; the pilot would

Footnote

[1] The CFI of the FTO has stated in correspondence to the AAIB that he had relinquished his position as CFI on 31 January, although he maintained that role on a 'de facto' basis until the FTO was closed down at end of May. Where referred to in this report, the term CFI relates to this de facto position.

pay for the cost of the fuel for the flight, at £25 per hour. The pilot responded by leaving a message to say that he could not carry out the flight because he was out of current practice. However, the CFI called him again clarifying that he did not mean for him to fly solo but that a more experienced pilot would accompany him. It was not established whether the pilot understood this to mean that the 'experienced pilot' was an instructor. However, the pilot agreed to this arrangement and shortly afterwards went to the airport.

History of the flight

The accompanying pilot was contacted on the morning of the accident by the CFI and asked if he would go on the flight to Exeter. He agreed and arrived at Blackpool Airport during the morning and made arrangements to refuel the aircraft.

When the pilot arrived at the airport, at around 1200 hrs, the aircraft had reportedly been refuelled to full tanks, and the two passengers were waiting to depart. He went out to the aircraft where he met the accompanying pilot and the passengers, all of whom were associated with the FTO, and they prepared to depart.

The aircraft took off from Runway 25[2] at 1225 hrs and, on climbing through 200 ft to 300 ft, entered cloud. At around 1,000 ft aal, the aircraft came out on top and continued to climb to its cruise altitude. The flight continued above a solid overcast layer of cloud until the aircraft was south of the Liverpool area, where it was clear. The weather conditions were clear for the remainder of the flight and an uneventful landing was made at Exeter at 1431 hrs.

Footnote

[2] Several witnesses saw the departure of the aircraft from Blackpool and commented that it seemed low. One became concerned that the aircraft was not going to clear a railway embankment close to the end of the runway.

The pilot taxied to the north side of the airport where the aircraft was shut down and the passengers disembarked. One went directly to the Aztec aircraft which was to be collected, the other had a conversation with the accompanying pilot. This included a discussion about the amount of fuel on board and a visual inspection of the fuel quantity in the tanks. The accompanying pilot apparently decided it was not necessary to refuel at Exeter and was heard to comment that "they could drop in somewhere on the way back if it became necessary". The opinion of the passenger, an experienced pilot who later flew the Aztec, was that there was sufficient fuel available in the tanks for around 2½ hours of flight.

It was not established whether the pilot himself was involved in these discussions but, from 1442 hrs until 1456 hrs, he was talking on the telephone. He made one call, to his mother, to ask if she could leave some cash out ready for him so that he could pay for the aircraft when he returned; another was to a friend at Blackpool, during which he asked about the weather and was told that it was "still misty".

The aircraft took off from Exeter at 1513 hrs; the Aztec aircraft with the two original passengers departed shortly afterwards. There was no contact between the aircraft en-route and the Aztec landed without incident at Blackpool at 1639 hrs.

A photograph recovered from the pilot's mobile telephone after the accident, showed the view from the aircraft in flight, at 1620 hrs, Figure 1. This revealed the conditions to be VMC, and it was assessed to have been taken in the area of Welshpool Airfield.

The pilot of G-BBBK contacted Blackpool Approach at 1652 hrs and reported his position as overhead Formby, 13 nm to the south of the airport. The controller passed

Figure 1

Photograph taken from G-BBBK in the Welshpool area
at 1620 hrs on 3 February 2007, some 52 minutes before the accident

the latest weather information, which was a visibility of 2,800 m, FEW clouds at 100 ft, BROKEN clouds at 200 ft and the QNH pressure of 1039 mb.

At 1658 hrs, the pilot reported at the Visual Reference Point (VRP) 'Marshside', 3.6 nm to the south-south-west of the airport, and requested a Surveillance Radar Approach (SRA). The controller replied that they were not likely to 'get in' from an SRA because the cloud was solid at 200 ft. The controller then asked if the aircraft was equipped with a transponder; the pilot replied in the negative. The controller advised, therefore, that he would not be able to see the aircraft on radar because the present weather conditions were causing clutter on the screen. At this point the accompanying pilot transmitted to the controller "Well, we're low on fuel so need to get down somehow". ATC then requested whether the aircraft was fitted with an ILS receiver, to which the accompanying pilot responded, in the vernacular, to the effect that there was no navigational equipment available. From this time on, most of the radio transmissions were made by the accompanying pilot.

At 1700 hrs, the controller asked for the altitude of the aircraft. On receiving the reply "2,000 feet", advised that, although there was no radar 'paint', the DF (radio direction finder) showed the aircraft to be north-east of the airfield. The accompanying pilot then asked the controller what he could suggest they do.

By 1702 hrs, the controller was concerned that the aircraft could be in difficulty; he asked the pilot for the number of persons on board. He contacted the ATC Distress and Diversion (D&D) unit and also initiated a 'local standby' for the airport emergency services. He then replied to the earlier question and the only suggestion he could

make was that perhaps the pilot could fly out over the sea, descend and use the airfield NDB or onboard GPS equipment to find the airfield.

At 1704 hrs, in response to a transmission from the aircraft of "inbound from Kirkham", a VRP 5.75 nm to the east, the controller asked if they had any ground contact; the reply was "no, none at all".

The accompanying pilot then said to the controller that they intended to "go out over the sea and descend". The controller advised that Leeds Airport was CAVOK. The reply from the aircraft was that there was not enough fuel on-board to get to Leeds. The controller now dealt with some inbound commercial traffic, directing them to a holding pattern.

At 1710 hrs, the controller asked for the height of the aircraft. The reply, which came from both pilots at once, was "400 ft". He then cleared the aircraft to land on any easterly facing runway. The accompanying pilot requested a QDM (DF reciprocal bearing) and the controller advised it was "138 Class B". For the next two minutes the controller passed several more QDM readings. At 1712 hrs, he requested the aircraft's altitude; the reply was "200 feet". He gave a warning to the pilot about obstructions on the land rising to 242 ft, if the aircraft was to cross the coastline, and then advised that the aircraft was tracking east but was to the north of the field. The accompanying pilot replied "copied", after which there was a brief continuation transmission, in which one pilot appeared to be speaking to the other, to the effect of "go south". The sound of the engine could be heard in the background to this transmission. The controller now advised that he had a faint contact on radar showing the aircraft on the shoreline, but also that it might not be accurate.

He then dealt with some other traffic before calling G-BBBK with updated weather information of overcast cloud at 100 ft. There was no reply to his transmission and, at 1714 hrs, after several further calls, he initiated aircraft accident action.

Location of the accident site

A number of vehicles and an inshore lifeboat searched along the shoreline for the aircraft. A Search and Rescue (SAR) helicopter was tasked from RAF Valley, Anglesey, and arrived in the area at 1815 hrs. The helicopter pilot reported that he had been unable to operate over the water because of the poor weather conditions, but that he was able to hover-taxi at low level along the shore. At 1907 hrs, the wreckage of the aircraft was located by both the inshore lifeboat and the helicopter. G-BBBK had come to rest in shallow water with just the top of its tail section visible above the surface. There was no sign of survivors at the site. Two bodies were recovered from within the aircraft the following morning.

Meteorological information

A meteorological aftercast for the region, obtained from the Met Office, gave the general synoptic situation between 1200 hrs and 1800 hrs and showed a static area of high pressure covering the British Isles feeding a very light north-westerly airflow over the Blackpool area. The satellite image at 1200 hrs showed low cloud covering the area from Blackpool to the south of the Crewe/Ternhill area; further south there was clear sky. For the return flight, extensive stratus cloud was present in the Manchester-Liverpool-Blackpool area with a base at 100 ft to 200 ft, and tops estimated at 1,000 ft to 1,500 ft.

The weather forecast for Blackpool, available for the pilot before the flight to Exeter, was the 1000 hrs to 1900 hrs

Terminal Area Forecast (TAF), issued at 0904 hrs. This contained the following information:

'Surface wind variable direction at 4 kt, visibility 500 m in fog, broken cloud at 100 ft; becoming between 1000 and 1200 hrs, visibility 3,000 m; becoming between 1100 and 1300 hrs visibility 6,000 m. No significant weather forecast and a 40% probability between 1300 and 1900 hrs of CAVOK.'

At 1156 hrs a new TAF was issued, valid from 1300 to 2200 hrs:

'Surface wind variable direction at 3 kt, visibility 1,200 m in mist, fog in the vicinity, broken cloud at 200 ft ;temporarily between 1300 and 2200 hrs, visibility 400 m, broken cloud on the surface; a 30% probability of temporarily visibility between 1300 and 2200 hrs of 4,000 m.'

At 1216 hrs an update to the 1000 to 1900 hrs TAF was issued:

'Surface wind variable direction at 4 kt, visibility 300 m in fog, broken cloud on the surface, temporarily between 1200 and 1900 hrs visibility 1,200 m in mist, fog in the vicinity, broken cloud at 200 ft, a 30% probability between 1200 and 1800 hrs of visibility 4,000 m in mist.'

The METAR for Blackpool issued at 1220 hrs, close to the time of departure of the outbound flight, was:

'Surface wind calm, visibility 1,500 m few cloud at 100 ft, overcast cloud at 200 ft temperature 5ºC dewpoint 4ºC pressure 1041 mb.'

The METAR for Blackpool issued at 1720 hrs, shortly after the accident was:

'Surface wind calm, visibility 2,500 m overcast cloud at 100 ft, temperature 4ºC, dewpoint 3ºC, pressure 1039 mb.'

Airport Low Visibility Procedures (LVPs) were in force at Blackpool throughout the day. This information was broadcast by means of the ATIS. The time of sunset was 1657 hrs.

The weather conditions in the local area around Blackpool in the late afternoon appear to have been similar. The meteorological visibility at both Manchester and Liverpool airports was reported as being 100 m. A satellite image at 1630 hours showed that there was an extensive area of unbroken fog around Blackpool.

Pilot information

The pilot started learning to fly in 1994 at the same FTO from which he departed on the day of the accident. He had also carried out all his initial flying training and subsequent flying there. He qualified for his Private Pilot's Licence (PPL) in August 2003, at which time he had achieved 70 hours of flight time. Since then he had worked towards obtaining an Airline Transport Pilot's Licence (ATPL); he completed the necessary technical exams for this in 2005. He had also been gradually accumulating flight time in order to meet the minimum 150 hours requirement for the flying training element of the Modular ATPL course. In 2006 he recorded three flights, the total duration of which was 3 hours and 45 minutes. His most recent flight prior to the day of the accident was on 28 October 2006. At the time of the accident, he had accumulated a total of 110 hours of flight time and had recorded a total of 1.3 hours of instrument flying experience.

