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CONTENTS (Continued)

MILITARY

ADDENDA and CORRECTIONS

(ALL TIMES IN THIS BULLETIN ARE UTC)

ACCIDENT

Aircraft Type and Registration:	Europa Classic, G-HOFC
No & Type of Engines:	1 Rotax 912S piston engine
Year of Manufacture:	1996
Date & Time (UTC):	1 June 2007 at 1450 hrs
Location:	Near Magor, Gwent, South Wales
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:	66 years
Commander's Flying Experience:	Total 1,575 hours Hours on type 1,023 hours (to be confirmed) Last 90 days - 17 hours Last 28 days - 7 hours
Information Source:	AAIB Field Investigation

The accident flight

The aircraft was returning from Bodmin airfield in Cornwall to Uckfield Farm strip, Whitston, South Wales. Witnesses on the ground in the immediate area of the accident described the aircraft flying normally, maintaining height and heading. The engine was running and sounded normal with no changes in power heard. The tail plane suddenly made large and rapid up and down movements, papers and other loose items were then seen to fall from the aircraft. At the same time the horizontal stabilisers separated from the tail followed by the wings folding upwards before they detached from the fuselage. The engine stopped and the fuselage and other aircraft structure fell to the ground, fatally injuring the two occupants.

Technical investigation

Examination of the wreckage at the accident site confirmed that the aircraft had suffered an in-flight structural failure which had resulted in the separation of both wings and tailplanes before the fuselage struck the ground.

The investigation, in which the AAIB is working closely with the Popular Flying Association, is at an early stage; however evidence has been found which may have immediate airworthiness implications to the aircraft type. Irregularities have been found with the structure of the right wing to which the rear lift/drag pin is installed. There is also evidence of movement of the tailplane surfaces beyond the normal range of movements, possibly as a result of flutter.

As a result of these initial findings, the Popular Flying Association has released two Airworthiness Bulletins requiring immediate and repetitive inspections; PFA 247/FSB006 *'Europa Classic and Europa XS Tailplane Flutter Avoidance and Integrity Of Tailplane Attachment'*, and PFA 247/FSB007 '*Europa Classic Integrity of Wing Attachment*'. The content of these Airworthiness Bulletins has been made mandatory in the UK by the issue of Mandatory Permit Directives 2007-005 and 2007-006.

The investigation is continuing and a final report will be published by the AAIB in due course.

INCIDENT

Aircraft Type and Registration:	Beech 90 King Air, OY-JRO
No & Type of Engines:	2 PT6 turboprop engines
Year of Manufacture:	1967
Date & Time (UTC):	9 January 2007 at 1529 hrs
Location:	Cardiff Airport
Type of Flight:	Commercial Air Transport (Non-Revenue)
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	None
Commander's Licence:	Air Transport Pilot's Licence
Commander's Age:	59 years
Commander's Flying Experience:	8,000 hours (of which 2,200 were on type) Last 90 days - 218 hours Last 28 days - 11 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft approached to land at Cardiff Airport with the landing gear not selected down. ATC alerted the pilot and the approach was discontinued. Poor weather and a high cockpit workload probably contributed to the pilot's lapse.

Commander's report

The aircraft was being flown on a positioning flight from Coventry to Cardiff. There were heavy showers in the vicinity of Cardiff, which was also subject to strong crosswinds and associated turbulence. The aircraft was radar-vectored initially, before establishing on the ILS for Runway 30 and, as the turbulence exceeded the auto-pilot's capabilities, the commander flew the approach manually.

The commander thought that he had selected the landing gear down by the time the aircraft reached 1,000 ft aal, as required by his company's procedures. He clearly recalled placing his hand on the control lever, and even applying the usual compensatory rudder trim adjustment. However, the aircraft was in a heavy shower at this point and the noise from precipitation striking the windscreen and airframe would have been expected to mask the sound of the landing gear lowering. The weather conditions were such that the commander's efforts were focussed solely on maintaining an accurate flight path, preventing a check of the landing gear indications until visual flight conditions were achieved. In fact it was a call from ATC, instructing a go-around, which alerted the pilot to the situation. The aircraft subsequently landed without further incident.

Comment

In an open and honest report, the commander attributed the incident to his failure to carry out the standard cockpit checks before landing, though he did not attempt to link this with the difficult flying conditions which almost certainly contributed to his lapse. The pilot also acknowledged the diligence and professionalism of the controller at Cardiff who alerted him to the situation.

INCIDENT

Aircraft Type and Registration:	Boeing 767-31K, G-DAJC
No & Type of Engines:	2 General Electric CF6-80C2B7F turbofan engines
Year of Manufacture:	1994
Date & Time (UTC):	21 October 2006 at 0735 hrs
Location:	Manchester Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 12 Passengers - 278
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Air Transport Pilot's Licence
Commander's Age:	36 years
Commander's Flying Experience:	5,800 hours (of which 4,500 were on type) Last 90 days - 115 hours Last 28 days - 22 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

On the aircraft's first flight since the left engine had been changed, the flight crew experienced burning smells together with smoke on the flight deck. The aircraft returned for an uneventful landing. The source of the smoke was suspected to be oil contamination associated with the replacement engine.

History of the flight

The aircraft was due to fly from Manchester to Palma, Majorca. It was its first flight since a period of maintenance during which the left engine was changed.

The engines were started without incident and the crew were cleared to taxi the aircraft to Runway 24L. As part of the taxi instructions they were also cleared to cross Runway 24R behind a landing Airbus A330. The commander, who was the handling pilot, stated that as they crossed Runway 24R, power was increased on the engines, the first time that any significant power had been used that day. At this point the pilots became aware of a smell of burning rubber and were also notified of a similar smell in the cabin by the Cabin Supervisor. The flight crew considered that the smell might have been due to taxiing behind the landing A330 and decided to delay their takeoff to see if the smell would clear. By the time the aircraft was cleared for takeoff, five minutes later, the smell had gone, both on the flight deck and in the cabin, and as a result the commander was happy to continue the flight. The weather at the time was fine with light winds, good visibility and scattered cloud at 3,000 feet.

Takeoff was commenced but on accelerating through approximately 80 kt the smell returned. The commander decided to continue the takeoff and stated that on becoming airborne the smell became stronger. At the same time faint traces of smoke appeared on the left side of the flight deck. The autopilot was engaged and the pilots donned their oxygen masks. The Cabin Supervisor reported to the flight crew that there were fumes and smoke in the cabin.

The flight crew declared a 'MAYDAY' to ATC, requesting an immediate return to the airport, and they were provided with radar vectors to position the aircraft downwind for an approach to Runway 24R.

The commander made an announcement to the passengers over the cabin public address system, advising them of the situation. He stated that this announcement, made with his oxygen mask on, came across only faintly in the cabin. At about this time the smoke on the flight deck had dissipated sufficiently for the commander to remove his oxygen mask before repeating his announcement to the passengers which this time could be heard more clearly.

The co-pilot completed the checklist for air conditioning smoke and the utility electrical busbar was switched off as an additional precaution. Once the aircraft was on finals, by which time the fumes were far less noticeable, the co-pilot also removed his oxygen mask. The flight crew completed an ILS approach and after landing cleared the runway onto an adjacent taxiway where the left engine was shutdown. The total airborne time was about nine minutes.

Communications were established with the attending fire services who informed the flight crew that there were no external signs of smoke or fire. The aircraft was then taxied to a remote stand using the right engine where the aircraft was shutdown. About eight minutes later steps were brought to the aircraft and the passengers were disembarked and taken by bus to an airport terminal. The commander stated that on boarding the aircraft, the fire service commented on the strength of the lingering odour of burning rubber and advised that the other cabin doors be opened.

Crew debrief

The crew were debriefed after the incident. The company medical adviser was contacted and he provided the crew with guidance on smoke inhalation and re-issued the operator's smoke inhalation policy to them. He also advised the crew to refrain from flying duties for 24 hours.

During the crew debrief it transpired that smoke had activated the rear left toilet smoke detector, prompting the cabin crew to prepare to discharge two fire extinguishers. The cabin crew had attempted to inform the flight crew (who were unaware that the smoke detector had activated) via the aircraft intercom but refrained from interrupting the co-pilot's declaration of an emergency to ATC.

Engineering issues

After the passengers had disembarked, an engineer boarded the aircraft and informed the flight crew that the replacement left engine had not been subjected to high-power ground runs because it had been supplied "pre-tested".

The source of the smoke was suspected to be oil contamination associated with the replacement engine. The operator was unable to establish the source of the oil contamination so the aircraft and engine manufacturer's advice was sought.

The possibility that the engine had been overfilled with oil was considered but discounted by the engine manufacturer because overfilling "does not result in contamination of the compressor and engine bleed off-takes". The manufacturer believed that the most likely reason for the oil smoke was contamination of the gas path during the engine's overhaul or during its installation in the aircraft. Moreover, although the engine had been test-run before installation, there is no test cell monitoring for smoke or smells emanating from the engine bleeds.

A further pilot report relating to cabin smells was submitted four days later when an electrical burning smell was reported. This was cleared by inspection of the cabin air re-circulation system.

INCIDENT

Aircraft Type and Registration:	Britten-Norman BN2A Mk III-2 Trislander, G-BEDP
No & Type of Engines:	3 Lycoming O-540-E4C5 piston engines
Year of Manufacture:	1976
Date & Time (UTC):	14 April 2007 at 0710 hrs
Location:	Stand 8, Jersey Airport, Channel Islands
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 1 Passengers - 3
Injuries:	Crew - None Passengers - None
Nature of Damage:	G-BEPD: left wing tip paint scraped and a small dent Jetstream: right wing tip strobe light lens and upper cover broken
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	29 years
Commander's Flying Experience:	836 hours (of which 36 were on type) Last 90 days - 67 hours Last 28 days - 36 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

Shortly after taxiing from Stand 8 at Jersey Airport, the left wing tip of G-BEDP collided with the right wing tip of a parked empty Jetstream aircraft.

Background information

The operating company's parking arrangement on Stand 8 at Jersey Airport meant that G-BEDP and the Jetstream were parked parallel to each other and the terminal building, facing west (see Figure 1). This had been the arrangements on Stands 8 and 9 since February 2007; prior to this Stand 7 was also available but was then closed due to conflictions with traffic from an adjacent roadway.

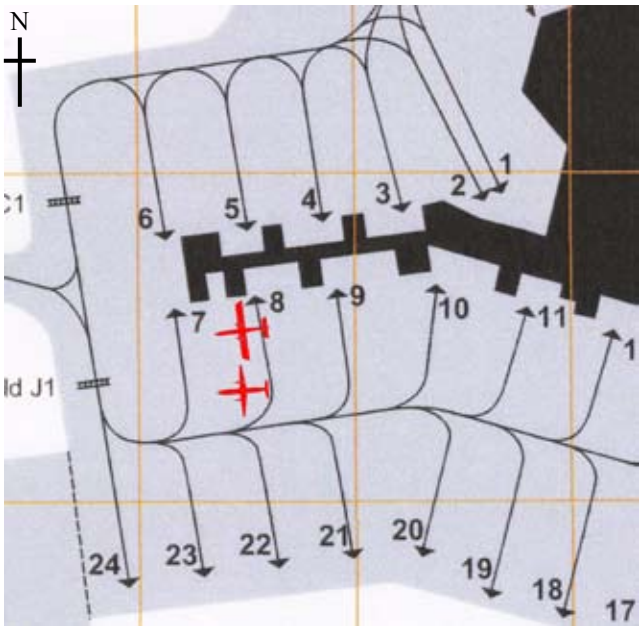


Figure 1

The evening before the incident, G-BEDP was parked on Stand 8 facing west close to the terminal. Later that evening a company Jetstream also parked on Stand 8, just to the left of G-BEDP. G-BEDP was scheduled to depart before the Jetstream the following morning.

History of the flight

The commander reported that prior to boarding G-BEDP, the marshallers brought his attention to the close proximity of the empty Jetstream. He judged that there was enough room to manoeuvre off the stand with the marshallers carefully monitoring both wing tips. This was to be achieved with one marshaller at the left wing tip and another watching the right wing tip whilst stopping traffic from driving across Stand 7. The commander described the position of the wing tips as "when viewed from the front, the wing tips were co-incident but the Jetstream's right wing tip was slightly forward of G-BEDP's left wing tip."

When ready to taxi, the commander repeated his instruction to the marshallers to monitor the wing tips and observed both marshallers giving him a "thumbs up" signal. After releasing the parking brake he advanced the throttle on the left engine to help turn the aircraft slightly right to clear the Jetstream's left wing tip. He then planned to straighten up and taxi off the stand. As the aircraft started to move, the commander looked to his right to check that he still had clearance from the terminal. He then looked left to see that the marshaller on the left wing tip was shaking his head and indicating to him to shut down the engines. The commander applied the parking brake, shut down the engines and instructed the passengers to disembark. He vacated the aircraft and realising that the wing tips had touched, inspected the damage caused. The incident happened during daylight hours.

Marshaller's comments

The marshaller monitoring the left wing tip had also marshalled the Jetstream onto Stand 8 the previous evening. He reported that he had planned to position the Jetstream slightly behind G-BEDP as it was due to depart before the Jetstream in the morning. However, when he indicated to the Jetstream's commander to stop, the aircraft continued forward, stopping with its right wing tip slightly forward of G-BEDP's left wing tip. He added that it was not considered necessary to push the Jetstream back to its intended parking position.

Follow-up action

The operating company's station manager stated that as a result of this incident the company's parking arrangements on Stands 8 and 9 have, in consultation with the airport authorities, been changed. Wing tip clearance requirements between adjacent aircraft have been increased and the aircraft are now parked facing south, away from the terminal. Yellow arrows have been painted on the ground to assist company pilots with the new arrangements.

INCIDENT

Aircraft Type and Registration:	Cessna 750 Citation X, G-CDCX
No & Type of Engines:	2 Rolls-Royce AE 3007C1 turbofan engines
Year of Manufacture:	2002
Date & Time (UTC):	20 September 2006 at 1740 hrs
Location:	Luton Airport, Bedfordshire
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	None
Commander's Licence:	Air Transport Pilot's Licence
Commander's Age:	N/K
Commander's Flying Experience:	8,500 hours (of which 300 were on type) Last 90 days - 20 hours Last 28 days - 10 hours
Information Source:	Aircraft Accident Report Form submitted and AAIB investigation of failed components

Synopsis

As the aircraft reached its cruising altitude, the fluid contents of Hydraulic System A were lost. The crew recalculated the distance required for a landing with this failure, and decided to continue to their planned destination, Luton Airport. As the aircraft slowed down after touchdown, nosewheel steering became ineffective and the aircraft drifted to the left of the runway. The aircraft came to a halt with its nosewheel in the grass at the edge of the paved surface. The aircraft was undamaged. Two defects were identified in the hydraulic system. One of these, a pressure hose failure, had probably been damaged on a previous flight.