On several occasions, the FTO had offered him the opportunity to fly an aircraft on a ferry or other similar flight. The arrangement was that he would fly the aircraft, sometimes with another more experienced pilot, for the cost of the fuel. These flights appeared to have been annotated with an 'x' in the pilot's personal flying logbook.

The passenger in the accident, who was the accompanying pilot, had a broad experience in general aviation. He had formerly held a PPL with an instructor rating and, in 1990, was issued a Basic Commercial Pilot's Licence (BCPL) for the purposes of instruction only. However, in 1991, he became medically unfit and his licence was withdrawn. He then did not hold a licence again until September 2003, when he obtained a National PPL (NPPL). He had recorded a total flying experience of 1,778 hours and it was reported that also had considerable time as a glider pilot. It was also reported that he had known the CFI for at least 21 years, and had often accompanied less experienced members of the FTO as a safety pilot. His most recent recorded flight prior to the accident was on 27 January 2007.

Regulation of flight

The flight was conducted as a private flight under the terms of the Air Navigation Order (ANO) 2000. There are a number of restrictions within the ANO which apply to PPL licence holders without an Instrument or IMC rating. Two of these are:

- *'a pilot must fly in sight of the surface and must not fly in a visibility of less than 3,000 m.'*
- *'a PPL holder is not allowed to carry passengers unless, within the preceding 90 days, unless he has made at least three takeoffs and three landings as the sole manipulator of the controls of an aeroplane of the same class as that being flown.'*

There are a number of restrictions which apply separately to a NPPL holder, some of which are:

- *'a pilot must not fly when the flight visibility is less than 5 km.'*
- *'a pilot must not fly when out of sight of the surface.'*
- *'a pilot must not fly at night or in circumstances which require compliance with the Instrument Flight Rules.'*

Aircraft details

The PA-28-140 aircraft has a fuel capacity of 41.6 Imp gal, of which 4 Imp gal are unusable, and it uses around 8 Imp gal/hr in normal use. A fuel tank is contained in each wing and a selector valve in the cockpit is used to select fuel from either tank to the engine; fuel cannot be drawn from both tanks at the same time.

G-BBBK was fitted with a combined VHF/VOR radio/navigational unit, but was not equipped with a transponder. An ADF receiver was installed but it is believed that this, and the VOR receiver, were inoperative. The accompanying pilot carried with him a handheld GPS receiver.

Weight and balance

The Basic Empty Weight of the aircraft was 586 kg. The estimated combined weight of the fuel (136 kg) and passenger load (320 kg) on departure from Blackpool was 456 kg, giving a takeoff weight of 1,042 kg. The maximum takeoff weight (MTOW) for the aircraft was 975 kg. The return flight from Exeter with less fuel

and two fewer people on board was within the MTOW limit. For both flights, the Centre of Gravity position was within limits.

Airport information

The aircraft departed from Runway 25 at Blackpool; this runway has an asphalt surface with a Take Off Run Available (TORA) of 799 m. There is a railway line on a raised embankment a short distance from the end of the runway, crossing the departure track. Runway 28 at Blackpool has a TORA of 1,869 m.

There is no VOR beacon located at Blackpool Airport, the nearest being WAL (114.10 MHz), some 22 nm to the south, and POL (112.1 MHz), 56 nm to the east. An NDB (420 KHz), BPL, is located on the Airport; Runway 28 is equipped with an ILS system.

There are a number of significant obstacles along the coastline at Blackpool in the area to the north of the airport, notably Blackpool Tower at 533 ft amsl and an amusement park ride at 242 ft amsl. There is an extensive wind farm offshore in the area.

There are several other airports in the local area, for example Woodvale and Warton, some of which are operational only during weekdays.

Recorded information

Recordings of the ATC communications with the aircraft were available for the investigation. Information from these recordings has been used in the history of flight.

Primary radar information from the radar head located at Blackpool Airport is not recorded although primary and secondary radar information from St Annes radar is recorded. Blackpool Airport ATC screens display both the Blackpool primary and St Annes secondary radar information. St Annes primary radar is available on the ATC screens, if selected, but this source of primary data is not approved for directing aircraft.

Recorded data from St Annes radar, identified as belonging to the accident aircraft, started at 1638 hrs with the aircraft near Mold, North Wales, when it was tracking to the North. Figure 2 shows this track just as G-BBBK approached Blackpool, and ends when radar contact was finally lost at 1713:18 hrs. Radar contact, however, was briefly lost at 1711:01 hrs (the end of the red track) in Figures 2 and 3, before being re-established 1 minute 39 seconds later (the start of the green track) for a further 38 seconds.

Figure 2

Radar track of G-BBBK positioning to land at Blackpool Airport

A radar track for the SAR helicopter was also available. Primary returns from this were evident down to an altitude of around 100 ft. The gap in the radar track of the aircraft suggests that the aircraft was most likely flying below this altitude between 1711:01 hrs and 1712:40 hrs, and after 1713:18 hrs.

Figure 3

Detail of last section of Radar track of G-BBBK.
Lack of data between 1711:01 hrs and 1712:40 hrs suggests that the aircraft was below 100 ft amsl between these times

Wreckage examination

An initial examination of the aircraft wreckage was carried out after the aircraft had been recovered from the sea by the emergency services and transported to Blackpool Airport. The rear fuselage and cockpit roof structure had been removed during the recovery operation. The engine and propeller remained attached to the forward fuselage, the engine having been pushed upwards by impact forces. The propeller blades had suffered from some bending but were relatively undamaged. The left wing had remained attached to the centre section of the fuselage; however, the right wing had separated from the aircraft during the impact sequence, the fuel pipe having been pinched closed where the wing had detached from the fuselage. The damage to the wing leading edges and the separation of the right wing indicated that the aircraft had struck the sea with a small amount of right roll, in a relatively level pitch attitude. Examination of the aircraft's control circuits indicated that there was no evidence of a pre-impact failure or restriction. All the damage identified was assessed as being the result of the impact with the sea or occasioned during the recovery operation. Due to the disruption of the airframe, no estimation of the pre-impact position of the engine controls could be made. The key had been snapped off in the ignition switch in the 'BOTH' magneto position.

Examination of the cockpit revealed that the fuel selector had been positioned to feed from the right tank. The barometric setting on the altimeter subscale was 1046 hPa, the VHF radio was set at 119.95 MHz (Blackpool Approach), the VOR receiver at 114.10 MHz (WAL) and the ADF unit to the 190/440 KHz range, with the tuning dial on 330 KHz.

A more detailed examination of the aircraft was carried out after the wreckage was recovered to the AAIB. Disassembly of the engine indicated that the engine had not suffered any pre-impact mechanical failure, but damage to the carburettor prevented it from being tested; a strip examination revealed no pre-accident defects. Functional testing of the engine ignition system showed

it to have been serviceable and the engine-driven vacuum pump showed evidence of rotation at impact.

The right wing fuel tank contained 3.3 Imp gal of fluid, whilst the left wing tank was found to be full of water. Analysis of the fluid samples recovered from the tanks confirmed that the contents of the left tank were predominantly sea water; the right tank was found to contain approximately 2.4 Imp gal of fuel together with 0.9 Imp gal of salt water.

X-ray images of the altimeter confirmed that the subscale adjustment gear train was intact and remained engaged. Movement of the subscale from its setting of 1046 mb to the pressure setting for Blackpool at the time of the accident, 1039 mb, was found to require approximately one and a half turns of the adjustment knob.

Aircraft records

From June 2003, the aircraft had been maintained in Blackpool by a maintenance/engineering organisation based at Bagby, Yorkshire. The airframe and engine log books indicated that the aircraft had been maintained in accordance with the CAA approved Light Aircraft Maintenance Schedule (LAMS). Certification stamps within the log books that made reference to file numbers, were confirmed by the maintenance organisation to relate to work cards provided and retained by the operator. The FTO, which had operated the aircraft, was in the process of changing ownership at the time of the accident and the new owners had not 'taken on' G-BBBK; this was to continue in operation with the outgoing CFI. No records could be found, either at the FTO or with the outgoing CFI, to support the certification stamps in the log books, as they were reported as having been mislaid during the transfer of ownership. However, the maintenance organisation had retained a copy of the aircraft's last Certificate of Airworthiness (CoA) renewal documentation, which was completed in March 2005. This indicated that the aircraft was compliant with the requirements at that time. The CoA was valid until 28 March 2008 and the aircraft had been certificated in the Private category.

Maintenance documentation requirements

The Air Navigation Order (ANO) 2000 states:

> ***'Aircraft, engine and propeller log books***
>
> *(4) Any document which is incorporated by reference in a log book shall be deemed, for the purposes of this Order, to be part of the log book.*
>
> *(5) It shall be the duty of the operator of every aircraft in respect of which log books are required to be kept to keep them or cause them to be kept in accordance with the foregoing provisions of this article.*
>
> *(6) Subject to article 91 every log book shall be preserved by the operator of the aircraft for a period of at least 2 years after the aircraft, the engine or the variable pitch propeller, as the case may be, has been destroyed or has been permanently withdrawn from use.'*

Analysis

Aircraft serviceability

No evidence was found to indicate that the aircraft had suffered from a structural failure or technical malfunction prior to the impact with the sea. Although the damage observed on the propeller was slight, the damage to the engine-driven vacuum pump confirmed that the engine had been rotating at impact. Given the position of the ignition switch, the successful test of the ignition system and the engine noise heard during the final radio transmission, it is highly likely that the engine

was operating at the time of impact, although no reliable estimation of the engine power setting could be made.

Whilst no technical defect was determined as being a causal factor in this accident, the absence of technical records referred to in the aircraft's log book meant that the aircraft operator had not complied with the requirements of the ANO. However, the available documentation indicated that the aircraft had been maintained in accordance with the requirements.

Pilot-in-command

The relatively inexperienced pilot was paying for the fuel for the two flights, the purpose of which was for him to build up his flight hours. He was seated in the left seat and he was almost certainly handling the controls throughout the accident flight. Thus, he should be considered the pilot-in-command even though he may have called upon the experienced accompanying pilot for help and advice. Nevertheless, it is the responsibility of the pilot-in-command to assure himself that a flight is conducted within the aircraft's operating limits, within his own capability and in accordance with the privileges of his licence.

Flight from Blackpool to Exeter

The weather for the takeoff and first part of the flight to Exeter did not meet the specified minima for visual flight. The pilot had not flown within the previous 90 days and, therefore, was not entitled to carry passengers. The aircraft was over its MTOW by some 67 kg. Moreover, neither pilot was qualified to fly in the prevailing weather conditions. Additionally, the aircraft was not equipped for flight in Instrument Meterological Conditions (IMC).

Why the pilot decided to set out on a flight in weather conditions that were not suitable for his experience and qualifications, and with the aircraft overweight, is not known but a possible explanation may be found by looking at the circumstances which led up to the flight.

The flight had been proposed by the 'de facto' CFI at the FTO. The fact that a person in a position of 'authority' made such a proposal may have led the pilot, who was relatively inexperienced, to think that there were no reasons why the flight should not take place. He had also been told that he would be accompanied by an 'experienced pilot'. Although he would be pilot-in-command, he may have thought that, as the accompanying pilot was more experienced than himself, or possibly that he was an instructor, he could 'take over' if necessary. If this was the case, it is considered unlikely, when he met the accompanying pilot, that he would have questioned his experience or qualifications. In addition, both the passengers were qualified pilots, one of whom had previously held an instructors rating.

By the time the pilot arrived at the airport, much of the planning and preparation for the flights had already been carried out. The accompanying pilot decided how much fuel to put on the aircraft, carried out the refuelling and also checked the weather. Therefore, most of the preparation and decision making for the flight had already taken place. The pilot had, therefore, effectively delegated some of the responsibility for the flight to the accompanying pilot. Whether either pilot gave any consideration to the loading of the aircraft is not known, but this is unlikely as the aircraft was determined to have been some 67 kg overweight at departure.

When the pilot arrived at the airport the passengers were ready and waiting. If the flight did not depart promptly it would not have been possible to return before dark. The pilot did not have a night rating. Thus, there was a time pressure and the pressure of the presence of waiting passengers to depart without delay.

The weather conditions at Blackpool on departure were such that LVPs were in force (as broadcast on the ATIS) and the aircraft entered cloud almost immediately after takeoff. It is not known whether the pilot had checked the weather and was aware this would occur, but he was not licensed or qualified to fly in cloud. It is not known if the pilot listened to the ATIS before departure but, on requesting taxi clearance, it would be expected for him to have advised ATC that he had received the current ATIS information.

The aircraft departed from Runway 25, which is one of the shorter runways available, entered the low cloud layer shortly after takeoff, then climbed and flew above cloud until south of Liverpool. This was not permitted under the privileges of the pilot's (private) licence, as all the flight was required to be conducted 'in sight of the surface'. However, once the aircraft was south of Liverpool, the flight conditions were good and a successful landing was made at Exeter.

Flight from Exeter to Blackpool

The weather forecast at Blackpool seen by at least the accompanying pilot before the flight, indicated that there would be an improvement in visibility to 6,000 m in the afternoon, with a 40% probability of CAVOK later. In reality, the improvement did not occur and the visibility remained poor with low cloud throughout the day. A correction was made to the forecast at 1216 hrs but, by this time, the pilot and his passengers were probably already with the aircraft and not aware of the change. Had the pilot checked the Blackpool weather while he was on the ground at Exeter, the continued poor conditions would have been apparent. It is unlikely that such an update was obtained but the pilot did speak to a friend on the telephone before departing and was told it was still misty.

The photograph at Figure 1 shows that, at 1620 hrs, the weather conditions were good in the Welshpool area and that the surface was 'in sight'. However, the sun was to set 37 minutes later and approximately 50 minutes of flight time remained before the flight was due to arrive at Blackpool.

As the aircraft approached the Liverpool area, the ground below would have become obscured by cloud. The pilot still had the opportunity to turn around and land elsewhere but the deteriorating weather did not act as a trigger for him to divert.

The weather conditions at Blackpool, at the time the aircraft was attempting to land, were not suitable for VFR flight. The cloud ceiling was between 100 ft and 200 ft aal and daylight was fading, conditions that would have made it nearly impossible for a pilot, flying an aircraft without serviceable navigation equipment and without instrument flying training and experience, to locate and land at the airport. There were few options open to the pilot. He was unable to make a safe approach and landing at Blackpool, the aircraft did not have enough fuel to fly to an alternate airport and the onset of darkness would have made it unlikely that a suitable field could be found for a precautionary landing beyond the area covered by cloud. In the event, it seems that he decided to descend through the cloud cover over the sea, in the hope of being able to find the airport from beneath the cloud.

Navigation

It was not possible for the pilots to navigate by visual references as they approached Blackpool as they stated that they had no visual contact with the ground. This had probably been the case for some time as the area of the overcast extended well to the south of Blackpool. The accompanying pilot's reply to ATC to the effect that

there was no navigational equipment available, indicated that either the ADF and/or VOR were not serviceable, or that without a VOR beacon on or close to the Airport, the VOR would have been of limited use. However, as several position reports were given by the aircraft, these were most likely derived from the GPS receiver carried by the accompanying pilot. Although he had asked for DF bearings on several occasions, there was no evidence that the pilot attempted to use either these or GPS information for an approach.

The altimeter subscale was found to be on an incorrect setting after the accident at 1046 mb; the QNH at the time was 1039 mb. It is highly unlikely that the adjustment mechanism could have altered the setting significantly in the accident, as it would have required 1½ turns of the knob. Therefore, if the pre-accident calibration of the altimeter was within normal limits, it is possible that the altimeter had been inadvertently set incorrectly. Such a mis-setting would have put the aircraft some 200 ft lower than indicated to the pilot so that, when they reported to ATC at 1712 hrs that they were at 200 ft, they could actually have been very close to the surface of the sea. This situation is supported by the radar data. The time and distance between the end of the red track and the start of the green track in Figure 3, would indicate that the aircraft did not fly a direct line between these points and that, at around 17:12 hrs, it was probably lower than 100 ft amsl, below radar cover.

Given the prevailing conditions of twilight, a very low and probably indistinct cloudbase, poor visibility and, most likely, a fairly featureless surface, it is highly likely that even when below 100 ft amsl, the pilot would not have been able to see the sea surface, or the coastline, before entering the water.

Aircraft fuel state

When the aircraft arrived in the vicinity of Blackpool Airport, there was insufficient fuel on-board to divert to another airfield. The nearest alternative offered by ATC was Leeds, an airport known to have good weather but some 40 minutes flying time away. Given that the aircraft's fuel tanks were full on departure from Blackpool, and considering the elapsed flight time, there should have been around 7.6 Imp gal of fuel (3.6 of which were useable) on-board at the time of the accident. Although only 2.4 Imp gal of fuel found was found in the right wing after the accident, it is possible that some had leaked away as a result of the accident. Also, as the engine could clearly be heard to be running in the background of the last radio transmission from the aircraft, it is unlikely that the aircraft ran out of fuel.

Supervision of the flights

Although the flight departed from the premises of a FTO, and was arranged at the suggestion of the 'de facto' CFI of that organisation, the agreement made for the use of the aircraft was apparently on a private basis. Therefore, the flight would not be required to be 'authorised' by the FTO.

The presence of a 'more experienced' or 'safety' pilot on board, (a fairly common arrangement in private flying) in addition to the two pilot-qualified passengers, did not alter the fact that the pilot was the pilot-in-command of the aircraft. As such, he was responsible for the decisions made concerning the flight and for its safe conduct, as required by the ANO.

Safety action

The circumstances of this accident are such that many of the rules governing the VFR private flight were not adhered to. As there is no doubt that sufficient information

is available through responsible training organisations, in CAA publications (including the ANO, Safety Sense Leaflets, GASIL, etc) in aviation magazines and via the internet, for private pilots to be reminded of, or make themselves aware of, the manner in which flights are to be conducted within the privileges of their licences, no Safety Recommendations are considered appropriate as a result of this investigation.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28-181 Cherokee Archer II, G-BVOA
No & Type of Engines:	1 Lycoming O-360-A4M piston engine
Year of Manufacture:	1979
Date & Time (UTC):	31 July 2007 at 1302 hrs
Location:	Rochester Airport, Kent
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - 1 (Minor) Passengers - 2 (Minor)
Nature of Damage:	Right wing detatched, damage to forward fuselage and left wing
Commander's Licence:	Private Pilot's Licence
Commander's Age:	71 years
Commander's Flying Experience:	262 hours (of which 74 were on type) Last 90 days - 3 hours Last 28 days - 0.5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The pilot had intended to carry out a local VFR flight from Rochester. During the takeoff run, vibration was experienced, which stopped when the nosewheel lifted clear of the ground. After takeoff, the stall warning sounded and the aircraft's wing was then seen to drop, recover, and then drop again, after which the aircraft landed back on the grass runway. Heavy vibration was again experienced and the pilot became concerned that the aircraft would 'nose over' and so modulated his braking. The aircraft failed to stop before leaving the runway and ran down an embankment, coming to rest next to a public road. The occupants received minor injuries.

History of the flight

The pilot had intended to carry out a local VFR flight, with two passengers, from Rochester Airport. The initial phase of the takeoff was uneventful; the pilot checked that the engine was operating at its maximum speed and that all other indications were normal. He reported that he experienced some vibration from the front of the aircraft during the takeoff run, which he attributed to the nose landing gear, as it stopped when the nose of the aircraft was raised. The aircraft lifted off at approximately 55 kt and was beginning to accelerate when the stall warning horn sounded. The pilot reportedly lowered the aircraft's nose and landed back on the runway. Heavy vibration from the nose landing gear caused the pilot to believe that there was

a danger of the aircraft 'nosing over' and, in an attempt to prevent this, he did not continually use maximum braking. The takeoff had been observed by ATC who reported that, after lifting off approximately one third of the way down the runway, the aircraft's right wing dropped, recovered momentarily, and then dropped again; the ATC officer activated the crash alarm. The aircraft ran off the end of the runway, coming to rest in bushes at the bottom of an embankment adjacent to a public road. The right wing detached during the impact sequence and the occupants, who suffered minor injuries, were assisted from the aircraft by the Airport Fire and Rescue Service. There was no fire.

Investigation

An external examination of the engine showed no evidence of any major failure, and the pilot did not report any loss of engine power during the takeoff run. Examination of the aircraft by the organisation which recovered the aircraft back to the airfield found no obvious reason for the vibration thought to have come from the nose landing gear.