History of the flight

As the aircraft reached cruising altitude, on a flight from Newcastle to Luton Airport, the master caution light illuminated, together with a 'LOW FLUID' caution for Hydraulic System A. The crew observed the hydraulic fluid level decreasing on the flightdeck display and, shortly afterwards, the A system Power Transfer Unit (PTU) failed. They completed the non-normal checklist for this problem, which included tripping the PTU circuit breaker. After declaring a 'PAN', the crew recalculated their landing distance requirements and decided to continue to Luton. The loss of Hydraulic System A disabled the left engine thrust reverser and required the landing gear to be deployed using the emergency system. It also meant that emergency braking and nosewheel steering systems would have to be used on landing.

The touchdown was uneventful and, as the aircraft decelerated through 70 kt, nosewheel steering was required to maintain the runway heading. After it had slowed further, nosewheel steering proved ineffective and the aircraft began to drift to the left edge of the runway. It came to rest with the nosewheel on the grass to the side of the runway but with both main wheel on the paved surface. The crew were uninjured and the aircraft was undamaged. The aircraft was recovered from the runway and towed to a maintenance hangar for investigation and rectification.

Hydraulic system description

The Cessna 750 is equipped with two independent hydraulic systems; each is powered by an engine driven pump (EDP). Power for System A is provided by the pump on the left engine and for System B by the pump on the right engine. Both systems provide power for the primary flight controls. System A provides the only power for the landing gear actuators, wheel brakes, nosewheel steering system, the inboard speed brakes and the outboard roll spoilers. In order to provide a secondary power supply in the event of an EDP failure, Hydraulic System A is fitted with a PTU, which is essentially a hydraulic pump driven by pressure from System B. The PTU operates automatically when a drop in system pressure is detected and is fitted with a flow limiter. This prevents an excessive drop in pressure in System B in the event of a fluid leak in System A. In addition, an emergency electric pump pressurises System A should both the left engine EDP and the PTU fail.

In the event of a complete failure of System A, landing gear deployment and emergency braking is provided by a pneumatic source, and nosewheel steering by a hydraulic accumulator. Two valves are fitted in the nosewheel steering system, which allow the system to become pressurised; a blocking (or sequence) valve and a steering shutoff valve. The blocking valve remains closed until it receives a signal from either of the main landing gear squat switches, and the steering shut off valve remains closed until the nose landing gear squat switch is activated. Should either of these two valves fail to open, the nosewheel steering system remains inoperative.

Aircraft examination

Initial examination of the aircraft revealed that two failures were present in Hydraulic System A which had led to the loss of its hydraulic fluid. A pressure hose connecting the PTU to the system had failed, and a leak was present between a pipe union and the hydraulic manifold. After the union had been disassembled, an O-ring seal within the union was found to be defective. Following replacement of the affected parts, tests were carried out on the nosewheel steering system and landing gear squat switches. These revealed that the operating solenoid within the blocker valve was operating intermittently; however, no abnormalities had been reported during routine testing of the system, or by the flight crew, prior to this incident[1]. The valve was removed and, together with the O-ring and the failed pipe, dispatched to the AAIB for detailed examination.

Examination of the O-ring revealed signs of mechanical damage to its outer edge, which were indicative of it having been 'pinched' during installation. There was also evidence of erosion of the edge of the seal face, which appeared to have been produced by a mechanical process; no evidence of any chemical erosion was identified during this examination. It was not possible to determine when the damage to the seal occurred.

Footnote

[1] The available evidence indicated that failures of this valve are uncommon and any reported failures are thoroughly investigated by the manufacturer.

The failed hydraulic hose, Part Number AE1011923H0152, was surrounded by a woven thermal sheath, which was in turn covered by a woven fibre protective outer sheath. The outer sheath had melted in five places along its length, exposing the thermal layer, which was discoloured. In one area, adjacent to the hose end fitting used to attach it to the pressure outlet of the PTU, the thermal layer had been 'blown' outwards; the hose had failed at this point. The damage observed was consistent with the hose having been exposed to abnormally high temperatures; there was no evidence of thermal distress to other components in close proximity. The aircraft's maintenance organisation stated that, prior to this event, Hydraulic System A had suffered a leak, unrelated to the defects described above, whilst the aircraft was in the descent phase of a flight. Due to a high cockpit workload, the flight crew had not tripped the circuit breaker for the PTU prior to landing, so it had remained running for some time before being shut down. They also stated that operation of the PTU with low fluid levels would have resulted in an increase in the temperature of the remaining fluid, and hence the PTU itself.

Conclusions

The failure of the emergency nosewheel steering was the result of an intermittent failure of the steering blocker valve solenoid. The loss of hydraulic fluid from System A was caused by the failure of the pressure hose connected to the PTU, and a damaged O-ring seal in a union associated with the hydraulic manifold. The failure of the O-ring, in isolation, was likely to have resulted in some loss of hydraulic fluid but it was considered unlikely that the rapid fluid loss witnessed by the flight crew would have resulted solely from this defect. The thermal damage to the PTU pressure hose indicated that it had been subject to temperatures beyond its normal range of operation. This would have affected its ability to withstand its normal operating loads. It was possible that the heat damage associated with the failure may have occurred during the incident flight, but it was considered more likely that the prolonged operation of the PTU during the previous fluid leak event resulted in thermal distress to the hose. This went undetected and probably led to its failure on this flight. No other failures of this nature have been reported and therefore no safety recommendations are considered necessary by the AAIB at this time.

ACCIDENT

Aircraft Type and Registration:	DHC-6 Twin Otter Series 310, G-BZFP
No & Type of Engines:	2 Pratt & Whitney PT6A-27 turboprop engines
Year of Manufacture:	1980
Date & Time (UTC):	22 March 2007 at 1750 hrs
Location:	Glasgow Airport, Renfrewshire
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 2 Passengers - 7
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to nose leg and fuselage skin
Commander's Licence:	Air Transport Pilot's Licence
Commander's Age:	62 years
Commander's Flying Experience:	11,623 hours (of which 2,964 were on type) Last 90 days - 148 hours Last 28 days - 59 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot, defect investigation report from operator and follow up telephone inquiries by AAIB

Synopsis

Whilst taxiing after landing, the lower section of the nose landing gear, including the wheel, detached from the nose leg. This resulted from corrosion damage to the screw threads of a lock nut used to secure the wheel fork to the lower extremity of the sliding element of the oleo strut. As a result of this incident, the operator has reviewed and amended their maintenance practices for the nose landing gear on the DHC-6.

History of the flight

After landing on Runway 09, the aircraft was initially directed to Stand 17 but, after making a 110º turn from Runway 09 threshold on to Taxiway Alpha, the crew were re-directed to Stand 22. Whilst taxiing behind two other aircraft, having completed approximately 10º of a left turn into cul-de-sac Mike, the lower section of the nose landing gear, including the wheel, detached from the oleo strut. The aircraft rapidly came to a standstill, resting on the projecting remains of the nose leg, with the underside of the aircraft's nose having made grazing contact with the ground. The crew informed ATC of the situation and requested attendance of the Airport Fire Service (AFS). After shutting shut down both engines, they were informed by both the Tower Controller and the AFS that there was no visible fire. No injuries were reported from the cabin, and the passengers were instructed to remain on board whilst options for evacuating with the aircraft were assessed. Having confirmed that using the

rear airstairs was a viable option, despite the aircraft's nose-down attitude, the passengers left the aircraft via these stairs, assisted by a fireman and the co-pilot.

The crew reported that they had felt a slight thump during the latter stages of the landing roll, at about 10 kt, whilst in the vicinity of the intersection of Runways 09/27 and 05/23. The thump provoked comment on the flight deck, and was described as similar to that produced by a car tyre running over a cat's eye. The crew commented that there is a slight lip on the paved surface in the area of the intersection that usually produces a slight bump during takeoff from Runway 27, but they stated that no bump of any kind had been felt during their previous landing on Runway 09.

Nose landing gear description

The DHC-6 nose landing gear is of a conventional design, incorporating a telescopic oil/gas oleo shock strut. The upper (fixed) section, which forms the cylinder of the shock strut, is attached at its upper end to the fuselage by means of a pair of integral lugs. The rearwards facing half of the lower end of the cylindrical housing is supported by a pillow block attached to fuselage structure; a semi-circular cap passes around the forward half of the housing, and is clamped to the pillow block by two bolts. The cap fitting incorporates a central recess in its outer face, into which a peg on the underside of the upper torque arm engages as the nose oleo extends fully. This arrangement holds the nosewheel in the straight-ahead position during flight in the event of a hydraulic or nosewheel steering system failure.

The lower (sliding) portion of the shock strut comprises the piston tube, the bottom end of which engages a socket in the nosewheel fork. This is secured in place by what the maintenance manual describes as a locknut, but which in practice comprises a large diameter, externally threaded steel barrel, with a shoulder at its lower end. This nut, inserted into the fork fitting from below, engages a female thread cut into the inner surface of the piston tube.

Aircraft examination

An investigation of the incident by the operator's Quality & Safety Department established that, during the aircraft's left turn into Taxiway 'M', the fork section of the gear, complete with its wheel, axle and the lower torque link arm, had detached from the lower end of the oleo strut. In so doing, the separated part of the gear caused secondary damage to the lower fuselage. At some stage during this process, a failure of the lower torque link arm occurred, adjacent to its hinged connection to the upper torque link arm, as a result of overstress. The operator subsequently carried out a detailed technical investigation into the cause of the failure, including an assessment of all relevant maintenance activities.

Failure investigation

The detailed examination of the failed landing gear carried out by the operator found that the nosewheel fork fitting, complete with the nosewheel, had detached from the piston tube due to a breakdown of the thread profiles. This had been caused by corrosion, which allowed the threads progressively to disengage from one another and, ultimately, the fork fitting to wrench free of the strut. Disassembly of the landing gear revealed the following:

- Remnants of a circumferential bead of sealant were found around the periphery of the piston tube where it abutted the top face of the fork fitting. The location of these remains was consistent with the piston tube having been correctly installed in the fork, and the locknut tightened, when the sealant was applied.

- A large disc of sheet rubber, not referenced in any of the applicable technical publications, was bonded onto the underside of the fork fitting, covering the head portion of the locknut and overlapping onto the surrounding regions of the fork. This apparently stemmed from a perceived need to prevent salt-water spray from entering the cavity of the locknut, via a large square cut-out in the head of the nut used to apply torque. (The aircraft is exposed to regular operations from beach landing sites when operating to various Scottish Islands.)

- The semi-circular cap fitting, that clamps the lower part of the leg fixed housing to the pillow block had been installed upside down. The sectional profile of the cap incorporates a large chamfer at its upper corner which prevents the underside of the torque link from fouling the cap at full oleo extension. Because the cap had been installed upside down, fouling had occurred, producing deep indentations on the underside of the upper torque link.

- The lower torque link arm was very stiff to move on its lower pivot connection to the fork housing. The stiffness was caused by over-tightening of the nut (by two full flats, ie 60º) on the bolt that forms the pivot at its attachment to the fork.

- The lower torque link arm was corroded in the vicinity of the bushes installed at its hinged connection to the upper torque arm.

The operator's review of relevant maintenance records established that:

- The nose landing gear assembly, Part No 71-100-29 S/N H430 was first installed in March 1999 but on a different aircraft. In October 2003, at 4,064 hours total time, it was subject to overhaul/repair. It was subsequently installed on G-BZFP in April 2004, at 4,409 total hours and, at the time of the accident, had accumulated a total of 6,566 hours and 11,184 cycles.

- The October 2003 overhaul/repair was carried out at the operator's workshops and included an inspection for corrosion in accordance with the Component Maintenance Manual (CMM) procedures. This had led to replacement of the lower torque link arm and fork assembly, and it appeared that the over-tightening of the torque link pivot bolt occurred at that time. Both the CMM and aircraft maintenance manual required the torque arm to be checked for 'freedom of movement' after re-assembly. The torque links were inspected in August 2004 by an engineer who has since left the company.

- The non-standard rubber sealing disc, bonded to the underside of the fork locknut, was fitted at the time of the October 2003 overhaul/repair.

- In November 2006, the fork fitting was removed from the strut as part of unscheduled maintenance. This was to replace the steering collar thrust washers, which had disintegrated. The work was carried out with the gear housing in situ, but entailed removal of the locknut assembly to allow the fork fitting to be disconnected from the piston tube, and removal of the cap fitting at the strut's lower attachment to the fuselage.

- During re-assembly of the fork to the strut, the rubber disc was re-bonded over the head of the nut. When the cap fitting was re-installed, it was fitted upside down.

Safety action

The Operator has since revised its maintenance procedures as follows:

1. In light of the company's frequent operation of the Twin Otter from beach landing strips:

   a. The aircraft's maintenance program has been amended to include disassembly and inspection of the shock strut piston tube and locknut assembly, to check for corrosion, as part of the annual inspection.

   b. The operator has obtained approval from the manufacturer for wet assembly of the locknut to the piston tube, using an approved primer, in accordance with procedures laid down in the manufacturer's Corrosion Prevention Manual**.**

   c. The interval between inspections of the torque links has been reduced from 2,400 hours to 200 hours.

2. No rubber sealing disc (or any other part not called up in the appropriate documentation) is permitted to be installed, and a quality and safety notice has been issued stressing adherence to the CMM.

3. The manufacturer's attention has been drawn to the lack of guidance in the maintenance manual regarding the need to ensure that the cap fitting at the lower attachment to the fuselage is installed the correct way up. The operator comments that the shape of the cap, with its the very large chamfer giving it a tapered appearance, arguably, could appear visually more correct when installed upside down than when fitted correctly. The maintenance manual instructions called simply for the cap to be re-fitted, and contained no caution highlighting the possibility, or the implications, of it being fitted upside down. At the time of writing, the operator had received no response from the manufacturer; whilst awaiting a response, the operator has issued additional guidance, in accordance with its own internal procedures, which supplement the maintenance manual instructions in this regard.

In view of the safety actions taken, it is not thought necessary for the AAIB to make any Safety Recommendations at this time.

INCIDENT

Aircraft Type and Registration:	DHC-8-311, G-WOWA
No & Type of Engines:	2 Pratt & Whitney Canada PW123 turboprops
Year of Manufacture:	1992
Date & Time (UTC):	31 December 2006 at 1250 hrs
Location:	Newquay (Cornwall) Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 3 Passengers - 51
Injuries:	Crew - None Passengers - None
Nature of Damage:	Frangible fairing on 'touched runway' sensor broken, light abrasion damage to underside of rear fuselage
Commander's Licence:	Air Transport Pilot's Licence
Commander's Age:	49 years
Commander's Flying Experience:	7,250 hours (of which 574 were on type) Last 90 days - 48 hours Last 28 days - 21 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and Quick Access Recorder information

Synopsis

Whilst landing at Newquay (Cornwall) Airport in turbulent conditions, the aircraft's tail struck the runway. Flight data information showed that an excessive pitch attitude had been achieved just prior to touchdown, whilst the airspeed was below the intended approach speed.

History of the flight

The aircraft was operating a scheduled service between Dublin Airport and Newquay (Cornwall) Airport. The aircraft departed Dublin at 1225 hrs, with 51 passengers and a crew of three on board. The aircraft commander was the handling pilot for the flight to Newquay, which was uneventful until the landing phase. Approaching Newquay, the crew initially received radar vectors, before flying a visual approach to Runway 12 with the flap set to 15º. There was overcast cloud at 2,100 ft, with smaller amounts reported at 1,200 ft and 700 ft. There was also a strong and gusty surface wind from the south-west, blowing directly across the runway, which gave rise to moderate turbulence on the approach. The commander reported that his target speed for the approach was 10 to 15 kt above the calculated V_{REF} speed, to allow for the gusty conditions.