A review of the weight and balance calculations completed by the pilot confirmed that the aircraft's Centre of Gravity position was within limits and that it was approximately 170 lb below its maximum takeoff weight. Photographs of the aircraft immediately after the incident, showed that the flaps were set at the Flap 25 position, which corresponded to the setting detailed in the PA-28-181 Pilots Operating Handbook (POH) for a short or soft field takeoff. The power-off stall speed, at the aircraft's estimated weight in this configuration, would have been approximately 48 kt. The reported weather conditions at Rochester at the time of the accident were a temperature of 23ºC with a light and variable wind of 5 kt.

The PA 28 wing is designed to allow the inner sections of the wing to stall before the outer sections, which allows the ailerons to remain effective at the stall. At high power, the propeller slipstream increases the effective airspeed of the inner portion of the wing, allowing it to produce lift below the 'power-off' stall airspeed. However the airspeed at which the sections of wing outside the propeller slipstream stall remain unaltered. Given the reported lift off speed of 55 kt, a variation in either the wind speed or direction immediately after takeoff may have reduced the aircraft's airspeed below its power-off stall speed, causing sections of the wing outside the propeller slipstream to stall.

Conclusions

The reported speed at which the aircraft lifted from the runway, 55 kt, was close to the POH figure of 48 kt for the stall in its takeoff configuration. In the wind conditions, therefore, it is likely that the wing drops seen by ATC resulted from the wing partially stalling. Once back on the runway, the heavy vibration experienced by the pilot led him to moderate his braking effort, and this may have prevented the aircraft from stopping before the end of the runway.

ACCIDENT

Aircraft Type and Registration:	Reims Cessna F152, G-BLZH
No & Type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1985
Date & Time (UTC):	4 September 2007 at 1400 hrs
Location:	Deanland Airfield, 4 miles north of Eastbourne
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to the left wing and the left elevator
Commander's Licence:	Private Pilot's Licence
Commander's Age:	78 years
Commander's Flying Experience:	932 hours (of which 82 were on type) Last 90 days - 10 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft landed on a short, wet, grass strip and went off the end of the runway.

History of the flight

The pilot flew the aircraft from Rochester to Deanland, near Lewes, in weather conditions described as good, and established the aircraft on long finals for Runway 24. This grass runway is 500 m long. The surface wind was from 290º at 5 kt, which resulted in a slight crosswind from the right. The pilot described the approach as normal and selected full flap with a view to performing a short field landing. After touching down on the runway centreline, the pilot applied the brakes and the aircraft started to drift to the left. The aircraft continued off the end of the runway, to the left of the centreline, with the brakes applied. The left wing struck a low hangar and the aircraft span around through 270º. The aircraft came to rest with the left elevator against the side of the building.

The pilot considered that he should have touched down 50 m shorter and 5 kt slower. He also believed that recent wet weather had made the short grass more slippery.

Comment

The CAA advice to pilots is that when landing on runways where the length is not generous they should ensure that they touch down at, or very close to, their aiming point.

The grass strip at Deanland is 500 m long. The Cessna 152 flight manual gives a landing distance from 50 ft of 1,200 ft (366 m). These performance figures are those achieved by the manufacturer using a new aeroplane and engine, in ideal conditions, and flown by a highly experienced pilot. The CAA therefore strongly recommend that pilots apply a safety factor of 1.33 for take off and 1.43 for landing to give an acceptable safety margin for an out-of-practice pilot, flying in less than favourable conditions and allowing for wear and tear on the aeroplane and engine. They also advise that as short wet grass is slippery pilots should apply an additional safety factor of 1.6. Thus, the landing distance required at Deanland for a Cessna 152 on short wet grass should be 366 m x 1.43 x 1.6 which equates to 837 m.

ACCIDENT

Aircraft Type and Registration:	Reims Cessna F182Q Skylane, G-BHIB
No & Type of Engines:	1 Continental Motors Corp O-470-U piston engine
Year of Manufacture:	1980
Date & Time (UTC):	30 September 2007 at 1215 hrs
Location:	Peterlee Airfield, County Durham
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Propellor tips damaged and possible shock-load of engine
Commander's Licence:	Private Pilot's Licence
Commander's Age:	53 years
Commander's Flying Experience:	889 hours (of which 522 were on type) Last 90 days - 33 hours Last 28 days - 8 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The propeller struck a brick whilst taxiing on grass.

History of the flight

After landing, the pilot taxied the aircraft down the tarmac taxiway but discovered the entrance to the grass parking area blocked by another aircraft. He decided to take a short cut into the parking area across an unmarked area of soft ground. As the nose of the aircraft dipped due to the soft ground, the propeller struck a large brick that was obscured by the long grass. The pilot shut the engine down and vacated the aircraft.

ACCIDENT

Aircraft Type and Registration:	Rockwell Commander 112TC, G-ERIC
No & Type of Engines:	1 Lycoming TO-360-C1A6D piston engine
Year of Manufacture:	1976
Date & Time (UTC):	11 July 2007 at 1900 hrs
Location:	Cranfield Airport
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to left wing, nose cowl and propeller
Commander's Licence:	Private Pilot's Licence
Commander's Age:	N/K
Commander's Flying Experience:	528 hours (of which 281 were on type) Last 90 days - 8 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft touched down with the landing gear in an unsafe condition. During the landing roll, the nose and left main landing gear collapsed, causing the aircraft to veer to the left side of the runway. The left wing, nose cowl and propeller of the aircraft were damaged, but the occupants were uninjured.

History of the flight

The pilot made an approach to land on Runway 21 at Cranfield Airport in good weather conditions. As the aircraft crossed the runway threshold,the pilot reported that he noticed that only the right main landing gear was indicating down and locked. He attempted to go-around but there was insufficient time for the aircraft to respond and it touched down on the runway. As it slowed during the landing roll, the nose and left main landing gear collapsed, causing the nose and left wing to come into contact with the runway. The aircraft veered to the left, coming to rest on the left-hand edge of the runway. The occupants, who were uninjured, exited the aircraft normally via the cabin doors.

The pilot stated that he had checked the landing gear position indications on the pre-landing checks and thought that he had seen three 'greens' after lowering the gear. There were no distractions to divert his attention during the approach.

At the time of writing, the aircraft had not been repaired.

If, during rectification, any pre-accident defects come to light, they will be reported in a future edition of the AAIB Bulletin.

ACCIDENT

Aircraft Type and Registration:	Taylor Monoplane, G-BFDZ
No & Type of Engines:	1 Volkswagen 1600 piston engine
Year of Manufacture:	1986
Date & Time (UTC):	23 June 2007 at 1400 hrs
Location:	Garston Farm Airfield, Marshfield, Wiltshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - None
Nature of Damage:	Engine and main spar detached from fuselage, landing gear bent
Commander's Licence:	Private Pilot's Licence
Commander's Age:	60 years
Commander's Flying Experience:	111 hours (of which 34 were on type) Last 90 days - 21 hours Last 28 days - 6 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

On approach to a farm strip, the aircraft encountered a sudden loss of lift. The pilot applied full throttle and lowered the nose, whereupon the aircraft struck the ground heavily in a nose-low attitude, detaching the engine.

History of the flight

The aircraft was approaching Runway 27 at the farm airstrip after a local flight where the wind was estimated as 250° at 15-17 kt. The approach was normal with an indicated airspeed of 60 kt reducing to 50 kt over the threshold. After the aircraft had passed about 50 metres beyond the threshold, and at a height of about 8 metres, the pilot experienced "a sudden loss of lift, presumably caused by a change in wind conditions". He immediately applied full power and lowered the nose, probably as an instinctive reaction to maintain airspeed. The aircraft struck the ground in a nose-low attitude and the engine and forward bulkhead detached. It came to rest with the tail in the air on the remains of the forward cockpit and the pilot evacuated via the detached canopy with minor injuries.

The pilot cites the cause of the accident as "over control in an attempt to avoid a heavy landing".

ACCIDENT

Aircraft Type and Registration:	Yak-50, G-IIYK
No & Type of Engines:	1 Ivchenko Vedeneyev M-14P piston engine
Year of Manufacture:	1984
Date & Time (UTC):	4 September 2007 at 1100 hrs
Location:	Lee-on-Solent, Hampshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Substantial damage to wings, engines, cowlings and fuselage
Commander's Licence:	Private Pilot's Licence
Commander's Age:	70 years
Commander's Flying Experience:	1,004 hours (of which 181 were on type) Last 90 days - 20 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

While manoeuvring the aircraft on the ground the pilot accidentally increased engine power; the aircraft moved forward and struck a fuel bowser and an adjacent low wall.

History of the flight

The aircraft had landed on Runway 23 and, having cleared the runway, the pilot taxied the aircraft to park on a tarmac area, with no forward obstruction. The chosen area was between a fuel bowser, located behind a low wall, and a hangar. The pilot would normally have parked on an adjacent grass area but this was in the process of being cut and he did not want to obstruct the operation. The engine was running at the normal idle setting of 45% rpm, and the pilot waited for the air pressure to build up as the long taxi, which included several brake applications, had reduced the pressure to 2.5 bar. Aircraft systems such as engine start, landing gear retraction and wheel braking on the Yak-50 are operated pneumatically by compressed air. Air from an engine driven compressor is stored in two spherical bottles (one main, one for emergency in-flight engine start) which are always charged whilst the engine is running. The wheel brakes are operated by squeezing a lever located on the control stick and steering is achieved by means of rudder pedal deflection which allows air pressure to the left or right brake.

The pilot noted that the air was taking longer than normal to recharge and whilst holding the brakes he closed the cockpit ventilation air valve, located below the instrument panel, to allow the air to recharge more quickly. The pilot considered this was necessary as in the high ambient temperature it was difficult to maintain the air-cooled engine temperature below 160ºC. As soon as the air pressure had reached 4 bar, he opened the cockpit air valve and carried out a standard engine run at 65% rpm. During this power increase the brakes held the aircraft stationary as normal. The pilot then released the brakes to apply left rudder and applied a trickle of power. He also operated the brake lever to obtain differential steering in order to turn the aircraft through 180º before shutting down. The aircraft began to turn but then continued straight ahead. The pilot pumped the brake lever without effect and he noted he was moving forward quite quickly despite the throttle being closed.