The crew experienced a significant downdraught when

below 100 ft above the runway, which caused a large speed fluctuation and attitude change. The co-pilot announced the speed loss and the commander corrected the situation. However, this was followed by a further disturbance at about 10 to 15 ft above the runway. The commander reported that the touchdown was smooth, although a caution light illuminated, alerting the crew to a pitch attitude in excess of 6º. A TOUCHED RUNWAY warning light also illuminated during the landing roll, informing the crew that a sensor beneath the aft fuselage had registered a contact with the runway. The commander did not recall an excessively large pitch attitude during the landing.

Meteorological information

A strong south-south-westerly airflow was affecting the area, ahead of a cold front which was approaching at 40 to 55 kt. The forecast, issued at 0730 hrs, was for a surface wind from 200º(M) at 15 kt, gusting to 25 kt, increasing in strength during the morning to 25 kt, gusting to 38 kt. The 0750 hrs weather report for Newquay Airport showed a southerly wind of 16 kt. Immediately after landing, ATC broadcast a surface wind of 25 to 30 kt with a recent gust to 36 kt.

Aircraft information

According to the aircraft load sheet, the landing mass was 41,649 lbs, which was 349 lbs below the maximum permitted for landing. At this mass, the V_{REF} would have been 108 kt with the flaps set to 15º. In accordance with the operator's Standard Operating Procedures, an additional margin should then be added to the V_{REF} to allow for wind effects. This figure would normally be half of the reported steady wind speed, plus the full reported gust factor, with a maximum total additive of 20 kt.

Landings are normally made with the flaps at 15º, although they can be made with flaps at 35º for specific reasons, such as for short runways. With flaps set at 15º for landing, the maximum acceptable wind strength from the reported direction was 31 kt. Aircraft technical publications alerted crews to the possibility of a tailstrike if the pitch attitude exceeded 6º during the landing.

Recorded data

Flight data from the aircraft's Quick Access Recorder showed that the aircraft initially descended to an altitude of about 2,300 ft, before descending further to 1,300 ft (about 1,000 ft aal). After a further 30 seconds the aircraft commenced its final descent, initially at a low rate of between 200 and 300 ft/min. At an altitude of about 800 ft the aircraft crossed the coastline (indicated by a step change of radio altitude) and thereafter flew a steady descent which averaged between 600 and 700 ft/min. This equated to an approach angle of about 3.4º.

The relevant recorded parameters for the latter stages of the approach are shown at Figure 1. As the aircraft descended on final approach, the speed remained at or above the 118 to 123 kt band (V_{REF}+10 to V_{REF}+15 kt) with a pitch attitude of between 2º and 3º. From about 16 seconds before touchdown, the flight data showed increasing pitch excursions which were countered by elevator input. The recorded pitch and elevator signals became out of phase, and both increased in amplitude as the aircraft continued its descent. This divergence culminated in two significant pitch excursions, at 6 and 2 seconds before touchdown. In the first case, the pitch attitude reached a maximum of 10.5º at a radio altitude of 24 ft, even after a significant corrective nose-down elevator input had been made. The pitch attitude then reduced to between 2º and 3º momentarily, before increasing again to reach 10.6º, at a recorded radio altitude of 11 ft.

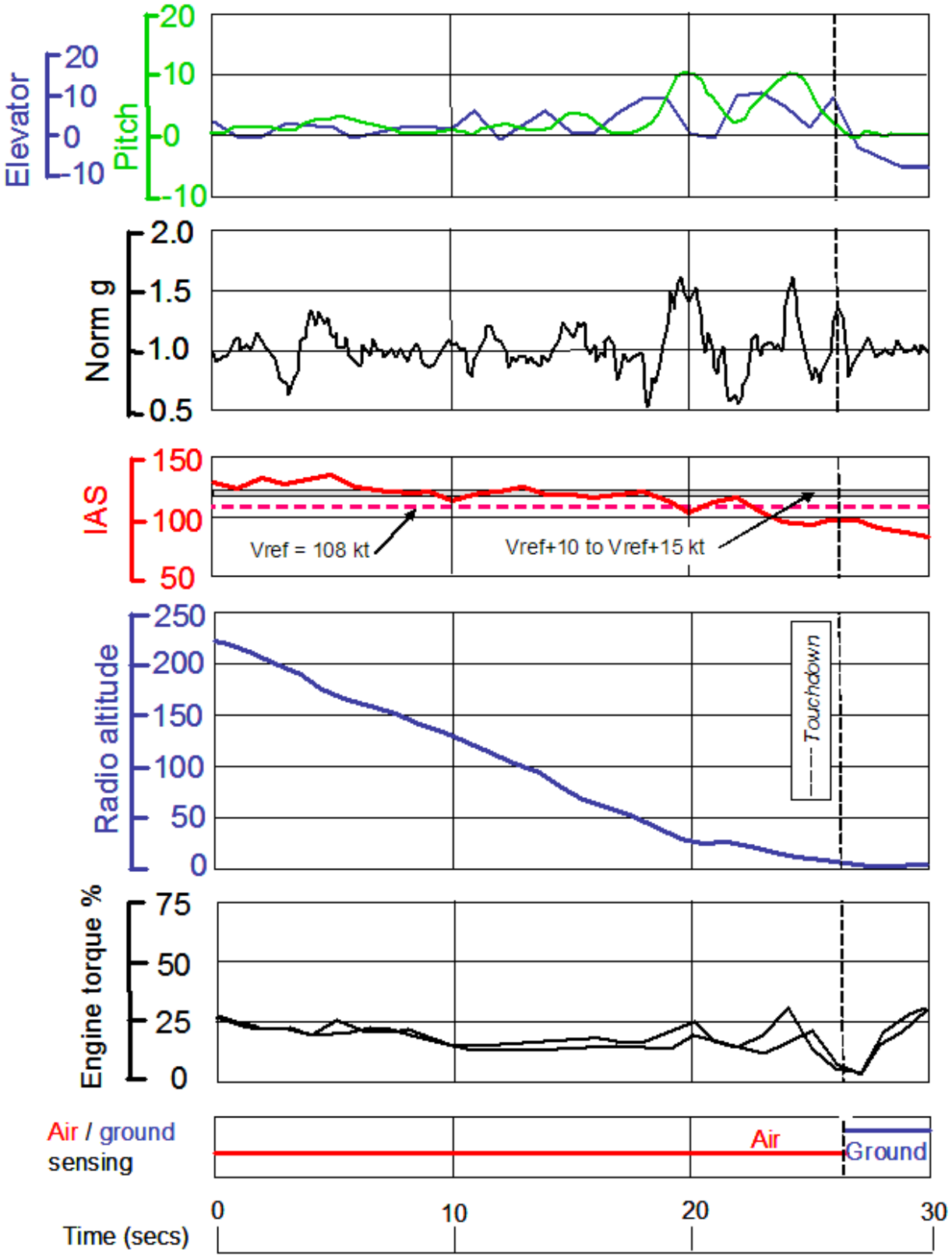


Figure 1

Relevant flight data parameters

During the first significant pitch excursion, the airspeed dropped to 105 kt (V_{REF} -3 kt), before recovering somewhat as the pitch attitude reduced. The airspeed then showed an overall downward trend for the remainder of the landing phase, reducing to 94 kt (V_{REF}-14 kt) at the peak of the second pitch excursion, just prior to the landing. The touchdown itself was recorded with a pitch attitude of 2º to 3º and an airspeed of 98 kt, and the pitch attitude at the point of touchdown was decreasing at a rate of about 5º per second. The peak normal acceleration at touchdown was 1.2 g, which was less than that associated with the two previous pitch excursions (about 1.4 g).

Engine torques remained steady as the aircraft neared the runway, but increased in response to the loss of airspeed associated with each pitch-up event. The maximum torque recorded by either engine below 100 ft was 31.2%. Pitch trim was in use during the approach, varying between 2.7 and 3.8 units of applied trim. During the final 200 ft the pitch trim remained steady at 3.1 units.

Discussion

The flight data showed that a stable approach was achieved initially, but that this became unstable at a late stage, probably due to a combination of the gusty conditions and the associated large control inputs. During the final stage of the approach the airspeed decayed to 94 kt, significantly below both V_{REF} and the target approach speed.

The significant downdraught reported by the commander below 100 ft is likely to be associated with the observed pitch excursion at about 24 ft, and the consequent loss of airspeed. Although some engine thrust was added to counter the speed loss, this was not effective and, after a brief recovery, the speed continued to decay until touchdown. It was during the second pitch excursion, shortly before main wheel touchdown, that the tail most probably contacted the runway. The flight data supports the commander's recollection that the touchdown itself was not at an exaggerated pitch attitude.

INCIDENT

Aircraft Type and Registration:	Jetstream 4100, G-MAJE
No & Type of Engines:	2 Garrett Airesearch TPE331-14HR-805H turbprop engines
Year of Manufacture:	1992
Date & Time (UTC):	11 January 2007 at 0755 hrs
Location:	In the descent passing FL75, 27 nm north of Southampton
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 3 Passengers - 17
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	51 years
Commander's Flying Experience:	17,000 hours (of which 2,000 hours were on type) Last 90 days - 220 hours Last 28 days - 60 hours
Information Source:	AAIB Field Investigation

Synopsis

At about FL75 during the descent into Southampton Airport, the right engine ran down and the propeller speed reduced. The crew suspected that a double engine failure may have occurred and transmitted a 'MAYDAY' call. Subsequently, the left engine was found to respond normally to power lever movements and the 'MAYDAY' was downgraded to a 'PAN' situation. The aircraft levelled at FL70 and the right engine restarted without crew intervention. Both engines continued to operate normally, the 'PAN' was cancelled and an uneventful landing was made at Southampton. The aircraft was fitted with the original version of engine air intakes and had been flying in conditions conducive to ice accretion. A later version of intake, designed to minimise the risk of ice ingestion, is available but it is not currently mandated by the UK CAA for these to be fitted to the Jetstream 4100.

History of the flight

The crew reported for duty at 0610 hrs at Leeds Bradford Airport for a scheduled flight to Southampton. Due to strong winds, extra fuel was carried and potential icing conditions were discussed. It was decided that the 'continuous ignition system' would probably be used throughout the flight. The flight departed at 0649 hrs with the commander as the Pilot Flying (PF) and the

co-pilot as the Pilot Not Flying (PNF). The engine anti-icing and continuous ignition, and propeller de-icing were selected ON, in accordance with the operator's Standard Operating Procedures (SOPs).

As the aircraft climbed to its cruising level of FL190, it experienced moderate turbulence up to FL150, with light-to-moderate airframe icing. During the flight, the crew occasionally heard ice being shed from the propellers, some of which impacted the fuselage, but airframe ice accretion was not sufficient to require operation of the pneumatic de-icing 'boots'. For approximately the first half of the cruise, the aircraft was continuously in cloud; for the second half, it was in and out of the tops of a cloud layer.

During the descent, the ice began to break off and, just prior to the incident, it was noticed that the accretion on the front of the propeller spinners, extended rearwards up to approximately four inches. The aircraft was cleared to descend from FL80 to FL70 and was given a radar heading to intercept the ILS localiser for Runway 20 at Southampton Airport.

The aircraft left FL80 and, as it passed FL75 and entered the tops of a layer of cloud, the crew heard the sound of what they thought were both engines running down. The power levers at this time were almost at the flight idle stop. The autopilot (AP) was engaged and no yaw was initially experienced. Both engine torque indications were perceived by the crew to be at zero and the right engine propeller speed had reduced[1]. After a brief discussion, the crew thought both engines may have failed and the PNF transmitted a 'MAYDAY' call, giving the aircraft's position and stating that they had an engine failure. The PF advanced what he thought was possibly both power levers, in order to level at FL 70, and, as he did so, the aircraft yawed to the right. He disconnected the AP, corrected the yaw and levelled off. He then confirmed that the left engine was operating normally and that the right engine had run down. The PF flew the aircraft manually at FL70, maintaining the intercept heading for the ILS, with the flight director bar set for the localiser. When both the crew had confirmed that only one engine had failed, the 'MAYDAY' call was downgraded to a 'PAN'. Shortly thereafter, the right engine restarted, without the crew performing the engine failure or relight procedures.

The flight crew matched the torque from the engines and, after confirming that their indications were normal, the AP was re-engaged. Following this, the 'PAN' call was cancelled.

Just after the cabin attendant had received the '10 minutes to landing' call from the PNF, she heard an engine run down. She secured the cabin and moved towards the flight deck and from the front right cabin window, she could see the right propeller turning slowly. She then made her way to the rear of the cabin, carrying out her normal pre-landing checks, and spoke to the PF on the aircraft interphone. Having confirmed to the crew that the cabin was secure she was briefed on the situation and instructed that normal landing procedures were to be applied. None of the passengers appeared to notice any abnormality.

The ILS approach was flown using the AP and a normal landing was made. The airport Rescue and Fire Fighting Service (RFFS) met the aircraft. Following a brief update of the RFFS on their dedicated frequency by the PNF that all was normal, the aircraft was taxied to its parking stand and shut down.

Footnote

[1] The manufacturer advises that the airline Operating Manual directs the crew to use propeller speed as the definitive diagnostic indicator for engine failure.

Weather

The synoptic situation at 0600 hrs was that a deep depression of 953 hPa, centred near Iceland, was feeding a gale force westerly flow over the British Isles. An area of frontal cloud and rain was also moving across the southern half of the country. The cloud for the route was 5/8 to 8/8 Stratus base 1,500 ft in thick multi-layers up to 11,000 ft to 12,000 ft. Further layers of cloud existed above 15,000 ft.

A radio-sonde was launched at Larkhill range on Salisbury Plain, approximately 25 nm west of the incident location, at 0638 hrs. This provided data on the winds and temperatures between 7,000 ft and 10,000 ft. The recorded data for the ascent is set out in Table 1 below.

The METARs for Leeds Bradford (EGNM) and Southampton (EGHI) airports covering the relevant times were:

EGNM 110650Z 24026G42KT 210V270 9999 RA SCT010 09/08 Q0992=
EGHI 110750Z 22024G40KT 220V290 9000 VCSH SCT018 BKN026 11/07 Q1010=

Use of Ice Protection Systems

Icing conditions are defined in the Company Operations Manual as:

'Outside air temperature (OAT) on the ground and for take-off is 5°C or colder, or total air temperature (TAT) is 10°C or colder, AND visible moisture in any form is present (such as clouds, fog or mist with visibility of one mile (1600 metres) or less, rain, snow, sleet and ice crystals).

The OAT on the ground and for take-off is 5°C or colder when operating on ramps, taxiways or runways, where surface snow, ice, standing water or slush may be ingested by the engines or freeze on engines, nacelles or engine-sensor probes'.

The Company Operations Manual sets out the following requirements for the use of ice protection systems:

'It is good airmanship to anticipate flight into icing conditions. Whenever possible flight crew should select the anti-ice protection system ON at least one minute before actual entry into such conditions. This serves two purposes; firstly it warms up the components and secondly checks for any malfunction of the anti-ice protection system.

In icing conditions before take-off or if the Captain considers icing conditions are likely to be encountered during the initial climb above 1600ft aal the following anti-ice selections should be made:

Height AGL	Wind speed and direction	Temperature °C	Dew Point °C
10,000 ft	260/80	-5.2	-5.2
9,000 ft	260/80	-3.2	-3.2
8,000 ft	260/80	-1.5	-1.6
7,000 ft	260/80	+0.7	+0.7

Table 1

IGNITERS.	*BOTH ON*
PROP ICE PROT.	*BOTH ON (Short or Long Cycle as required)*
ENG/ELEV ICE PROT.	*BOTH ON'*

The Operations Manual also defines the requirements for takeoff in icing conditions which are:

'If the temperature on the ground is 10° (OAT) or less and icing conditions exist at or below 1600ft AAL, take-off must be carried out with:-

APR armed

Engine and propeller anti-icing ON

Flow Selectors OFF'

The above procedures are consistent with the aircraft manufacturer's Aircraft Flight Manual (AFM).

Additional information

The aircraft manufacturer has advised that they know of only two previous occurrences of icing-related Jetstream 41 engine flame-outs in the last eight years; both occurred in South Africa.

The Met Office, who supplied the data included in the Weather paragraph, offered the following comment:

'*Based on this information* [weather data relating to that encountered by G-MAJE at the time of the engine rundown] *the risk of airframe icing looks to be high, indeed the temperature range-1 celcius through to -5 celcius could be considered the classic range for the phenomena to occur.'*

Flight Recorders

The aircraft was fitted with a Solid State Flight Data Recorder (FDR) and a Cockpit Voice Recorder (CVR). Both recorded details of the event.

The relevant FDR parameters are illustrated in Figure 1. Whilst flying at an altitude of 8,000 ft and an indicated airspeed of around 200 kt, engine torque was reduced from 40% to around 10% on both engines. This initiated a descent rate of around 1,500 ft/min. Total air temperature at that time was recorded as being +8.5°C. As the aircraft passed through 7,500 ft, the right engine speed began to decrease and its torque reduced to 0%. At the same time, the PF noted "SOMETHING NOT QUITE RIGHT THERE". The PNF responded with "TORQUES GONE BOTH DOUBLE FLAME OUT". Four seconds later, the PF responded with "YEAH WE GOT TORQUE ON THE LEFT", which the PNF acknowledged, following which he transmitted a 'MAYDAY' call.

As the right engine speed reduced, the aircraft began to yaw to the right, but this was counteracted by the application of opposite rudder. Torque on the left engine was increased, the autopilot was disconnected and the aircraft levelled at just under 7,000 ft.

Around 73 seconds after the onset of the initial decay, the right engine speed increased from 25% back to 100%; after a further 10 seconds, the right engine torque increased to 44% and, 15 seconds later, torque levels on both engines became symmetrical at 40%. Throughout this incident, the left engine speed was recorded at 100%.

No de-icing or power lever parameters were recorded on G-MAJE.

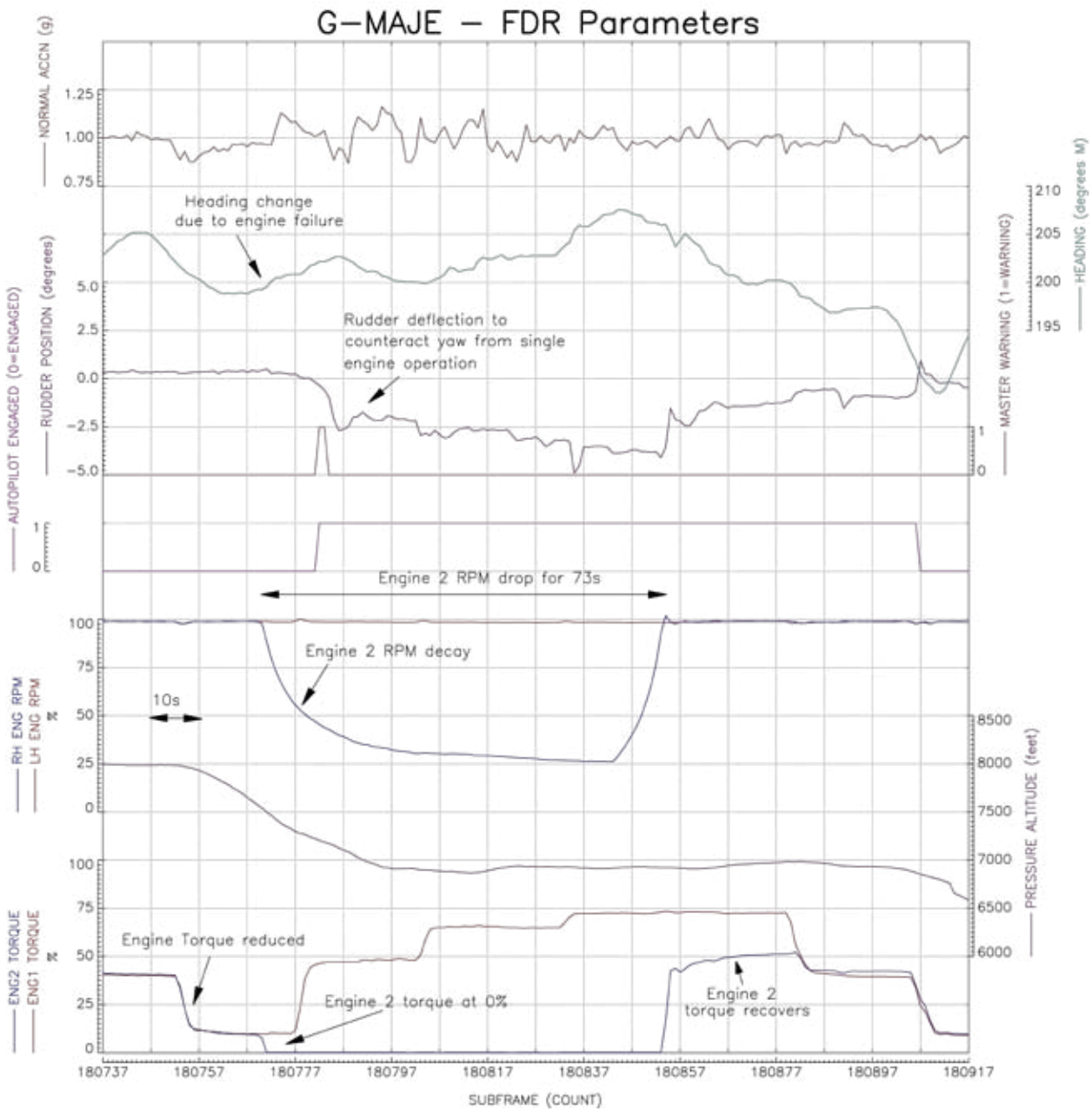


Figure 1

Engineering examination

Subsequent to this incident, the aircraft engines and anti-icing systems were examined and test run on the ground, up to full power. No technical defects were identified and the aircraft was subsequently returned to service.

Both engines were fitted with the original standard of air intake, Figure 2. Although the intake lip region is de-iced using hot air bled from the engine compressor, under certain icing conditions, it is known that ice may build up in the region between the intake upper lip and the spinner. Tests conducted by the manufacturer, following a number of in-flight flameout events soon after entry into service, identified that an airflow reversal occurs above the lip. This can allow accumulated ice to 'slip' down into the engine air intake, when the aircraft flies

into warmer conditions. As a result, a number of design changes were introduced in 1993/94 to improve the intake heating capability and the intake lip profile to reduce its susceptibility to accrete ice. These changes returned the intake to the required airworthiness standard (Service Bulletin J41-A72-001) and, at that time, the AFM was amended to include the requirement of selecting 'continuous ignition' for flight in icing conditions. The continuous ignition system fitted to each engine employs two igniters and should restart the engine within five seconds following a flameout. The manufacturer reports that very few instances of icing related engine flameouts have occurred in the last eight years.

Figure 2

Original standard of air intake fitted to G-MAJE

Subsequently, a modified air intake, Figure 3, was made available for operators of the Jetstream 4100 to fit as a direct replacement, ref Service Bulletin J41-71-031 issued on 24 April 1998. The essential difference is that the upper section of the intake lip is faired to the shape of the spinner. Replacement of this item is not mandated for by the UK CAA, as the original airworthiness issue was addressed by the action stated above. The manufacturer's records show that six sets of intakes have been ordered, but only two are known to have been fitted to aircraft.

Analysis

The crew had the engine anti-icing system selected ON throughout the flight in accordance with the company SOPs. They had monitored the ice building up on the wing leading edges and propeller spinners but judged that it was not severe enough to require operation of the wing/tail leading edge de-icing system. Throughout the flight, the crew occasionally heard ice shed from the propellers impacting the fuselage and, during the descent, the propeller spinner ice accretion also reduced. However, it is likely that ice had accumulated above the upper lip of the air intake whilst flying through the tops of stratiform cloud, where the conditions were conducive to the formation of airframe icing, and slipped down

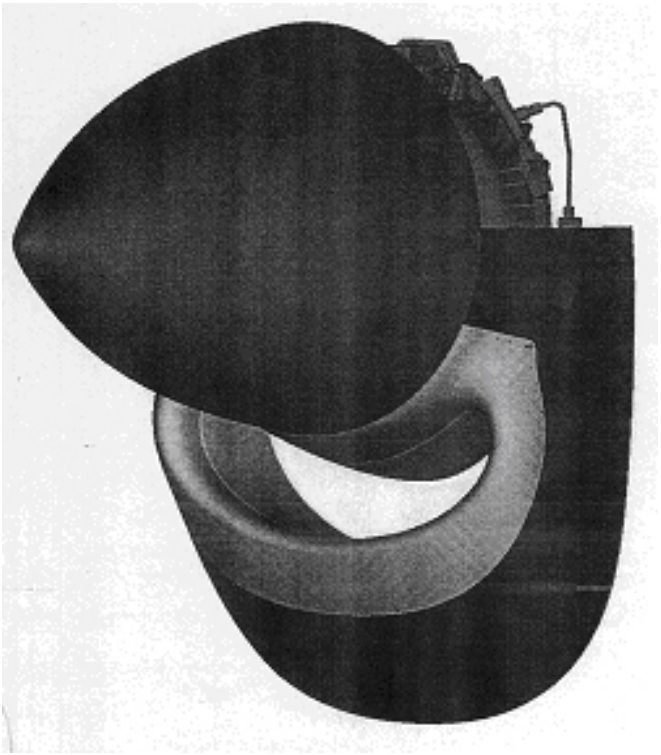


Figure 3

Diagram of the modified standard of air intake

into the intake as the aircraft descended into slightly warmer air.

Before the right engine ran down, both engines were at a low power setting and initially, the low torque indications led the crew to believe both engines had failed, although only the right propeller speed indication, the definitive diagnostic parameter, had reduced. However, the yaw induced when the power levers were advanced, indicated that the left engine was in fact still operating normally.

The crew did not have the time to carry out the procedure to secure the failed engine, or attempt a relight, in accordance with the emergency checklist. Various factors were considered to have led to this situation: the benign nature of the failure, together with the necessary time taken to analyse the problem, the need to maintain control of the aircraft and comply with ATC instructions. In addition, some 62 seconds later, the right engine began an auto-restart as a result of the operation of the continuous ignition system, following which, both engines ran normally.

It was not established why the right engine did not auto-restart within five seconds or why, given that both engines were likely to have experienced exactly the same environmental conditions, only the right engine was affected. Given, also, that there have only been two reported incidences of flameout in the last eight years, the possibility that the right engine was predisposed to flame-out in the 'right' conditions (due to, for example, the condition of the igniters or fuel nozzles) could not be dismissed. Also, the current maintenance checks on the anti-icing system, such as were performed after this incident, address system integrity not the effectiveness of its performance. Since being returned to service, no further reports of problems with the right engine have been received.

Conclusions

In the absence of any technical defects being identified during the examination of the aircraft, it was concluded that the right engine run down may have resulted from the ingestion of ice accretion from the lip of the air intake, formed whilst flying through the tops of a cloud layer with an OAT of around -1ºC to 0ºC. With the standard of intake fitted to G-MAJE, it is a characteristic that ice may occasionally accrete in the region between the upper lip of the air intake and the spinner, in the right conditions, despite the engine anti-ice system being operative. It was not established why only the right engine was affected and why it took a relatively long time to auto re-start, giving rise to the possibility that the right intake and/or the igniters and fuel nozzles may not have been functioning optimally.

INCIDENT

Aircraft Type and Registration:	Let 410 UVP-E, OK-UBA
No & Type of Engines:	2 Walter M601E turboprop engines
Year of Manufacture:	1989
Date & Time (UTC):	18 January 2007 at 1114 hrs
Location:	Ronaldsway Airport, Isle of Man
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 2 Passengers - 2
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to the left tip fuel tank
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	46 years
Commander's Flying Experience:	2,030 hours (of which 1,170 were on type) Last 90 days - 77 hours Last 28 days - 32 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft was taxiing in strong winds for a scheduled departure. During one particular gust the aircraft was tipped briefly on to its left wing tip fuel tank before settling back on to the landing gear. There were no injuries and the aircraft was towed back on to stand with the damage limited to the wing tip fuel tank. The aircraft had been taxiing in winds which were gusting to 57 kt. Since the incident, the operator has introduced a wind speed limit for ground operations.

History of the flight

The aircraft was taxiing for a scheduled departure from Runway 26 at Ronaldsway Airport, Isle of Man. The surface wind was from 260º at 37 kt, gusting to 57 kt; the visibility was good and there were scattered cumulonimbus cloud at 2,000 ft agl.

The aircraft taxied from Stand 11 on the main apron, along Taxiways F and A towards holding point A2. The commander reported that, while he was taxiing out, he decided to abort the flight and return to the stand because of the strength of the wind. As he was approaching holding point A2, and before he was able to advise ATC of his intentions, a strong gust of wind lifted the right wing sufficient for the left wing tip fuel tank to touch the ground. The aircraft then settled back on to its landing gear and the crew brought it to a stop. At the time of the incident the wind was from the aircraft's right quarter.

The Airfield Fire and Rescue Service attended the aircraft but there was no fuel leak and none of the passengers or crew was injured. The passengers were returned to the terminal by coach and the aircraft was towed back on to stand. The left wing tip fuel tank was damaged.

In assessing the cause of the incident, the commander, who had 170 hrs experience as pilot-in-command on the Let 410, stated that he did not realise that the wind at the time was strong enough to lift the right wing.

Aircraft information

The manufacturer does not specify a wind speed limit for ground operations. However, since the incident, the operator has introduced a wind speed limit of 40 kt for all ground operations, with the exception that this can be increased to 45 kt for commanders with more than 300 hrs as PIC on the Let 410. The wind speed at any time is calculated as the sum of the steady wind plus half the gust factor: eg for a steady wind of 30 kt, which is gusting to 50 kt (gust factor 20 kt), the sum equals 40 kt.