He reached down, whilst still holding the brake lever to attempt to close the cockpit air valve in order to build up the necessary air pressure for the brakes. The throttle was still at idle power. Realising he was moving towards the low brick wall that surrounded the fuel bowser, he decided shutting the engine down would have more effect in stopping the aircraft. However, as he moved his hand from the cockpit air switch to the magneto switch, he caught the throttle with the sleeve of his flying suit and in doing so inadvertently applied full power. The aircraft then accelerated towards the low wall. The pilot closed the throttle but by this time the landing gear had passed through a gap in the low wall, the wings mounted the wall and the aircraft hit the cab of the fuel bowser. The aircraft came to rest after the propeller struck the windscreen of the cab. The pilot isolated the fuel and shut down before exiting the aircraft uninjured.

Pilot's report

In a very comprehensive report the pilot considered that the cause of the accident was the inadvertent power increase which resulted from catching the throttle in the sleeve of his flying suit. He concluded that there may have been an air leak in the landing gear air system, which resulted in the air pressure depleting more quickly than usual and thus causing the loss in braking effectiveness.

ACCIDENT

Aircraft Type and Registration:	Zenair CH701SP, G-CCSK
No & Type of Engines:	1 Rotax 912 ULS piston engine
Year of Manufacture:	2004
Date & Time (UTC):	2 August 2007 at 1445 hrs
Location:	Netherthorpe Airfield, Nottinghamshire
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Nose wheel assembly and propeller damaged, probable shock-loaded engine
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	51 years
Commander's Flying Experience:	7,315 hours (of which 3 were on type) Last 90 days - 114 hours Last 28 days - 42 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

History of the flight

The aircraft owner was a student pilot who had completed 110 hours of flying training for a Private Pilot's Licence. He had previously flown a Cessna 150 but had recently purchased the Zenair 701.

On the day of the accident, the instructor and student completed two flights together, the first of which was a familiarisation flight. The aim of this flight was to demonstrate the differences between the Zenair 701 and the Cessna 150. During the flight the student pilot occupied the right seat whilst the instructor flew the aircraft from the left seat.

On the second flight, the student occupied the left seat. The flight was planned to include some general handling to be followed by three circuits. The general handling and the first two circuits were uneventful. The instructor reported that during the approach for the final landing, the aircraft's rate of descent increased on short finals. The student applied more power than required during the flare to land, and then closed the throttle; this was followed immediately by a rapid forward control input. The nose gear struck the ground and collapsed, allowing the propeller to contact the ground. The instructor completed his post-crash actions and both crew members exited the aircraft without injury.

The instructor considered that the accident was caused

by the student's lack of familiarity with the Zenair 701, which is more sensitive in pitch than the Cessna 150.

Comment

When occupying the left seat of a Cessna 150, the pilot's left hand normally operates the control yoke, whilst the right hand normally operates the throttle. In the left seat of the Zenair 701, the controls are the other way round; the pilot's left hand normally operates the throttle, and his right hand operates the control column. To recover from a high rate of descent on short finals, assuming that the airspeed is correct, the correct control inputs would be to apply power (throttle forward), whilst raising the nose (control column / yoke back). It is possible that during the final moments of the approach the student, under stress, reverted to the previously learnt hand movements required for recovery from an increased rate of descent.

ACCIDENT

Aircraft Type and Registration:	RAF 2000 GTX-SE, G-HOWL
No & Type of Engines:	1 Subaru EJ22 piston engine
Year of Manufacture:	1997
Date & Time (UTC):	31 March 2007 at 1220 hrs
Location:	Eddsfield Airfield, North Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 Passengers - N/A
Nature of Damage:	Cockpit, rotor, propeller, undercarriage and mast damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	60 years
Commander's Flying Experience:	1,017 hours (of which 207 were on type) Last 90 days - 14 hours Last 28 days - 7 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft experienced a high rate of descent during a downwind takeoff and impacted the ground before the pilot was able to take corrective action.

History of the flight

The pilot had flown to Eddsfield, an unmanned grass airfield near the East Coast in North Yorkshire, where he landed and refuelled. Prior to his next flight he assessed the wind to be approximately 020°/7 kt. He decided to accept the slight tailwind component and use Runway 27 for takeoff, to avoid a 15 ft high hedge at the eastern end of the runway. Before takeoff he switched on the fuel pump, applied carburettor heat, span the rotor up to 200 rpm, selected carburettor heat off and applied full throttle. He reported that the takeoff was normal and that the aircraft climbed rapidly to a height of approximately 160 ft. It then encountered a severe downdraft and descended rapidly. The pilot initially thought the engine had lost power but then saw an indicated airspeed of 50 mph and a normal full power engine speed of 5,220 rpm. He attempted to turn into wind but this resulted in an increased rate of descent.

The pilot turned the aircraft back onto its original westerly heading. This arrested the rate of descent, which nevertheless remained rapid and he attempted to land on the runway remaining ahead of him. The airspeed had reduced to approximately 30 mph but the

pilot did not notice the low speed warning light flashing. This warning light flashes when the airspeed falls below 46 mph.

At approximately 50 ft the pilot lowered the nose of the aircraft and partially closed the throttle resulting in an almost vertical descent. The aircraft impacted the ground on its left side in a shallow nose-down attitude, bounced and rolled to the right. The rotor and propeller were destroyed when the right hand side of the aircraft impacted the ground. The pilot was able to turn the ignition switch off with his foot and vacated the aircraft having sustained superficial head injuries.

Airfield information

Eddsfield Airfield has a single grass runway aligned east-west and is situated on high ground at the head of a shallow valley which slopes down from the airfield in the direction that G-HOWL took off. The airfield guide used by the pilot indicated that turbulence was possible from trees rising to 80 ft on the approach to Runway 27. A website which provided information about the airfield indicated that this runway was 800 m long with a takeoff run available (TORA) of 700 m and a landing distance available (LDA) of 775 m.

Discussion

The pilot considered that experiencing a high rate of descent after takeoff distracted him from monitoring his airspeed. Although he attempted to increase airspeed by lowering the nose, his instinctive reaction to the aircraft approaching the end of the runway was to partially close the throttle. This prevented any increase in airspeed and led to the final vertical descent.

Pilots familiar with the RAF 2000 have stated that the minimum power required speed (MPRS) [1] for this aircraft with a single occupant and full fuel would be approximately 60 mph. The accident aircraft had decelerated to half this speed. At full power, the RAF 2000 fitted with the Subaru EJ22 engine was considered unlikely to maintain level flight at 30 mph and the reduction in the vertical component of lift during a turn would exacerbate the problem.

The angle of climb of any aircraft is reduced by a tailwind on takeoff.

Conclusion

The aircraft experienced a high rate of descent during a downwind takeoff. The pilot attempted to manoeuvre the aircraft and climb at an airspeed at which the aircraft was unlikely to be able to maintain height. Although the pilot lowered the nose in an attempt to recover the aircraft to stable flight, there was insufficient height remaining in which to do so before it impacted the ground.

Footnote

[1] MPRS is equivalent to the best lift/drag speed and is also the best rate of climb speed for a gyroplane.

ACCIDENT

Aircraft Type and Registration:	Robinson R22 Beta, G-UNYT
No & Type of Engines:	1 Lycoming O-320-B2C piston engine
Year of Manufacture:	1989
Date & Time (UTC):	13 January 2007 at 1021 hrs
Location:	Hollis Farm, Tupton, Derbyshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Minor) Passengers - None
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	46 years
Commander's Flying Experience:	2,697 hours (of which 1,500 were on type) Last 90 days - 30 hours Last 28 days - 12 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and examination of the wreckage by the AAIB

Synopsis

Following a successful approach to a low hover, the helicopter was manoeuvring when it struck the ground.

History of the flight

Following a 10-minute local flight the helicopter was returning to its base, which was a private landing site at Hollis Farm. The wind was from the west at 20-25 kt. The helicopter approached over an adjacent field, entered a hover and began to manoeuvre towards the landing site. As the helicopter began to turn, the pilot, who was also an instructor on this type of helicopter, reported seeing the low rotor rpm light illuminating and hearing the associated horn sounding. The helicopter began to descend and struck the ground with the front of the skids. It then nosed over and came to rest in an inverted position. Both occupants were uninjured and vacated the aircraft without difficulty and, having done so, the pilot re-entered the cockpit in order to turn off the engine ignition and the battery master switch.

The pilot inspected the impact site and noted from the ground marks that the left skid had slid approximately 2 ft and then dug into a hole in the ground. He concluded that this was what had caused the helicopter to nose over. He commented that he believed the low rotor rpm warning was due to a 'partial governor failure', which he had experienced previously on another R22 helicopter.

The Hollis Farm landing site is a confined farmyard with a small hangar to the north, and bordered by a single-storey house to the east and the main farm house to the south. The approach to the farmyard is dependant on the wind direction. On this occasion the pilot approached from the west into a large sloping field. His plan was to transition into the hover over the field, turn to the east and then continue forward to land in the farmyard.

Weight and balance

The maximum permitted gross weight for the helicopter is 622 kg. The basic weight for G-UNYT was 400 kg. The pilot reported his weight was 82 kg, the passenger weight to have been 80 kg and the weight of the fuel to have been 33 kg, giving a total weight of 595 kg.

Low rotor rpm warning and governor system

Normal rotor rpm is between 97 and 104%. If the rotor rpm should fall to 95% or below, a low rotor rpm horn will sound and a light will illuminate. A governor system is fitted to assist the pilot to control rotor rpm within the normal operating range. The governor controller, a solid-state analogue circuit box, is mounted behind the left seat. An electrical rpm signal from the right hand magneto is sent to the governor controller, which compares the signal against a datum and applies corrective input forces to the throttle via a friction clutch which can be easily overridden by the pilot. The governor is only active above 80% engine rpm and can be switched on or off via a toggle switch on the right seat collective control.

The collective pitch control lever is positioned to the left of the pilot and on the forward end of the lever is a motorcycle type twist grip throttle. The collective pitch control lever is connected to the main rotor blade pitch change mechanism by a system of control rods that change the main rotor blade pitch collectively. A mechanical linkage correlates the rotor blade collective pitch angle to the engine throttle. As the collective lever is raised more engine power is provided by opening the throttle automatically via the linkage.

Wreckage examination

The engine governor system was inspected by the helicopter manufacturer's representative in the presence of an AAIB Inspector. Information from the maintenance manual indicated that the majority of governor problems are caused by the magneto tachometer contact assembly being out of adjustment or faulty. The sensor connection to the right magneto was checked and appeared satisfactory.