ACCIDENT

Aircraft Type and Registration:	Cessna 150F, G-BSZV
No & Type of Engines:	1 Continental O-200-A piston engine
Year of Manufacture:	1965
Date & Time (UTC):	15 March 2007 at 1031 hrs
Location:	Sandown Airport, Isle of Wight
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers – N/A
Nature of Damage:	Noseleg detached, engine frame and cowling distorted, engine and propeller damaged. Minor damage to fuselage skin
Commander's Licence:	Student Pilot
Commander's Age:	69 years
Commander's Flying Experience:	31 hours (of which 31 were on type) Last 90 days - 11 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft unexpectedly rolled left shortly before landing and bounced. The subsequent touchdown was on the nosewheel and the nose landing gear leg collapsed.

History of the flight

The student pilot was making an approach to grass Runway 23 at Sandown to complete his first solo landing of the day, having earlier conducted two landings with an instructor. The wind was reported to be 230°/10 kt. During what he considered to be a normal approach, the student selected full flap at 400 ft agl, advised the AFISO that he was on finals, selected carburettor heat COLD at 250 ft and crossed the runway threshold at approximately 10 ft. He stated that as he raised the nose to flare for touchdown a gust of wind, which he judged was from the north-northwest, caused the aircraft to roll to the left. He applied right rudder and right aileron inputs but was unable to level the aircraft.

The student judged that the aircraft was unstable and decided not to attempt a go-around. On touchdown, with full right rudder still applied, the nose landing gear leg collapsed and the aircraft continued for a short distance before coming to rest in a nose-down attitude with the base of the engine cowling on the runway surface. There was no fire. The student switched off electrical power and

vacated the aircraft, uninjured and without assistance. The aerodrome fire and rescue service attended shortly afterwards.

Although the student pilot did not recall it, the AFISO on duty at the time of the accident stated that the aircraft bounced following its first touchdown and that the subsequent touchdown was on the nosewheel. Ground marks identified by the AFISO as having occurred during the accident sequence indicated that the aircraft had touched down more than once.

Engineering inspection

The nose leg failed at its attachment to the engine mount and rotated aft, causing damage to the base of the engine cowling and lower fuselage skin aft of the firewall. Contact with the runway damaged the propeller and shock-loaded the engine. There was no evidence of any pre-existing mechanical defect which might have contributed to the incident.

Discussion

Inexperienced pilots might be tempted to control a bounce on touchdown by lowering the nose of the aircraft, which will usually result in a touchdown on the nosewheel with a high rate of descent. The nose landing gear of most aircraft is intended to provide stability and control on the ground but not to support the loads encountered on first contact with the runway during landing. Also, the nosewheel of the Cessna 150 is turned whenever an input is made on the rudder pedals. Consequently, when the student pilot landed with full right rudder applied, the nosewheel would also have been turned to the right, increasing the load on the nose landing gear leg when the nosewheel touched the runway surface.

ACCIDENT

Aircraft Type and Registration:	DH82a Tiger Moth, G-AXXV (DE992)
No & Type of Engines:	1 De Havilland Gipsy Major 1C piston engine
Year of Manufacture:	1944
Date & Time (UTC):	19 June 2007 at 1358 hrs
Location:	Membury Airstrip, Wiltshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to propeller, engine shock-loaded, damage to right upper and lower left wings
Commander's Licence:	Private Pilot's Licence
Commander's Age:	54 years
Commander's Flying Experience:	564 hours (of which 507 were on type) Last 90 days - 11 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft was landing on a grass airstrip when it was caught by a gust of wind, causing it to rotate to the right and come to rest on its nose.

History of the flight

The aircraft was being flown to Membury Airstrip to have some minor maintenance carried out. The approach was made towards a mown grass strip on the airfield, which afforded a landing almost into the easterly wind. This was described by an observer as "gusty". The pilot was not aware of any drift during the approach, although flight conditions were "a little bumpy" and, just as the aircraft was about to touch down, the left wing lifted suddenly. This caused the aircraft to rotate to the right before nosing into the ground. It remained in this nose-down attitude as the occupants climbed out, shutting the aircraft down as they did so.

The pilot attributed the event to a sudden and unexpectedly strong gust that caught the aircraft during the landing flare. He additionally commented that the aircraft heading may have been less aligned with the wind direction than he had thought, which may have accounted for the left wing being affected. Finally, he noted that, given the conditions, he might have considered reducing the gust response of the aircraft by 'wheeling' it onto the ground, (which results in a slightly higher landing speed) rather than attempting a three-point landing.

ACCIDENT

Aircraft Type and Registration:	Europa, G-BWRO
No & Type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	1997
Date & Time (UTC):	21 May 2007 at 1345 hrs
Location:	Fishburn Airfield, Co Durham
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to nose landing gear, right main landing gear, propeller, right wing leading edge and minor damage to flap and rudder
Commander's Licence:	Private Pilot's Licence
Commander's Age:	58 years
Commander's Flying Experience:	303 hours (of which 47 were on type) Last 90 days - 20 hours Last 28 days - 10 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft encountered a sudden shift in the wind direction late during the approach which resulted in the aircraft contacting the runway prematurely and veering off to the left.

History of the flight

A short local flight was planned from Fishburn Airfield. The aircraft took off in an easterly direction using the single grass runway. Weather conditions and visibility were good and the wind was a light southerly at 4 to 5 kt. The aircraft returned after approximately 30 minutes and the pilot assessed the conditions to be the same light southerly wind as when he had departed. He called on the radio to rejoin the circuit, but received no reply and thereafter performed radio calls 'blind'. He entered the circuit for Runway 26, considering that, given a light crosswind, this was the best option as it has an upslope of 1.6%. The approach was normal, with the aircraft 'crabbed' slightly to the left to offset the wind drift. On final approach the pilot selected 20º flap (3/4 of the full flap extension) and reduced the airspeed to 65 kt. At approximately 15 ft above the runway threshold the aircraft began to lose height rapidly and, as it touched down, began to veer to the left. The pilot applied full power to initiate a go-around but, the aircraft did not accelerate and departed the runway

to the left. It travelled a distance of approximately 200 m before coming to rest in a hedge which ran parallel to the runway. Both occupants, who were wearing full shoulder harnesses, were uninjured and vacated the aircraft without difficulty.

The pilot assessed the cause of the accident to be a sudden shift of the wind while on short finals from a light southerly crosswind to an easterly tailwind of 10-12 kt. This shift in wind direction and strength was confirmed to him by observers on the ground. He also commented that the performance of the aircraft did not enable it to out-climb the runway upslope.

ACCIDENT

Aircraft Type and Registration:	Ikarus C42 FB100 VLA, G-WOLV
No & Type of Engines:	1 Rotax 912 ULS piston engine
Year of Manufacture:	2006
Date & Time (UTC):	16 March 2007 at 1425 hrs
Location:	Lower Upham Airfield, Hampshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - 1 (Minor)
Nature of Damage:	Engine, propeller and nose landing gear detached, damage to left wing tip
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	38 years
Commander's Flying Experience:	588 hours (of which 8 were on type) Last 90 days - 34 hours Last 28 days - 19 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and additional enquiries by the AAIB

Synopsis

The aircraft was taking off from a grass airstrip. The ground roll had seemed normal but, when airborne, the aircraft appeared reluctant to climb. The left wing dropped, struck the ground and the aircraft cartwheeled to a halt. Both occupants escaped with only a minor injury to the passenger.

History of the flight

The pilot in command of the aircraft was a qualified instructor on conventional light aircraft with an endorsement to instruct on microlight aeroplanes as well. G-WOLV was registered on a Permit to Fly issued through the Popular Flying Association. The purpose of the flight was to familiarise the passenger (an experienced PPL holder) with the aircraft type during a local recreational sortie. Accordingly, the pilot occupied the right seat, although it was not an instructional flight, so that her passenger could better see the instruments from the left: she states that she was perfectly comfortable with this arrangement.

The pilot positioned the aircraft for takeoff close to the beginning of Runway 04 to carryout the power and pre-takeoff checks. She recognised that the windsock was indicating a slight tailwind component (given as 300º at 8 kt by Southampton ATC) and that the takeoff direction was slightly uphill - usual practice at this airfield due to noise restrictions - but this did not concern her unduly.

The passenger was briefed about the short takeoff run and told to expect a high-nose attitude during climb out because the pilot knew that this would be different from his normal experience.

Having done this, the aircraft was lined up and full power applied for takeoff. During the takeoff run, the pilot held the control stick just aft of neutral, glancing at the airspeed indicator to check that it was registering an increase, and waiting for the cues that the aircraft was ready to 'unstick'. As the nosewheel lifted off, she rotated and the aircraft became airborne. Despite the fact that the takeoff run had appeared normal, once airborne the aircraft did not appear to want to climb and, whilst the pilot considered her options, the left wing dropped at a height of about 20 to 30 feet agl. She took normal recovery actions but there was insufficient height available for these to be successful and the aircraft struck the ground in a left wing low/nose-down attitude, cartwheeling through about 270º and detaching the engine/nose gear assembly. The two occupants evacuated using the aircraft door, with a minor injury being suffered by the passenger. The pilot briefly returned to switch off the magnetos. The aircraft had come to rest in an upright attitude, slightly less than half-way along the 648 metre grass runway

Discussion

In a detailed and frank account of the accident, the pilot provided an attempt to explain the apparent reluctance to climb by the aircraft which had appeared to accelerate and rotate normally. She cited the following as possibly influencing events:

1) The wind might have momentarily increased in strength. Although the Southampton METAR at the time gave 300º at 08 kt, varying between 260º and 330º, a report a few hours earlier had the wind gusting up to 23 kt.

2) The upslope on the runway not only may have given the illusion that the aircraft was not climbing normally but might also have resulted in insufficient height to enable the stall recovery action to be successful.

3) Although she recalls that engine rpm was normal during the pre-takeoff checks, there might have been a subtle loss of power during the takeoff run. The engine does not have a selectable carburettor heat control to prevent carburettor icing. Instead pilots are required to check that a minimum oil temperature of 50ºC is displayed before attempting to take off. The pilot is fairly sure that she did this.

4) The aircraft was some 8 kg above the maximum takeoff weight, although she believes that the basic weight of the aircraft may have been 18 kg less than shown on the weight and balance schedule.

5) The pilot also recalled that she had set the pitch trim correctly, since she pointed out the unusual LED display of trim position to her passenger as part of the pre-takeoff checks.

ACCIDENT

Aircraft Type and Registration:	Jabiru UL-D, G-SUTD
No & Type of Engines:	1 Jabiru 2200A piston engine
Year of Manufacture:	2006
Date & Time (UTC):	18 February 2007 at 0945 hrs
Location:	Wickenby Aerodrome, Lincolnshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Aircraft damaged beyond economic repair
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	52 years
Commander's Flying Experience:	73 hours (of which 2.5 were on type) Last 90 days - 3 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and telephone enquiries by the AAIB

Synopsis

The engine was being started prior to an instructional sortie and it came to life at a high power setting. The aircraft accelerated rapidly towards some obstacles, which it struck before the pilot could react.

History of the flight

The pilot of G-SUTD had recently purchased the aircraft and had been taking instruction in order to gain experience on the type. He had flown two sessions with instructors and it was his intention that this would be the last lesson before flying the aircraft solo. The instructor was late arriving, so the pilot was advised to position and prepare the aircraft for flight. Having topped up the oil, he pulled the aircraft out of the hangar and undertook the external checks. He then boarded and prepared for starting.

He followed the normal procedure of opening and closing the throttle, switching on the master switch, fuel pump and both magnetos. Because it was the first start of the day, he also applied full choke before pressing the starter button. The propeller turned but the engine did not start. He switched everything off before repeating the procedure but to no avail. On the third attempt, the engine fired and ran up to speed so rapidly that it took the pilot by surprise; the aircraft quickly accelerating away towards a Portakabin building in front. The pilot used the rudder pedals to turn the aircraft to the left, away

from the building, and succeeded in merely clipping a corner of it with the right wingtip. Unfortunately, the space he was now heading for was occupied by a weighbridge which the aircraft struck, coming to rest on a sidewall. The aircraft, which was severely damaged and subsequently declared a total loss, had some six flying hours logged since new.

The pilot did not recall the position of the throttle when the engine started and is at a loss to explain how it appears to have been at a high power setting. He states that the whole incident took only a few seconds to cover the 25 to 30 metres between the aircraft's parked position and the weighbridge. He does not recall whether he set the parking brake, but admits that it probably was not set as he had just pushed the aircraft out of the hangar (the brakes are actuated by a lever forward of the centrally mounted control column and can be locked for parking using a ratchet mechanism). He believed a major factor in the accident was his inexperience both on type and flying generally.

ACCIDENT

Aircraft Type and Registration:	Pioneer 300, G-TREX
No & Type of Engines:	1 Rotax 912 ULS piston engine
Year of Manufacture:	2006
Date & Time (UTC):	7 March 2007 at 1225 hrs
Location:	Bembridge Airfield, Isle of Wight
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to propeller, lower cowling, radiator and nose gear retraction mechanism
Commander's Licence:	Private Pilot's Licence
Commander's Age:	72 years
Commander's Flying Experience:	20,777 hours (of which 110 were on type) Last 90 days - 14 hours Last 28 days - 8 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

The nose gear leg collapsed on landing because it was not fully extended. A wiring loom had jammed the nose gear extension screwjack, preventing full extension.

History of the flight

The Pioneer 300 is a homebuilt two-seat aircraft operated under a Permit to Fly. It has a low wing, retractable tricycle landing gear and conventional flying controls. The pilot was undertaking a cross-country flight from Gloucestershire Airport to Bembridge airfield. During the downwind leg for a landing on Runway 30, the pilot extended the landing gear. The green light, to indicate that the landing gear was down and locked, did not illuminate, but a visual inspection through the clear panel in the nose gear bay revealed that the nose gear appeared to be fully extended. The pilot pulled the circuit breaker for the electric gear extension and then applied the manual handle for gear extension, but no further movement could be obtained. He raised the gear partially, using the manual handle and then re-extended it, resulting in the nose gear returning to its original position. He therefore assumed that the gear was extended and that there was an indication problem.

The pilot carried out a normal approach and landing but, when the nose of the aircraft was lowered, the nose

gear collapsed and the propeller struck the ground. The aircraft slid to a stop with its lower cowling resting on the ground. The pilot shut down the aircraft and then he and his passenger exited the aircraft in the normal manner.

Aircraft examination

The pilot examined the aircraft and discovered that a wiring loom had jammed the nose gear screwjack. This prevented the nose gear from fully extending and prevented the over-centre downlock from engaging. On landing, the nose gear load was applied directly to the screwjack, causing it to shear and allow the nose gear to collapse. The pilot reported that the rudder trim indicator and switch wires had some slack in them and he suspected that one of these wires came loose from the wiring loom which runs through the console tunnel. He believes that one of these wires was dragged into the unprotected nose gear screwjack when he lowered the gear, and that the screwjack then dragged in 10 more wires until it jammed.

The pilot stated that, pending PFA approval, he intends to fit a cover over the screwjack to prevent a repeat occurrence. The PFA commented to the AAIB that an alternative solution might be to ensure that the wires in the vicinity are safely secured.

ACCIDENT

Aircraft Type and Registration:	Piper L18C Super Cub, G-BBYB
No & Type of Engines:	1 Continental C90-8F piston engine
Year of Manufacture:	1952
Date & Time (UTC):	17 March 2007 at 1215 hrs
Location:	Headcorn Airfield, Kent
Type of Flight:	Aerial Work
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Propeller bent, tailfin and wings damaged, wing support struts bent
Commander's Licence:	Private Pilot's Licence
Commander's Age:	48 years
Commander's Flying Experience:	135 hours (of which 5 were on type) Last 90 days - 4 hours Last 28 days - less than 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The pilot lost directional control during the takeoff on his first solo flight on the type. He therefore attempted to abandon the takeoff but the aircraft nosed over and became inverted.

Summary of pilot's report

A period of circuit consolidation was carried out by the accident pilot under the supervision of a club check pilot. During this period, four touch-and-go landings took place, followed by a full-stop landing. The check pilot then left the aircraft, having recommended that the accident pilot carry out one or two solo circuits.

The pilot taxied to the holding for Runway 29, carried out the pre-takeoff checks and visually checked the final approach. He noted that the circuit was busy. He then made a radio call stating that he was ready for departure, lined up and commenced the takeoff run. This was straight until he lifted the tail, shortly after which the aircraft hit a small undulation causing it to lift off to a height of two to three feet. The aircraft immediately veered and drifted to the right whilst the pilot tried to correct with application of rudder. The aircraft touched down again but the pilot was not able to regain directional control. As the aircraft was heading for the fence line, the pilot closed the throttle and commenced braking. The aircraft then nosed over and became inverted. The pilot released his harness, shut off the fuel and exited through the door.

Subsequent investigation of the airfield's wind recording equipment indicated that a number of gusts occurred at the time of the accident. It was noted that for the duration of each gust the wind backed to south-west. Observation of the windsock confirmed this trend. It appears that during the consolidation flight the wind had been steady at 8-10 kt. Some 2½ hours before the accident, the actual wind had been reported as 250º/09 kt.

The pilot believes that the aircraft became airborne with insufficient airspeed and was affected by the gusting crosswind. As this was his first solo flight on the aircraft type, the change in characteristics without the passenger weight may have been a contributing factor, although he had been briefed to expect this.

Check pilot's comments

The check pilot noted that the accident pilot had previously carried out a number of dual details on the type. On one of these he was reported as having coped well in blustery conditions. The check pilot considered that the accident pilot had carried out the dual circuits and landings safely prior to the accident flight.

ACCIDENT

Aircraft Type and Registration:	Piper PA-23-250 Aztec, G-BBEY
No & T ype of Engines:	2 Lycoming IO-540-C4B5 piston engines
Year of Manufacture:	1973
Date & Time (UTC):	29 June 2006 at 1237 hrs
Location:	Near Thirkleby Hall, Thirkleby, North Yorkshire
Type of Flight:	Private
Persons on Board:	Crew -1 Passengers - None
Injuries:	Crew - 1 (Fatal) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	64 years
Commander's Flying Experience:	466 hours (of which 251 were on type) Last 90 days - 32 hours Last 28 days - 9 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft was making its first flight following a period of maintenance that had included work on the aircraft's left engine fuel system. On takeoff, it became apparent to witnesses that there was a problem with one, or possibly both, engines. The pilot flew a close-in circuit and returned to the airfield but, on landing, the aircraft bounced several times and a go-around was initiated. The aircraft was seen to climb slowly and at low speed before it banked steeply to the left, and directional control was lost. The aircraft stalled and dropped the left wing at a height too low for the pilot to effect a recovery.

The investigation determined that a reduction of power affecting the left engine occurred, probably due to blockage of a fuel injector nozzle.

History of the flight

The pilot, who was also the owner of the aircraft, arrived at Bagby Airfield on the morning of the accident. The aircraft had recently completed a period of maintenance and he intended to fly it to Gamston Airfield, where it was normally based.

During the morning, the pilot had taxied the aircraft to the fuel pumps and refuelled the left outer fuel tank. The pumps were located next to the maintenance hangar where the work on the aircraft had been carried out. The owner of the maintenance company reported that the pilot had requested his help as he was unable to get the right wing navigation light or left wingtip strobe light to work. No fault was found with the navigation light and the strobe light was made

serviceable by changing a connection on the strobe light power pack.

Shortly after midday, the pilot boarded the aircraft and started both engines. A witness reported that the engines appeared to start and run without problem and that the aircraft was then taxied out of view towards the threshold of Runway 24. He recalls hearing what he believed were power checks being carried out on the aircraft, but did not recall hearing the propellers being exercised as would be usual during a feathering operation check.

At about this time, the owner of the maintenance organisation received a call on his mobile telephone from the pilot. He reported that the pilot appeared to be in the aircraft with the engines running and had asked for one of the engineers to go to the unmanned tower to give him a radio check. The pilot gave no indications that there were any problems with the aircraft.

An engineer duly went to the tower to give the pilot the radio check as requested; again the pilot did not report any problems. Three engineers from the maintenance organisation saw the aircraft take off from Runway 24. They were immediately concerned as one, or both, engines sounded to be running rough and smoke was seen coming from the engine exhausts. One of the engineers described seeing black smoke coming from the left engine exhaust, with a lesser amount of grey smoke coming from the right engine exhaust. The others reported smoke coming from both engines, one describing it as having a similar appearance to a smoking diesel engine. Additionally, the takeoff ground roll was excessive.

The aircraft became airborne about three-quarters of the way along the runway and the landing gear was then seen to retract. One of the engineers ran to the tower and called the pilot over the radio to warn him that they believed the aircraft had a problem and to advise him to return. The pilot did not reply immediately but then made a transmission reporting that the aircraft was not climbing properly. It was then seen to fly a left circuit to Runway 24 with the aircraft appearing to be lower and closer to the airfield than normal. When on final approach for Runway 24, the pilot asked for visual confirmation that the landing gear was down. The engineer in the tower could see that it was and reported this back to the pilot.

The aircraft continued the approach and appeared to land heavily on its main wheels, following which it bounced back into the air. It was then seen to pitch down, land on its nosewheel, and run along on this wheel[1] before the main wheels touched down again. The aircraft bounced into the air again, subsequently bouncing two or three times in the same manner as it passed down the runway. When it was about two thirds of the way down the runway, the aircraft became airborne again and one witness then saw the landing gear being raised. Witnesses also recall seeing smoke still coming from the engines, one describing it as dense black smoke from the left engine and less dense smoke from the right engine.

The aircraft was seen to climb slowly at low speed, bank steeply to the left and turn onto a reciprocal heading to the runway. It then turned to the left again, at a height of about 100 ft, before the left wing suddenly dropped. The aircraft pitched down, hit the ground and burst into flames.

Airfield description

Bagby is an unlicenced grass airfield with two runways. The main runway, Runway 06/24, is 710 metres long and is crossed near the threshold of Runway 06 by the second runway, Runway 15/33, which is 450 metres long. At the time of the accident the grass was dry.

Footnote

[1] Commonly referred to as 'wheelbarrowing'.

The airfield website publishes the following information:

> *'Runway 24 has a pronounced 2.6% downslope. This means (if you are landing downhill) that accurate speed control is vital to avoid that long float and desperate feel for the runway, or alternatively wheel barrowing at high speed down 24. In light and no wind conditions locals almost invariably land uphill and take off downhill.'*

Pilot's flying experience

Log book entries show that the pilot had been flying from Bagby since 1995 and had undertaken numerous flights from the airfield since that time. He was, therefore, familiar with its sloping runway and circuit patterns.

The pilot attained a multi-engine rating in 1989, since when he had conducted almost half of his flying on various multi-engine types. He had been flying the PA-23 Aztec since 1990. In the six months prior to the accident, he had flown for about 47 hours, of which only 3.5 hours were on multi-engine aircraft. On 14 February 2006, the pilot flew with a flying instructor from Gamston to Bagby, as the instructor wished to assess the aircraft with a view to leasing it from the owner. The instructor stated that, during this flight, the owner had practised flying with asymmetric power without, apparently, any problems. On the aircraft's penultimate flight, the pilot flew from Gamston to Bagby for maintenance. No problems were reported concerning this flight.

Weather

The following weather conditions were recorded shortly after the accident:

Wind 250º at 5-8 kt, visibility in excess of 10 km, broken cloud at 2,000 ft, temperature 22ºC, QNH 1019 hPa.

Accident site

The accident site was located 0.8 km to the south of Bagby airfield, at a position 0.25 km east of the A19 trunk road and 33 metres south of the entrance road to Thirkleby Park. The area around the accident site consisted of large open fields with small areas of woodland interspersed with the occasional building. A holiday caravan park and recreational area, together with some holiday apartments, were located less than 1 km to the east-north-east of the accident site.

Accident site examination

Examination of the accident site showed that the aircraft impacted the ground in a near vertical nose-down attitude, with a high rate of descent, initially with the forward fuselage and then the left propeller and left wing tip. The ground impact marks indicated that the aircraft was spinning to the left and had struck the ground on a west-south-westerly heading. Following the initial impact, the aircraft rotated in a cartwheeling motion, resulting in the right propeller and right wing tip impacting the ground. As a result, both wing spars failed in the areas between the engines and the fuselage, causing the wings to become detached. The fuselage and wings were thrown approximately seven metres to the north, with the fuselage coming to rest inverted and partially on top of the upright right wing. The left wing, which was also upright, came to rest to the north of the fuselage.

Initial wreckage examination

Fuel from the ruptured wing tanks had ignited and a substantial fire ensued which consumed the majority of the aircraft structure. Ground marks made by the propellers showed that they were both being driven by their respective engines, the right at high power and the left at medium power. Before the wreckage was disturbed,

an examination of the flying control systems showed that they had been intact, with no disconnections between the flying control surfaces and the cockpit controls. It was not possible to establish if any pre-impact jam or restriction had occurred, or the position of the flaps.

Engineering examination

After the wreckage had been recovered to the AAIB at Farnborough, both fuel-injected engines were taken to an approved engine overhaul facility for a detailed strip examination. This examination revealed that they had been in reasonable mechanical condition but there was evidence to indicate that they had experienced long periods of inactivity. The majority of the engines' ancillary equipment, such as the magnetos and fuel servo units, were excessively fire damaged and could not be tested. Limited visual examinations of these items did not identify any obvious pre-impact faults or failures.

The engine mounted fuel injector distribution valves, fuel pipes and injector nozzles were removed and tested. It was found that the fuel injector distribution valves and the fuel pipes fitted to both engines performed satisfactorily. However, one of the left engine injector nozzles was found to be blocked; the remaining five were found to function in a satisfactory manner. Analysis of the substance that had caused the blockage showed it to be an aluminium alloy corrosion product. When the fuel injector distribution valve from the left engine was dismantled it was found that heavy corrosion was present within the aluminium alloy body of this unit. This corrosion had occurred in the fuel chamber section of the valve, indicating that the chamber had been contaminated by water. Due to the severe post-impact fire, it was not possible to determine the serviceability or cleanliness of the fuel system in the airframe.

All six fuel injector nozzles from the right engine were found to function at flow rates ranging from 91% to 55% of the specified maximum flow rate. Detailed examination of the nozzles found that the flow restrictions had been caused by a general build-up of ferrous corrosion products and nickel.

Both propellers were taken to an approved propeller overhaul facility for a detailed strip examination. There was no evidence seen in either unit to indicate a pre-impact fault or failure that would have prevented normal operation. Evidence from witness marks seen within the propeller mechanisms indicated that all propeller blade pitch angles were consistent with the propellers being driven by the engines at the moment of impact.

A small number of items from the landing gear were identified and examination indicated that the gear was close to, but not in, the fully retracted position.

The post-impact fire precluded the possibility of establishing if there had been a bird strike, a pre-impact fire or, for example, if a panel or engine cowling had become loose or detached. However, no aircraft parts were found along the flight path between the takeoff point and the point of impact.

Maintenance history

During the five years prior to the accident, the aircraft had been stored for long periods of time in the open, with no maintenance activity or engine runs being carried out. The aircraft was stored in the open from July 2005 to February 2006 prior to being sold to the owner/pilot involved in the accident. In February 2006, in preparation for the sale, maintenance work was carried out at Bagby. This consisted of a 50 hour Inspection, in accordance with the Civil Aviation Authority Light Aircraft Maintenance Schedule (LAMS), replacement

of the engine spark plug high tension springs and ferrules, work on the fuel system, and the fitting of four new fuel tank filler caps. During this inspection, water contamination was found in the fuel system. As a result, the maintenance organisation drained all the fuel and water from the aircraft, removed a number of the fuel system filters and other components, flushed the fuel system, cleaned the filters and components and re-fitted them to the aircraft. Following this work, the aircraft was flown by the new owner from Bagby to Gamston, without any reported problems. Over the next two months the aircraft's airframe log book records that it flew for a total of 3 hours 10 minutes, which included its penultimate flight from Gamston to Bagby. It was not recorded if the pilot experienced any problems with the aircraft on this flight, and no problems were mentioned to the maintenance organisation.

Once at Bagby, the aircraft underwent further maintenance which consisted of an Annual Inspection in accordance with LAMS, the fitting of two overhauled propellers and general aircraft husbandry. Following this, a number of engine ground runs were carried out. During the first of these, it was noted that the left engine was running very unevenly and would not produce full power, and that the right engine had an excessive magneto 'rpm drop'. Examination of the left engine revealed that one of the fuel injector nozzles was blocked by material described as debris/particles, the appearance of which did not lead the maintenance engineer to think that it was corrosion debris. All the injector nozzles were then removed, cleaned, checked for correct spray pattern and refitted to the engine. Also, the engine fuel system was flushed, a process which did not reveal any signs of corrosion products. The spark plugs were removed from the right engine, cleaned and refitted. During a number of subsequent ground runs, both engines performed satisfactorily.

Analysis

Witness information indicated that a problem may have existed with both engines, once the aircraft had begun its takeoff run. This became evident to observers on the airfield as rough running with smoke coming from both engine exhausts. The examination of the engines revealed that two different types of corrosion debris had affected many of the fuel injector nozzles. The blocking of one of the six fuel injector nozzles, on the left engine was established by analysis to have been a result of by-products from the corrosion of aluminium alloy. This most probably originated within the fuel injector distribution valve body where evidence of corrosion was found.

Such a blockage would have resulted in the engine running unevenly and at reduced power, and excess fuel being delivered to the other five nozzles. This would have caused the engine to run in a fuel-rich condition, and to emit blackish coloured smoke from the engine exhaust. The presence of a nozzle blocked by corrosion debris on the left engine, which occurred so soon after the reported satisfactory post maintenance engine runs, would seem to indicate that, despite the cleaning and flushing of the engine's fuel system, not all of the corrosion debris had been removed from the system.