The throttle connection was checked over the full range of movement and found to be functioning correctly. The maintenance manual requirements are for a minimum of 4 lb throttle friction, a minimum moving governor friction of 8 lb with a breakaway friction of 0 to 0.5 lb greater and a minimum 2:1 ratio of governor to throttle linkage friction. The frictions were checked and were within the maintenance manual limits. The pilot, who often flew this helicopter, stated that he had experienced no previous problems with the governor system.

External examination of the engine showed evidence of power at impact. As found, the governor system was selected 'ON', and carburettor heat was selected partially towards the 'HOT' position, and the mixture control was fully rich.

Discussion

The pilot described hearing the lower rotor rpm warning. However no cause could be found for a loss of rotor rpm. No faults were found in the governor system. The helicopter manufacturer and other operators of the

type have stated that the governor system is extremely reliable and there is no history of 'partial governor failures'. No previous governor problems had been experienced on G-UNYT and therefore a failure, although though not impossible, appears unlikely.

When the helicopter enters the hover, the pilot raises the collective lever and the governor system responds by opening the throttle to maintain the rotor rpm. It is necessary to remain relaxed on the twist grip control to allow the governor to operate. It is possible that if the throttle is gripped too tightly then the governor actuator can be prevented from moving the throttle.

In a still-air hover the amount of power required is reduced due to the effect of increased air pressure or 'ground cushion' below the rotor disk. This effect reduces as airflow, or wind, increases. At the time of the accident G-UNYT would have been close to its maximum weight. In the hover, with a wind of 20-25 kt, it is possible that, at this weight, there would have been a negligible margin of power. Thus the low rotor rpm warning could have been triggered if the collective lever had been raised in response to a descent and, without any more power available, the rotor rpm would start to decay.

ACCIDENT

Aircraft Type and Registration:	Schweizer 300, G-JAMA
No & Type of Engines:	1 Lycoming HIO-360-G1A piston engine
Year of Manufacture:	2004
Date & Time (UTC):	7 September 2007 at 0905 hrs
Location:	Biggin Hill Airfield, Kent
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Tail rotor driveshaft sheared, tail rotor destroyed and cabin pierced by one tail rotor blade
Commander's Licence:	Student
Commander's Age:	32 years
Commander's Flying Experience:	30 hours (of which 30 were on type) Last 90 days - 18 hours Last 28 days - 6 hours
Information Source:	Aircraft Accident Report Form submitted by the Operator

Synopsis

As the helicopter started to lift, it began to yaw rapidly anticlockwise. It fell off the helipad and the tail rotor struck the ground. The tail rotor driveshaft sheared and parts of a tail rotor blade penetrated the cabin injuring the pilot.

History of the flight

The student pilot was planned to fly a solo, land-away, navigation exercise, as part of his PPL(H) course. He had flown the route three days earlier with an instructor. He was considered, by his instructor, to be an above average student. The weather conditions were good with a variable light wind.

The aircraft was parked on a tarmac helipad which was approximately four inches above the surrounding grass and near to a hangar. Once the pre-flight checks were completed the student raised the collective lever to take off. The aircraft started to yaw rapidly, with the nose of the aircraft going to the left (the same direction as the main rotor blades). The aircraft completed one and a half revolutions without leaving the ground. During these revolutions, the aircraft drifted towards the edge of the helipad. The back of the aircraft went off the edge of the helipad, which caused the aircraft to pitch up, and the tail rotor struck the ground.

The tail rotor blades broke into pieces and the tail rotor driveshaft sheared. A part of one of the tail rotor blades went through the aircraft's skin at the back of the cockpit and penetrated the pilot's seat causing him an injury that required four stitches. The aircraft was shut down and the pilot vacated normally.

The student believed that there may have been a fault with the aircraft, but a thorough examination found no pre-existing defects that would have caused the accident.

ACCIDENT

Aircraft Type and Registration:	Escapade Jabiru (3), G-PADE
No & Type of Engines:	1 Jabiru 2200A piston engine
Year of Manufacture:	2004
Date & Time (UTC):	9 September 2007 at 1344 hrs
Location:	Lydd Airport, Kent
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Broken propeller and landing gear, abraded wing tip
Commander's Licence:	Private Pilot's Licence
Commander's Age:	55 years
Commander's Flying Experience:	393 hours (of which 66 were on type) Last 90 days - 17 hours Last 28 days - 9 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

During a crosswind landing the aircraft touched down whilst drifting to the left. The left wing tip touched the runway and the left landing gear failed allowing the propeller to make contact with the runway.

Aircraft description

The Escapade is a two-seat, three-axis, high-wing aircraft that can be fitted with either a nose or tail wheel. The aircraft involved in this accident had been assembled from a kit, by the pilot, in the tail wheel configuration.

History of the flight

On the day prior to the accident the pilot had flown his first cross-channel flight as pilot-in-command to Abbeville in France. The accident occurred the following day as he returned to his private farm strip via Lydd Airfield, in loose formation with the three other similar sized aircraft that had joined him on the trip.

The pilot reported that the flight to Lydd took about three hours and he contacted Lydd Approach before joining overhead for a landing on Runway 03. He reported that as he started to round out, the aircraft ballooned about four feet into the air before it settled back towards the runway. Then, just as the aircraft was about to touch down, it weathercocked into wind. The pilot said he corrected this movement by applying left rudder, but the right wing lifted and the aircraft started to drift to the left. The left main wheel touched down and shortly afterwards the left wing tip made contact

with the runway. Almost immediately the left landing gear broke away from the aircraft, the propeller struck the runway and the aircraft slewed to the left coming to rest approximately 90º across the runway. The pilot, who was unhurt, turned off the magneto switches, the electrical master switch and the fuel before vacating the aircraft.

Weather

ATC at Lydd commented that due to the coastal effects it is not unknown for the wind direction to vary along the runway. ATC records show that at 1320 hours the wind was from 120º at 6 kt and just after the accident, at 1350 hours, it was from 150º at 8 kt. It is, therefore, probable that the pilot landed with a slight tail wind.

Pilot's comments

The pilot's report contained a very honest account of the factors that he felt contributed to the accident. He commented that he felt tired as he neared the end of the flight, which he believed was probably a result of the nervous energy generated by his first solo flights across the channel. He normally operated from a small grass strip which demanded his full concentration, but the combination of his tiredness and the long asphalt runway at Lydd meant that he relaxed and let his concentration drop. When things started to go wrong he was reluctant to go around, given the size of his aircraft and length of the runway, and remembers being conscious of what people might say. The pilot concluded his report by saying that he had learned a huge lesson.

ACCIDENT

Aircraft Type and Registration:	Mainair Blade, G-MZMB
No & Type of Engines:	1 Rotax 462 two-stroke piston engine
Year of Manufacture:	1998
Date & Time (UTC):	14 April 2007 at 1807 hrs
Location:	Mellor, Blackburn. Lancashire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Serious) Passengers - 1 (Serious)
Nature of Damage:	Microlight destroyed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	47 years
Commander's Flying Experience:	393 hours (of which 123 were on type) Last 90 days - 4 hours Last 28 days - 1 hour
Information Source:	AAIB Field Investigation

Synopsis

The microlight was returning to Higher Barn Farm airstrip, east of Preston, when the engine began hunting from low to moderate power. After several cycles the engine stopped and the pilot attempted to carry out a forced landing in a grass field. The airspeed decayed and the microlight probably stalled, undershooting the intended landing area, and collided with a substantial hedge. Both the pilot and passenger received serious injuries. It was highly likely that fuel starvation, due to a lack of fuel, was the cause of the engine failure.

History of the flight

The pilot was carrying out the fourth flight of the day in his microlight aircraft which he based at Higher Barn Farm, a privately owned grass airstrip. His first flight was one solo circuit to confirm that the microlight was operating normally, before he carried passengers later that afternoon. His first passenger arrived at about 1245 hrs and was provided with safety clothing and a protective helmet. A safety briefing was given and, following a normal start and departure, a flight in the local area was conducted at about 2,000 ft. The microlight returned some 15 to 20 minutes later and parked adjacent to the hangar.

Having met his next passenger, the pilot refuelled the microlight. Firstly, he measured out a quantity of two-stroke oil and poured it into the single fuel tank, which had a capacity of 24 litres. He then filled the tank with petrol, which mixed with the oil to make the correct

two-stroke mixture. After refuelling, the pilot started the engine on the third attempt, and let it run for a short period before shutting it down. The passenger, who was himself an experienced microlight pilot, then occupied the rear seat and the pilot sat in the front seat.

The microlight departed at approximately 1530 hrs, initially landing at Pilling Sands where the engine was shut down. Before he took off to fly to Middleton Sands for refreshments, the pilot rang Heysham power station to advise them that he would shortly be flying past,. No times were recorded for these flights. The pilot reportedly checked the fuel quantity before departing Middleton Sands and noted that the tank was approximately half full. After departing Middleton Sands, the microlight flew south along the M6 motorway, to Preston, and then east, to the area of Mellor and Salesbury, northwest of Blackburn. After flying around the general area, it was then flown back towards Higher Barn Farm airstrip.

Witnesses on the ground at Nab's Head, heard the sound of a microlight approaching. Initially, the engine sounded normal but it began a 'hunting' sound before coming into their view, at a low height. It was heading southwest. The engine sound then stopped and the microlight disappeared into a valley and out of sight.

The witnesses rang the emergency services and then went to locate the accident site. They found the pilot and passenger still seated in the wreckage which was entangled in a small thicket of brambles and stout holly trees. Both occupants were seriously injured and the witnesses, one of whom was a nurse, provided first aid until the emergency services arrived. The rear seat passenger, in his conversation with the nurse, stated "the engine just cut out". Both pilot and passenger were evacuated to hospital.

Microlight performance

Data provided by the manufacturer showed that this model of microlight has a fuel consumption of between 9 and 14 litres/hour, depending on the power setting. Its stall speed is approximately 30 mph.

Accident site and microlight examination

It was apparent that during the latter part of its approach, the microlight had cleared the top of a large tree but had then descended rapidly, and landed heavily, before colliding with a boundary hedge/thicket separating two large fields in the bottom of the valley. It had run into the thicket horizontally, at ground level, and the trike was wedged between two holly trees, whose trunks were about 10 cm in diameter. A third, similar, trunk between these two had been knocked down and was apparently the reason for severe facial injuries suffered by the pilot. The wing was entangled in the upper branches of the trees.