The partial restrictions found in all the fuel nozzles on the right engine were found on test to cause reductions in the maximum specified flow rates of between 91% to 55%, and were caused by the products of corrosion of ferrous and nickel materials. Their origin was not established and they were considered by both the maintenance and an approved engine overhaul organisation to be the effect of long term usage. Although any partial restriction has the potential to cause a reduction in power, particularly at high fuel flow rates, both engines reportedly ran satisfactorily during ground runs prior to

the accident flight. Also, the propeller ground witness marks indicated that the right engine was running at a high power level at impact. Therefore, it is likely that the restrictions identified had been present for a time and had not altered the power output of the engine on the accident flight, compared with previous flights.

The reason for grey/black coloured smoke, seen by witnesses to come from the right engine during the takeoff, was not established. The maintenance engineer offered the view that smoke may often emanate from these engines on takeoff, with the mixture set at full rich, but the possibility that it was also associated with the nozzle partial restrictions could not be completely dismissed.

During the takeoff roll, it should have been possible for the pilot to realise that there was a power problem by the aircraft's rate of acceleration, engine indications and a possible power asymmetry, which might have been evident through the aircraft attempting to yaw. It is not known at what point the pilot became aware of this loss of power, but his radio call to the effect that the aircraft was not climbing demonstrates that he did know there was a problem shortly after becoming airborne. Despite any power loss experienced at the time, he was then able to complete a tight low level circuit to land back on Runway 24.

The pilot's radio call when on final approach, asking for a check that the landing gear was down, could have indicated that he was either unable to confirm it was down, due to an unknown problem with the cockpit indications or, possibly, that he was under considerable pressure and did not have sufficient spare mental capacity to check for himself. It is also possible that, if he did feel under pressure, the desire to get the aircraft on the ground quickly could have lead to the subsequent touchdown being sufficiently hard to make the aircraft bounce. A natural tendency, following a bounce, and especially with a runway downslope, can be for a pilot to pitch the aircraft nose down. This appears to have occurred, resulting in the aircraft running along on its nosewheel, or 'wheelbarrowing', as warned of in the airfield brief. To minimise the risk of such problems, the runway normally chosen by pilots for landing at Bagby is Runway 06. Even with the strength of the tailwind that would have been experienced at the time of the accident, this would have been an option.

The pilot's decision to go-around was presumably made when he considered that he could not stop the aircraft safely in the remaining runway length. The aircraft would not have decelerated normally as it bounced along the runway and, when power was re-applied, it would appear that there was minimal distance in which to accelerate to a safe flying speed. The aircraft was seen to climb away slowly, suggesting that it could have been below its optimum single-engine climb speed as it became airborne. If so, this would have reduced the aircraft's capacity to either accelerate or climb. However, the very fact that the aircraft was seen to climb also suggests that sufficient power might have been available, at that time, for the aircraft to accelerate in level flight. Given that the pilot had chosen to land back at the airfield he was faced with making low level turns through a total of 360º or 180º for Runways 24 or 06 respectively. The possibly less risky alternatives would have been to fly straight ahead and carry out a forced landing or, if sufficient power was available, gain height before returning to land or find an alternative airfield.

In order to accelerate the aircraft, the pilot would have had to fly straight and level, or in a shallow descent if height permitted, and raise the landing gear and flaps. It is not known what flap setting was selected at the

time of the attempted go-around but the landing gear retraction sequence began shortly after the aircraft took off. It was not found in the fully retracted position, and it could not be determined whether it was either just about to complete the retraction cycle, had just started an extension cycle, or had unlocked from the up position due to the impact rupturing the hydraulic lines.

Witnesses described seeing the aircraft bank steeply to the left at a height of approximately 100 ft shortly after it become airborne, and turn on to the runway reciprocal heading. Control of the aircraft was then lost, the left wing dropped and the aircraft entered a spin to the left. The reason for the loss of control would seem to have resulted from insufficient power being available to sustain the aircraft's speed whilst the pilot tried to remain airborne. In this slow speed situation, with an attendant high angle of attack, any increase in the aircraft's pitch attitude was likely to have led to the wing stalling. The fact that the aircraft turned to the left and dropped the left wing may have resulted from the right engine producing more power than the left, resulting in a yaw to the left as the wing stalled. From such a low height, it would not have been possible for the pilot to recover the aircraft from the ensuing spin before striking the ground.

Although the pilot had been flying the PA-23 Aztec since 1990, and a variety of other multi-engine aircraft since that time, he had only flown for 3.5 hours in such types in the six months prior to the accident.

Conclusions

Following maintenance work on the aircraft's left engine fuel system during an annual check, the aircraft appeared to suffer a significant reduction in power from the left engine on takeoff. This was either not recognised by the pilot in time to stop the aircraft safely on the runway, or it occurred too late in the takeoff roll. The reduction in power probably resulted from the complete blockage of one fuel injector on the left engine, caused by corrosion products associated with the aircraft's left engine fuel system. Having flown a tight circuit, the pilot landed the aircraft back at the airfield, but appeared to mis-judge the subsequent landing, possibly, due to the nature of the sloping runway. This resulted in the aircraft bouncing repeatedly. A go-around was initiated and the aircraft became airborne, but it was seen to climb only slowly. The aircraft then banked steeply to the left on to a reciprocal heading but, subsequently, control was lost, the aircraft stalled and entered a spin from a height too low for the pilot to effect a recovery. The aircraft consequently crashed and caught fire.

INCIDENT

Aircraft Type and Registration:	Piper PA-28-161, G-BGPJ
No & Type of Engines:	1 Lycoming O-320-D3G piston engine
Year of Manufacture:	1979
Date & Time (UTC):	17 August 2006 at 1200 hrs
Location:	Woodvale Airfield, Lancashire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Fire damage within engine compartment. Some wiring and hoses damaged
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	52 years
Commander's Flying Experience:	4,500 hours (of which 2,000 were on type) Last 90 days - 240 hours Last 28 days - 70 hours
Information Source:	AAIB Field Investigation

Synopsis

The engine stopped twice following an uneventful local flight. The pilot tried to restart the engine but with no success and he was told that there were flames around the nose landing gear leg. The pilot and passenger evacuated the aircraft rapidly and the fire was quickly extinguished. Examination revealed that one of the two hollow arms of the horseshoe-shaped float in the carburettor contained a substantial amount of fuel, which prevented the needle valve from fully closing. This allowed excess fuel to flow through the carburettor's jets, giving a rich mixture and, at low power, caused the engine to suffer a rich fuel mixture cut. It also caused fuel to pour out of the carburettor into the air box. Safety Recommendation 2007-040 is made to the FAA.

History of the flight

During the landing roll following an uneventful local flight the engine stopped. The pilot restarted the engine and taxied the aircraft to the hangar and on closing the throttle, the engine stopped again. He tried to restart the engine but with no success and decided to shut down the aircraft. The pilot was discussing the possible causes of the engine failures with his passenger when his attention was caught by a passer-by. On opening the cockpit door he was informed that there were flames around the nose landing gear leg. The pilot and his passenger rapidly evacuated the aircraft and the fire was quickly extinguished using a foam fire extinguisher.

Engineering examination

Initial examination by a licensed aircraft engineer found that there had been moderate to severe fire damage in the lower engine bay area, which had burnt through the engine fuel primer hose and some electrical cable insulation. After the primer hose was replaced, the engine was started and run up to full power without any problems but, when the power was reduced to idle, the rpm was lower than normal, black puffs of smoke were seen to come from the exhaust and the engine stopped. Fuel was then seen running down the back of the carburettor air box. Further engine runs were carried out and on each run the engine performed normally above 800 rpm but on a number of occasions when it was below 800 rpm it ran rich, stopped and fuel was observed running from the carburettor air box. The carburettor was removed and, along with the failed fuel primer hose, was sent to AAIB for examination.

Examination of the engine fuel primer hose indicated that the failure was as a result of the fire and did not contribute to the initial event.

The carburettor, a Marvel-Schebler model MA-4SPA, was taken to an authorised overhaul organisation and placed on a test bench, where it was found that the fuel level in the float chamber was well above the maximum level allowed and, in certain angular positions, fuel poured out from the inside of the carburettor's bore. The unit was dismantled and one arm of the horseshoe-shaped white plastic hollow float, part number 30-804, was found to be almost completely full of an AVGAS - a coloured fluid (Figure 1). It was later confirmed by chemical analysis that this fluid was pure AVGAS. Examination of the float revealed that a minute area of the plastic hot-weld joint between the float chamber and its lid had not been welded during manufacture. This minute gap in the weld was so small that when the float, containing the AVGAS, was placed in a vacuum chamber only a barely discernible amount of fuel escaped.

In late September 2006 the same overhaul organisation received a Marvel-Schebler/Precision Airmotive carburettor from an operator with the report '*Engine cuts on landing roll – engine seems to run rich*'. On examination one arm of the float, Part No 30-804, was found to be full of fuel.

Carburettor float history

The engine was supplied by the manufacturer as a zero-timed overhauled unit with an overhauled carburettor fitted. The engine had achieved 51 hours since the overhaul.

Review of occurrence reports, and other information, shows that Marvel-Schebler carburettor floats have a history of absorbing fuel and becoming heavy and therefore less buoyant. Consequently they do not fully close the needle valve between the fuel bowl and the main jets. This allows excess fuel to flow through the carburettor's jets giving a rich fuel mixture which can, at low power, cause the engine to suffer a fuel rich cut and fuel to pour out of the carburettor into the air box.

Over the years the Marvel-Schebler carburettor floats have gone through a number of design changes following incidents of the floats absorbing fuel, causing engine running problems and fuel leakage. In July 2002 the white hollow plastic float, part number 30-804, was introduced to replace the fabricated hollow brass float because of fuel ingress into the hollow arms around the soldered joints. After a period of time in service it was found that the white hollow plastic floats leaked fuel into the arms around the hot weld joints. A total of approximately 17,000 of these floats were manufactured.

Figure 1

Float arm containing fuel

In September 2005 a blue sealed solid float, Part No 30-864, was introduced and, to date, there have been no reported cases of ingress of fuel into the float arms.

In March 2006 the Federal Aviation Administration issued a Special Airworthiness Information Bulletin (SAIB), No CE-06-33. This alerted repair stations and mechanics, holding Inspection Authorisation, of service difficulties and safety issues associated with certain Marvel-Schebler/Precision Airmotive float-type carburettors. In the SAIB the following statements were made:

> *'We have received several reports of poor idle cut-off or of fuel leaking from the carburetor after shutdown. The conditions reported were the result of fuel leaking into the carburetor float, a damaged or worn float, or a damaged or worn float valve. Since this condition, if uncorrected, can lead to in-flight fire or loss of power due to an overly rich fuel mixture, we are issuing this SAIB to assure timely dissemination of this information to maintenance personnel. While such issues are not new or specific to any particular carburetor float design, it is possible that mechanics and operators with little or no exposure to carburetors*

could fail to recognize the potential cause and possible effects of such conditions. Precision Airmotive LLC has issued Service Letter (SL) SIL MS-12, dated February 24, 2006, to provide information regarding these problems.

OPERATOR ACTION: Operators of aircraft equipped with float type carburetors should be aware of the potential for these conditions to exist and should immediately remove an aircraft from service if fuel leakage or poor idle cut-off are evident. The operator should have qualified maintenance personnel inspect the aircraft prior to return to service.

MAINTENANCE ACTION: Mechanics addressing these issues should inspect the carburetor for signs of fuel leakage. This may be evidented by fuel stains from the bowl vents in the throat of the carburetor and/or fuel in the air box. Remove carburetors with signs of fuel leakage and send them to a qualified repair station for inspection and repair.'

This FAA SAIB raises awareness of the issue and the implications of defective carburettor floats but does not require corrective action. In view of the apparently high rate of safety occurrences with this particular design of carburettor float:

Safety Recommendation 2007-040

It is recommended that the Federal Aviation Administration (FAA) review the continued airworthiness of the Precision Airmotive float, part number 30-804, fitted to Marvel-Schebler/Precision Airmotive carburettors.

Further information

On 9 September 2006 a Robin R2120, F-HAPC, suffered a power loss during initial climb at Ferrieres en Brie, in France, and the aircraft was destroyed in the subsequent forced landing. The carburettor float (Part No 30-804) was found to contain a large amount of fuel and the BEA (Bureau d'Enquetes et d'Analyses) has formed safety recommendations to the EASA and the FAA relating to the withdrawal of this particular design of float.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28-161, G-OBFC
No & Type of Engines:	1 Lycoming O-320-D3G piston engine
Year of Manufacture:	1995
Date & Time (UTC):	15 April 2007 at 1200 hrs
Location:	Henstridge Airfield, Somerset
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Severe damage to port wing and stabilator
Commander's Licence:	Private Pilot's Licence
Commander's Age:	54 years
Commander's Flying Experience:	137 hours (of which 60 were on type) Last 90 days - 7 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft became high on its approach to a relatively short runway, at an airfield with which the pilot was unfamiliar. The aircraft landed some distance along the runway, and the pilot was unable to bring it to a stop before it struck a boundary fence, causing substantial damage to the aircraft and some damage to the fence. The pilot identified a number of contributory factors, culminating in the fact that he did not abandon the landing whilst it was still safe to do so.

History of the flight

The Bournemouth based club aircraft departed from Bournemouth Airport at 1115 hrs for a flight to Henstridge Airfield, 23 nm to the north-west. The weather for departure was fine, but the visibility deteriorated considerably in haze as the aircraft flew further inland. The pilot had planned to fly to the town of Sturminster Newton, 4 nm from Henstridge, and then on to the airfield, but had difficulty in identifying the town in the deteriorating visibility. He therefore flew back up his route as far as the larger town of Blandford Forum and, having positively identified his position, set course once again for Sturminster Newton. At this point the aircraft was flying at approximately 2,000 ft agl, and it was just possible for the pilot to keep the ground in sight.

Henstridge was subsequently identified, and the pilot changed radio frequency from Bournemouth Radar to the Henstridge Air/Ground station. The pilot was informed that Runway 25 was in use, with a right-hand

circuit that was clear of other traffic. As the aircraft approached the airfield from the south at about 2,000 ft agl, the alternator warning light illuminated. Although this extinguished when the alternator switch was cycled, the pilot remained concerned about the possibility of an electrical failure in the hazy conditions, and was therefore keen to land without undue delay.

The pilot flew overhead the airfield before turning right to join downwind, keeping close to the airfield because of the poor visibility. This lead to the aircraft being high on its final approach, and it remained high despite the use of 40º of flap and 'S' turns on finals. The pilot also considered that the wind, which was otherwise light and variable, may have been giving up to 8 kt of tailwind at the time of landing.

The aircraft touched down at least one third of the way into the 750 m runway, and the pilot commenced heavy braking. By the time he considered rejecting the landing, the aircraft had lost too much speed, though it was decelerating too slowly to avoid a collision with the boundary fence. The pilot steered the aircraft to the right just before the fence, but the left wing tip struck it and the aircraft yawed rapidly to the left before coming to rest. The left wing tip sustained major damage in the collision, and the wing failed at its junction with the fuselage, causing fuel to spill from a ruptured fuel line; the fence was also damaged. Airfield personnel were on the scene very quickly and assisted the aircraft occupants. The pilot and his passenger were uninjured and able to vacate the aircraft via the main door. There was no fire, but the fire service attended and dealt with the fuel spillage.