Although it appeared that there had been no weight on the wheels as the microlight entered the thicket, tracks made by all three wheels could be discerned some 19 metres before the thicket, and it was apparent that after the microlight had touched-down, it had bounced. It was, therefore, surmised that it had been close to flying speed when it collided with the thicket, and evident that had been brought to a halt in less than the length of the trike.

There was no evidence of any major mechanical failure of the engine, which could be turned by hand and there appeared to be no loss of compression in either cylinder. The ignition system was examined and found to be serviceable, as was the engine-driven fuel pump. Inspection of the fuel system generally found no evidence of blockages, and the fuel filter was free of debris. No evidence of water was found in the fuel system or tank;

the carburettor bowl was found to contain only a small quantity of fuel. The fuel tank was found to contain slightly less than two litres of fuel, with no evidence that any leakage had occurred. The unusable fuel is quoted by the manufacturer as two litres. In addition, the flexible fuel feed pipe, which hangs down inside the tank from the top, was deflected to one side, such that it did not draw fuel from the tank's lowest point.

There is no fuel gauge fitted to this microlight; fuel tank contents are assessed visually through the translucent plastic wall of the tank against a calibrated scale. The location of the tank was such that the pilot would require to lean out to one side, look to the rear and downwards to assess its contents.

The carbon fibre three-bladed propeller was completely intact, and virtually unmarked, suggesting that no power was being developed by the engine at the time of the collision with the thicket.

Discussion

The pilot had suffered severe head injuries and had very little recall of the accident. Whilst the microlight had departed from Higher Barn Farm with the fuel tank full, it was not possible to determine the microlight's flight time after departure or what power settings had been used. The fuel system was intact with no leaks identified and the tank had not ruptured on impact. Therefore, as the fuel tank was found to contain only two litres of fuel after the accident, the available flight time should have been between 1½ hours and 2½ hours, depending on the power set during flight. If the microlight had departed Middleton Sands with the fuel tank half full, there would have been around 11 litres of useable fuel on board, sufficient for between ¾ of an hour and 1¼ hours of flight time, again depending on the power set.

The witnesses were consistent in their evidence of the low height of the microlight as it came into view, with the engine 'hunting' before it stopped. From that height, the pilot had limited options for carrying out a forced landing. He appeared to have been trying to land in one of the large fields in the bottom of the valley but, as the microlight crossed a large tree, it stalled and landed heavily before entering the thicket.

The investigation concluded that the engine had stopped, probably resulting from fuel starvation due to a lack of fuel, and that the pilot was unable to reach a suitable area on which to carry out a forced landing, due to his low height.

ACCIDENT

Aircraft Type and Registration:	Pegasus Photon, G-MTAL
No & Type of Engines:	1 Rotax 277 piston engine
Year of Manufacture:	1986
Date & Time (UTC):	5 September 2007 at 1012 hrs
Location:	Davidstow Moor Airfield, Cornwall
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Damage to wing keel, king post and fuselage pod
Commander's Licence:	Private Pilot's Licence
Commander's Age:	78 years
Commander's Flying Experience:	130 hours (of which 0.15 were on type) Last 90 days - 2 hours Last 28 days - 0 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Just after landing, G-MTAL encountered a gust of wind. The pilot was unable to control the subsequent roll and the aircraft came to rest on the left wing's leading edge.

History of the flight

The pilot was planning his maiden flight in Pegasus Photon, G-MTAL; a single-seat, tricycle landing gear, microlight. Its cross wind limit was a "maximum 8 mph". As it was a single-seat aircraft, another pilot flew a circuit in G-MTAL and confirmed that the weather was suitable for the maiden flight.

The pilot took off in G-MTAL approximately 20 minutes later. Concrete Runway 30 was in use and the surface wind was 315º/3-6 kt. Shortly after getting airborne, the pilot encountered conditions "rougher" than anticipated. On his first approach to land he elected to go around due to turbulence. During his subsequent approach the conditions were "much better", but after touching down, the aircraft encountered a gust of wind and rolled to the left. The pilot was unable to control the roll and the aircraft rotated about its front and left wheel, before it came to rest on the left wing's leading edge. He received a hand injury that required hospital attention.

Pilot's comments

In an open and frank report the pilot stated that the causes of the accident were his lack of familiarity with the aircraft and the wind conditions. Additionally, he agreed that his lack of flying recency was likely to have been a contributory factor. He added that all his previous flying experience has been in weight-shift microlights.

ACCIDENT

Aircraft Type and Registration:	Pegasus Quantum 15-912, G-TUSA
No & Type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	2001
Date & Time (UTC):	31 July 2007 at 1815 hrs
Location:	Weston Zoyland, Near Bridgwater, Somerset
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Minor) Passengers - 1 (Minor)
Nature of Damage:	Aircraft damaged beyond economic repair
Commander's Licence:	Private Pilot's Licence
Commander's Age:	49 years
Commander's Flying Experience:	1,941 hours (of which about 600 were on type) Last 90 days - 32 hours Last 28 days - 17 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

As the aircraft was about to rotate on takeoff, it veered to the right and collided with an adjacent fence.

History of the flight

The pilot intended to undertake a local flight with a passenger who had flown in a microlight on two previous occasions. The surface wind was approximately 270º/5 kt and the pilot chose tarmac Runway 16 for departure. As the pilot began to rotate the aircraft during the takeoff, it veered to the right and collided with a fence near the edge of the runway, which brought it to a stop. The pilot and passenger, who were both wearing full harnesses and helmets, received minor injuries in the accident which left the trike severely damaged.

Comment

The pilot was unable to offer a cause of the accident, other than possible windshear. Given the light wind reported, it would be surprising for this to be the cause of such a loss of control.

The foot rests for both the pilot and passenger were connected to allow either person to use them to steer the nosewheel. An inadvertent passenger input on the right foot rest might have been sufficient to cause it to veer to the right as described.

ACCIDENT

Aircraft Type and Registration:	Skyranger 912S(1), G-CDIU
No & Type of Engines:	1 Rotax 912ULS piston engine
Year of Manufacture:	2005
Date & Time (UTC):	29 September 2007 at 1500 hrs
Location:	Roddige Lane, Lichfield, Staffordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - 1 (Minor)
Nature of Damage:	Front wheel strut bent, propeller damaged, engine and dashboard appear to be pushed in slightly
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	37 years
Commander's Flying Experience:	53 hours (of which 7 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 long and ran off the end of the grass strip into a ditch.

Significant flight details

The 390 m grass Runway 02/20 at Roddige Lane was dry and firm and the grass was short. The wind was from 280º at 10 kt. The pilot reported that he arrived overhead and descended to circuit height to join the pattern.

During the approach, second stage of flap was set and an airspeed of 55 kt was maintained. The pilot recalled thinking that he was a little higher than during a landing he had carried out at the same location on the previous week, but considered the situation was still satisfactory.

By the time the aircraft was half to two thirds of the way along the strip, all three wheels were on the ground. With the stick held fully back and brake pressure applied, however, the pilot found that the aircraft did not respond as normal and it was difficult to stop or steer it. He then became aware that he had reached the end of the strip and had no option but to allow the aircraft to enter a ditch.

The pilot subsequently considered that the aircraft was higher than normal during the approach, and that, combined with the surface conditions, made it too difficult to bring the aircraft under control. With commendable frankness he concluded that it was an error on his part which lead to the accident.

ACCIDENT

Aircraft Type and Registration:	Tipsy Nipper T.66 Series 2, G-ARBP
No & Type of Engines:	1 Volkswagen 1834 piston engine
Year of Manufacture:	1960
Date & Time (UTC):	1 August 2007 at 0910 hrs
Location:	Seighford Airfield, Staffordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Substantial damage to right wing, landing gear and propeller
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	80 years
Commander's Flying Experience:	7,322 hours (of which 366 were on type) Last 90 days - 0 hours Last 28 days - 0 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft encountered sudden turbulence whilst on final approach and subsequently struck an earth bank. A large HGV positioned under the flight path and close to the approach end of the runway was believed to be a major factor in creating the turbulence.

History of the flight

The pilot was flight testing a new propeller and elected to make an approach at 55 mph using 1,900 rpm. The wind was reported as being from 250° at 4 to 12 kt, with CAVOK conditions. A large Heavy Goods Vehicle (HGV) was positioned close to the approach end of the runway and on the extended centreline, and as the aircraft passed over the vehicle, the nose and the left wing of the aircraft rose. The aircraft subsequently hit a bank of earth and sustained substantial damage; the pilot was uninjured. The pilot attributed the accident to the aircraft stalling as a result of encountering sudden and severe turbulence. The pilot had extensive flying experience, including experience of encountering wake vortices from passenger transport aircraft, and he drew on his experience in assessing the cause. The Tipsy Nipper is small single seat monoplane of only 6 m span and 329 kg maximum takeoff weight, and hence has limited tolerance to turbulence.

Airfield information

Runway 31 at Seighford Airfield is 450 yards long, and

is a section of the runway of a disused RAF station. Immediately before Runway 31 on the approach is a paved area used for HGV training.

ACCIDENT

Aircraft Type and Registration:	Team Minimax, G-MYAT
No & Type of Engines:	1 Rotax 447 piston engine
Year of Manufacture:	1992
Date & Time (UTC):	16 June 2007 at 1100 hrs
Location:	1 mile west of Ditchling Beacon, Sussex
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Left wing spar, spinner and propeller broken, starboard floor panel damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	43 years
Commander's Flying Experience:	410 hours Last 90 days - N/K Last 28 days - N/K
Information Source:	Aircraft Accident Report Form submitted by the pilot and telephone conversation

Synopsis

During a cross-country flight the pilot encountered increasingly strong winds. He elected to carry out a precautionary landing, which was not successful.

History of the flight

The aircraft was being flown from a private strip in Norfolk to Sandown, Isle of Wight, with an en route stop for refuelling at Laindon in Essex. At 0730 hrs he had obtained weather information from Norwich Airport which included a wind estimate of 220º at 10 to 12 kt.

After crossing the Thames Estuary, at a point approximately five miles west of Southend, the pilot became aware that the wind was increasing. By the time he reached Tunbridge Wells he considered that he needed to carry out a precautionary landing. He began looking for a suitable site and continued to do so for some 15 minutes. When Brighton came into view he was in the region of Ditchling Beacon.

The conditions became very turbulent, with the aircraft rising and sinking dramatically. He considered that it was wise to land as soon as possible rather than delay his landing in the hope of finding an ideal site. As he descended, it appeared to him that the wind was becoming stronger. He turned on to his final approach with full

flap lowered and an indicated airspeed of 55 mph, at which point his ground speed appeared to him to be between 15 and 20 mph. Nonetheless he considered that the approach was progressing well until he reached a height of approximately 10 feet above ground level, at which point a powerful gust caused the aircraft to roll to the right, through a large angle, prompting him to apply full left rudder and full left aileron. This levelled the aircraft but the left wing then struck the ground which also caused the nose to come into ground contact.

Pilot's comment

The pilot subsequently judged the wind strength to have been 30 to 35 kt at the accident site. He considered, in retrospect, that his choice of landing site involving approaching in the lee of a large hill during strong wind conditions, was not wise.

AIRCRAFT ACCIDENT REPORT NO 5/2007

This report was published on 6 December 2007 and is available on the AAIB Website www.aaib.gov.uk

REPORT ON THE SERIOUS INCIDENT TO AIRBUS A321-231, G-MEDG DURING AN APPROACH TO KHARTOUM AIRPORT, SUDAN ON 11 MARCH 2005

Aircraft Operator:	British Mediterranean Airways Limited (known as BMED)
Aircraft Type and Model:	Airbus A321-231
Registration:	G-MEDG
Location:	On final approach to Runway 36, Khartoum Airport, Sudan
Date and Time:	11 March, 2005 at 0033hrs All times in this report are UTC

Synopsis

The incident was notified to the Air Accidents Investigation Branch (AAIB) on 14 March 2005. By that time the aircraft had returned to the UK where the aircraft's Flight Recorders were interrogated. The AAIB investigation team comprised:

Mr J J Barnett (Investigator-in-Charge)
Mr N C Dann (Operations)
Mr P Wivell (Flight Recorders)

The aircraft was attempting to land at Khartoum by night in conditions initially reported as blowing sand but which were in fact consistent with a forecast dust storm. Runway 36 was in use but the ILS on this runway was out of service. The commander assessed the weather conditions passed to him by ATC and believed that he was permitted, under his company's operations policy, to carry out a Managed Non-Precision Approach (MNPA) to Runway 36. This type of approach requires the autopilot to follow an approach path defined by parameters stored in the aircraft's commercially supplied Flight Management and Guidance System (FMGC) navigation database.

On the pilot's approach chart, which was also commercially supplied but from a different supplier, the final descent point was depicted at 5 nm from the threshold of Runway 36 whereas the FMGC's navigational database had been correctly updated with a recent change to this position published by the Sudanese CAA which placed it at 4.4 nm from the threshold. The discrepancy amounted to a difference in descent point of 0.6 nm from the Khartoum VOR/DME beacon, the primary navigation aid for the non-precision approach.

The pilots commenced the approach with the autopilot

engaged in managed modes (ie the approach profile being determined by the FMGC instead of pilot selections). The aircraft began its final descent 0.6 nm later than the pilots were expecting. Believing the aircraft was high on the approach, the handling pilot changed the autopilot mode in order to select an increased rate of descent. The approach became unstable and the aircraft descended through 1,000 ft agl at an abnormally high rate. The aircraft then passed through its Minimum Descent Altitude (equivalent to a height of 390 ft agl) with neither pilot having established the required visual references for landing. Instead each pilot believed, mistakenly, that the other pilot was in visual contact with the runway approach lights.

When the confusion between the two pilots became apparent, the aircraft had descended to approximately 180 ft agl and the handling pilot commenced a go-around. Between 3.4 and 5.1 seconds later, with the aircraft at a radio altitude of approximately 125 ft agl, in a position approximately 1.5 nm short of the runway, the Enhanced Ground Proximity Warning System (EGPWS) "TERRAIN AHEAD, PULL UP" audio warning was triggered. The correct emergency pull-up procedure was not followed in full, partly because the handling pilot had already initiated a go-around. The minimum recorded terrain clearance achieved during the recovery manoeuvre was 121 ft.

One further non-precision approach to Runway 36 was attempted using selected autopilot modes. The crew were attempting a third approach when they received visibility information from ATC that was below the minimum required for the approach. The aircraft then diverted to Port Sudan where it landed without further incident.

The following causal factors were identified:

1. The pilots were unaware of a significant discrepancy between the approach parameters on the approach chart and those within the navigation database because they had not compared the two data sets before commencing the approach.

2. Confusion regarding the correct approach profile and inappropriate autopilot selections led to an unstable approach.

3. The unstable approach was continued below Minimum Descent Altitude without the landing pilot having the required visual references in sight.

4. The UK CAA's guidance and the regulatory requirements for approval to conduct MNPA were fragmented and ill-defined.

5. The operator's planning and implementation of MNPA (Managed Non-Precision Approaches) procedures included incomplete operational and written procedures and inconsistent training standards.

6. The ability of the installed EGPWS to provide sufficient warning of inappropriate terrain closure during the late stages of the approach was constrained by the lack of a direct data feed from the GPS navigation equipment.

Following this serious incident, significant safety action was taken by the operator and the UK CAA. The AAIB made four safety recommendations.

Findings

1. The UK CAA had no official policy in place at the time of the incident which adequately described all the requirements for MNPA operations.

2. The pilots had not received all the appropriate training in MNPA operations from the operator.

3. The operator had received five feedback forms relating to issues associated with MNPA to Runway 36 at Khartoum.

4. The operator had not processed any MNPA feedback forms received prior to the incident.

5. The operator's Operations Manual recommended avoiding flight into sandstorms.

6. The aircraft was operated into conditions reported as blowing sand.

7. The pilots were passed incomplete or inaccurate information on the visibility at Khartoum.

8. The JAR-OPS1 minimum RVR for the approach was 1,600 m but this was inconsistent with the 1,600 m visibility specified by the Sudanese authorities on the State chart.

9. No check was made that the approach information on the chart agreed with that in the navigation database.

10. MNPA's were only authorised in VMC.

11. An MNPA was commenced to Runway 36 at Khartoum in IMC.

12. At the time of the incident, the operator used charts and databases supplied by different commercial organisations.

13. The FMGC navigation database correctly reflected the most recent revision of the Sudanese AIP which placed the FAF at 4.4 DME from the KTM VOR/DME beacon.

14. The approach charts showed the FAF at 5 DME from the KTM VOR/DME beacon; this position did not reflect the latest Sudanese AIP revision.

15. The autopilot flew the managed approach in accordance with the parameters stored in the FMGC navigation database.

16. The aircraft started its descent in a managed approach mode at KTM 4.4 DME.

17. The commander changed to selected descent mode at KTM 4 DME, believing the aircraft was high on the approach profile.

18. The maximum descent rate achieved during the final approach was 1,728 ft/min at a point where the aircraft was 1,100 ft aal, less than 4 miles from touchdown and whilst in IMC.

19. The approach was unstable as the aircraft passed through 1,000 ft agl.

20. The operator required that a go-around be

flown for any unstable approach in IMC when passing 1,000 ft agl.

21. As MDA was reached, each pilot mistakenly believed that the other pilot was visual with the runway approach lights.

22. No decision calls were made in accordance with the operator's procedures when approaching or at MDA.

23. TOGA power was selected approximately 160 ft below the published MDA, equating to 210 ft below the company MDA.

24. The minimum terrain clearance recorded was 121 ft agl at a position more than 1.5 nm from the runway threshold.

25. Between 3.4 and 5.1 seconds after the go-around manoeuvre had been initiated, an EGPWS pull up warning was triggered.

26. The EGPWS worked in accordance with its design and contemporary certification requirements.

27. It is likely that the EGPWS alert would not have provided sufficient warning time to prevent a CFIT accident.

28. During the EGPWS alert, the sidestick was not maintained in the fully aft position as required by the Emergency Procedure.

29. Since the initial TAWS certification requirements were drawn up, the EGPWS manufacturer has improved the system's design to reduce the CFIT risk areas.

30. A direct feed to the EGPWS of GPS position and accuracy data is necessary to improve EGPWS performance during the late stages of an approach.

31. Recent aircraft manufacturer's revisions to the integration procedures for EGPWS into Boeing and Airbus aircraft require pure GPS data, including GPS accuracy information, to be routed directly to the EGPWS.

32. In this incident, currently certified but not mandated EGPWS integration improvements could have yielded an earlier "TOO LOW TERRAIN" alert.

Safety Recommendations

The following Safety Recommendations have been made:

Safety Recommendation 2007-041

Airbus should revise the expanded information *'Pull up to full backstick and maintain'* of the A320 Emergency Procedure for the EGPWS Alert "TERRAIN TERRAIN PULL UP" to remove any ambiguity about the amount of rearwards sidestick that should be applied.

Safety Recommendation 2007-042

Airbus should expedite publication of guidance material relevant to flight and ground operations by Airbus aircraft types in conditions of blowing sand or low drifting sand.

Safety Recommendation 2007-044

The European Aviation Safety Agency, in conjunction with industry, should review the current TAWS

system design criteria (ETSO-C151a), and installation certification criteria, with particular emphasis on the timeliness of alerting when close to the runway. Revisions to these standards arising from this review should apply retrospectively to all aircraft currently covered by the TAWS mandate.

Safety Recommendation 2007-046

The UK CAA should publish guidance to pilots regarding the appropriate action when faced with a conflict in approach parameters between their approach charts and an FMS database authorised for managed non-precision approaches.

FORMAL AIRCRAFT ACCIDENT REPORTS ISSUED BY THE AIR ACCIDENTS INVESTIGATION BRANCH

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.

2007

1/2007 British Aerospace ATP, G-JEMC 10 nm southeast of Isle of Man (Ronaldsway) Airport on 23 May 2005.

Published January 2007.

2/2007 Boeing 777-236, G-YMME on departure from London Heathrow Airport on 10 June 2004.

Published March 2007.

3/2007 Piper PA-23-250 Aztec, N444DA 1 nm north of South Caicos Airport, Turks and Caicos Islands, Caribbean 26 December 2005.

Published May 2007.

4/2007 Airbus A340-642, G-VATL en-route from Hong Kong to London Heathrow 8 February 2005.

Published September 2007.

5/2007 Airbus A321-231, G-MEDG during an approach to Khartoum Airport, Sudan on 11 March 2005.

Published December 2007.

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