Contributory factors

In his report, the pilot attributed the accident to a number of factors, which together formed a classic accident chain of events. These were the poor visibility, the non-standard circuit at an unfamiliar airfield, a shorter runway than the pilot was used to, and the distraction of the alternator warning light, which added a perceived time pressure to the landing.

Nevertheless, the above factors did not make an accident inevitable. The final factor, as the pilot recognised in his honest report, was the fact that the unsatisfactory approach and landing was continued beyond the point at which it could safely have been abandoned.

Safety action

The pilot's flying club commented that the pilot was a fairly regular flyer who remained current on single-engine piston aircraft, but who was probably less current with operations to relatively short runways. As a result of this accident, the club initiated a review of its recurrent training policy for those pilots who wished to conduct operations into or out of short runways and airstrips.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28-235, G-BAMM
No & Type of Engines:	1 Lycoming piston O-540-B4B5 engine
Year of Manufacture:	1965
Date & Time (UTC):	5 April 2007 at 1235 hrs
Location:	Sandown Airport, Isle of Wight
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Nose gear oleo destroyed, propeller bent, damage to nosewheel and engine
Commander's Licence:	Private Pilot's Licence
Commander's Age:	50 years
Commander's Flying Experience:	363 hours (of which 233 were on type) Last 90 days - 3 hours Last 28 days - 0.83 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot; Occurrence Report Forms submitted to the CAA by airport employees; telephone inquiries to recovery/repair agency

Synopsis

After a normal approach to land, the aircraft bounced, following which the nose landing gear failed. An assessment of the failure showed it to have resulted from an overload, with no evidence of a pre-existing defect.

History of the flight

After a normal circuit, the pilot began his descent for Runway 23 at an indicated airspeed of 90 mph, with two stages of flap and with the engine set at 1,700 rpm. There was no appreciable crosswind and, having selected the carburettor air control to COLD and full flap at a height of 300 ft, the descent continued normally. As the aircraft crossed the threshold at an airspeed of 80 mph, the pilot closed the throttle and the aircraft touched down, with the main landing gear contacting the ground at about 75 mph, some 5 mph above his target touchdown speed of 70 mph.

Upon touchdown, the pilot became aware that the aircraft bounced slightly, which he attributed to being slightly fast and the presence of a slight bump in the runway surface. Although there was no headwind, he considered that there was still ample runway available in which to stop. However, to his surprise, as he

lowered the nosewheel onto the runway the aircraft pitched forward until its nose contacted the grass, after which it slid gently along the runway centreline to a halt. After checking that his passenger was not injured and switching off the magnetos and the battery, the pilot and passenger vacated the aircraft unaided.

In his report, the pilot stated that he held the nosewheel off during the bounce, and that there had been no indication to him that it had contacted the ground until the aircraft finally pitched down onto its nose. He expressed the opinion that the landing had not been heavy, and was unable to explain why the gear had collapsed. However, witnesses saw the aircraft bounce several times, and the gear collapse upon touchdown from the final bounce. This last bounce was described by one witness as "the steepest".

The engineer who recovered the aircraft reported that the nose leg oleo had failed in bending due to overload.

ACCIDENT

Aircraft Type and Registration:	Piper PA-34-200T Seneca II, G-BCVY
No & Type of Engines:	2 Continental TSIO-360-E piston engines
Year of Manufacture:	1974
Date & Time (UTC):	1 May 2007 at 1044 hrs
Location:	Oxford Airport, Kidlington
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to right landing gear, wing and propeller
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	56 years
Commander's Flying Experience:	9,740 hours (of which 2,900 were on type) Last 90 days - 155 hours Last 28 days - 53 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Whilst attempting to land in an asymmetric power configuration in crosswind conditions, the aircraft touched down heavily on its right landing gear, causing it to partially collapse. As a result, the aircraft veered off the right side of the runway before coming to rest.

History of the flight

A visual approach was being flown to Runway 01, with asymmetric power, by a student pilot as part of an initial Instrument Rating test with a flight examiner. The student flew a stable approach with the aircraft's heading offset to the right to allow for the cross component of the wind, which was reported on the previous circuit as varying between 040º/10 kt and 060º/17 kt. However, by aligning the nose of the aircraft with the runway too soon before touchdown, the aircraft began to drift to the left. The student attempted to correct this by lowering the right wing but did not control the rate of descent. The aircraft touched down firmly, right wheel first, with a significant amount of right yaw, causing the partial collapse of the right landing gear to partially collapse. The examiner then took control, but was unable to prevent the aircraft from veering off the right side of the runway onto the grass, where it came to rest. There was no fire and both occupants were uninjured.

ACCIDENT

Aircraft Type and Registration:	Piper PA-38-112 Tomahawk, G-RVRG
No & Type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1979
Date & Time (UTC):	18 April 2007 at 1305 hrs
Location:	Manchester (Barton) Airport
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Left main landing gear collapsed
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	28 years
Commander's Flying Experience:	400 hours (of which 163 were on type) Last 90 days - 84 hours Last 28 days - 21 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Shortly after the aircraft touched down, it hit a bump in the runway causing it to become airborne again. On the second touchdown the left main landing gear collapsed. The cause of the accident was the failure of the left main landing gear securing bolt.

History of the flight

The pilot, who was a flying instructor, reported that that he was conducting an introductory circuit lesson during which he operated the flying controls. On the third touch-and-go to Runway 27R the speed over the threshold was 65 kt and the pilot made a power-off landing. He described the initial touch down as being soft, however shortly afterwards the instructor and student described the aircraft hitting a divot with some force, causing the aircraft to become airborne again in a nose-high attitude. The pilot moved the control column forward and applied power to arrest the rate of descent. When the aircraft touched down for the second time he opened the throttle to commence the touch-and-go, but despite his control inputs the aircraft began to drift to the left across the runway. The pilot immediately abandoned the takeoff and attempted to keep the aircraft on the runway. Just before the aircraft came to a halt it ground looped and came to rest facing in the opposite direction

Damage to aircraft

The maintenance organisation who repaired the aircraft reported that the left main landing gear

securing bolt (part number 401 511) had failed causing the left landing gear to collapse. Heavy landing checks were carried out and no further damage was found to the aircraft. Although the maintenance organisation had no previous experience of the failure of this bolt, they introduced a programme to replace the bolt on all of the flying school's PA-38 fleet at every annual inspection.

Condition of runway

An airfield guide describes the surface at Manchester Barton as *'undulating in places'*. The Operations Manager reported that they conduct a full daily inspection of the runway and that he was unaware or any divots or holes in the area where the aircraft touched down.

ACCIDENT

Aircraft Type and Registration:	Replica War P-47, G-BTBI
No & Type of Engines:	1 Continental Motors O-200-A piston engine
Year of Manufacture:	1985
Date & Time (UTC):	6 April 2007 at 1530 hrs
Location:	Yeatsall Farm, Abbots Bromley, Staffordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Both wings separated, fuselage damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	48 years
Commander's Flying Experience:	329 hours (of which 8 were on type) Last 90 days - 9 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft approached too low and, whilst attempting a go-around, struck a hedge.

History of the flight

The pilot reported that the aircraft was returning from Tatenhill to its home base of Yeatsall Farm. After an uneventful flight, he positioned the aircraft to join downwind for Runway 05. The windsock was motionless and the nearby reservoir indicated little wind. Being concerned about the length of his ground roll in zero wind conditions, the pilot selected Runway 05 since the ground at the overshoot end was suitable to run on to without damage. It was normal practice at Yeatsall to use Runway 05 in zero wind conditions. The runway was reported to be of grass and 500 metres long. Two closely spaced hedges, orientated at approximately right angles to the runway centre-line, formed boundaries of a minor road which passed the south-western limit of the field.

The pilot lowered the landing gear and proceeded to slow the aircraft down to approximately 75 mph as it descended on a curved approach, executed to maintain visibility with the runway. At this speed there is no forward vision due to the long nose and the aircraft attitude. The pilot's normal approach is curved all the way to the ground, but on this occasion the final approach was straight and the pilot lost perception of his height in relation to the threshold. Realising the limited view from the cockpit was not right, he applied

full throttle to go around. The engine picked up, but unfortunately at that point the aircraft flew through the first of the two hedges and came to rest at the base of the second hedge.

Survival and evacuation

The pilot reported that his four-point harness held, significantly reducing the potential for injury. He switched off the electrics, turned off the fuel and vacated the aircraft. He noticed fuel escaping from the engine compartment and called the fire service, who proceeded to cover the aircraft in foam as a precaution.

ACCIDENT

Aircraft Type and Registration:	Tecnam P2002-EA Sierra, G-RLMW
No & Type of Engines:	1 Rotax 912ULS piston engine
Year of Manufacture:	2006
Date & Time (UTC):	11 June 2007 at 1100 hrs
Location:	Glassonby Airfield, Penrith, Cumbria
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Nose landing gear, propeller, and wings damaged
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	62 years
Commander's Flying Experience:	468 hours (of which 26 were on type) Last 90 days - 19 hours Last 28 days - 10 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

During takeoff on a grass runway, the aircraft crested a rise in the runway, became briefly airborne, settled onto the ground and then bounced back into the air. It then veered to the left and struck a fence.

History of the flight

The pilot reported that he was taking off in still air conditions on grass Runway 36. Approximately 50 m into the takeoff roll with full power applied, the aircraft crested a rise in the runway and became airborne prematurely. It veered to the left, settled onto the ground and bounced back into the air. The pilot continued the takeoff, was regaining control of the aircraft and bringing it back on course, when it struck a fence and came to a stop. The aircraft sustained damage to its nose landing gear, propeller and wings; several fence posts were also damaged. The pilot shut the aircraft down and vacated the cockpit without difficulty.

The pilot commented that he may have avoided the fence had he aborted the takeoff when the aircraft first bounced.

ACCIDENT

Aircraft Type and Registration:	Yak-52, G-LENA
No & Type of Engines:	1 Vedeneyev M-14P piston engine
Year of Manufacture:	1983
Date & Time (UTC):	22 July 2006 at 1846 hrs
Location:	Bournemouth Airport, Dorset
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Fatal) Passengers - 1 (Fatal)
Nature of Damage:	Aircraft destroyed, with post crash fire
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	49 years
Commander's Flying Experience:	2,500 hours (of which 34 were on type) Last 90 days - 8 hours Last 28 days - 2 hours
Information Source:	AAIB Field Investigation

Synopsis

Following a pleasure flight in the local area, the aircraft made an approach and a high-speed, low-level pass adjacent to the runway threshold, in front of a group of onlookers. Witnesses saw the aircraft pitch up to an attitude of 30º to 40º and climb to a height of around 200 ft, before starting a climbing roll to the right. The roll continued, the aircraft became inverted and entered a near-vertical rolling dive from which it did not recover. It impacted the ground and caught fire. The impact was not survivable and both the pilot and his passenger received fatal injuries.

Examination of the wreckage failed to reveal any malfunction of the aircraft. It was, however, established that the passenger, occupying the rear seat, only used the lap strap elements of his seven-point harness. The reason for the pilot losing control of the aircraft could not be positively established. It was possible however, for the rear seat crotch strap buckle to have become trapped in the flight controls in such a manner as to prevent the pilot from applying corrective left roll control inputs.

Background to the flight

The flight had been arranged by friends of the passenger, who held a National Private Pilot's Licence (NPPL), as part of his 60th birthday celebrations. They had contacted the pilot of G-LENA, knowing him to be a co-owner of the aircraft, and had asked him to take the passenger for a flight from Bournemouth Airport.

Although they offered to cover some of the costs of the flight, the pilot declined any contribution. The pilot and passenger had not previously flown together, but were acquainted.

On the day of the accident, a licensed engineer travelled to Compton Abbas Airfield, where the aircraft was normally based, to carry out a 50 hour check on G-LENA. Members of the syndicate which owned the aircraft assisted with the check and also attempted to resolve a defect affecting the intercom system. They removed, inspected, and re-soldered headset sockets in the cockpit.

The work proceeded without difficulty and, when it was complete, a ground run was carried out which showed the engine to be operating normally. Subsequently, an inspection was carried out to ensure that no oil leaks were present. Two syndicate members then flew the aircraft on a short local flight which, reportedly, did not include aerobatics.

When the pilot arrived at Compton Abbas, he met other members of the syndicate and discussed the weather and his planned flight to Bournemouth. He prepared the aircraft for flight, replacing the parachutes with cushions and, in due course, boarded G-LENA. He carried out his pre-flight checks and took off for Bournemouth. The aircraft landed without incident, taxied to a parking position outside a flying club and shut down.

Here, the passenger and a large number of his friends and family had gathered, both in the club house and on its patio. This overlooked the threshold of Runway 26 and the area to the south and west - the area in which the aircraft later impacted the ground.

In due course, the pilot and passenger met and discussed the intended flight at some length. Witnesses recalled that the discussions centred on the passenger's desire for a pleasurable flight around the local area and that he did not wish to experience aerobatics.

History of the flight

Before boarding the aircraft, the pilot gave his passenger a safety briefing. The pilot then occupied the front cockpit, his passenger the rear, and photographs taken at the time show both wearing their shoulder harnesses as they sat in the aircraft. The pilot attempted to start the engine but the pressure in the on-board air reservoir, required to operate the starter motor, became depleted before the engine became self-sustaining. The pilot and passenger disembarked and the pilot flew, in another aircraft, to Compton Abbas, where a compressed air cylinder was obtained. He then returned to Bournemouth and re-boarded G-LENA with his passenger.

A friend of the passenger assisted him into the aircraft and noticed that he did not secure the shoulder straps of the seven-point harness. He offered him assistance, but the passenger declined, stating that he would not require the shoulder straps. It was not established whether the pilot was aware that his passenger was wearing only the lap strap element of the harness; it was established during the investigation that the crotch strap was also unsecured. The engine was started using air from the external compressed air cylinder.

The aircraft taxied out and took off from Runway 26. The takeoff appeared normal until the aircraft became airborne, when it was seen to remain very low over the runway whilst accelerating. The landing gear was seen to retract and the aircraft entered a 'zoom climb' before departing to the south-west.

It was not established what happened from the time the

aircraft departed to the south-west until it approached the airfield from the south-east. At 1844 hrs the pilot called Bournemouth Tower. He reported in the circuit on left base leg and requested "A LOW APPROACH AND GO AROUND AND THEN JOIN DOWNWIND RIGHT TO LAND". He was instructed to report on final approach and, in due course, when the controller observed the aircraft on approach, he cleared it for a low approach and go-around. These transmissions between the aircraft and ATC all appeared normal.

Witnesses at various locations on the airport observed the aircraft's approach. Some recalled a 'puff of smoke' during the latter stage of its approach, co-incident with a change in the engine note, which suggested to many an increase in engine power. Some witnesses commented that part of the approach was flown level, a few hundred feet above the surface, and that the aircraft then dived towards the Runway 26 threshold area, gaining speed. Witnesses agreed that the engine note, from the power change on the final approach until the accident, was constant and indicative of a high power setting. The final part of the approach to the airfield was seen by witnesses to have been flown towards an area between the runway threshold and the flying club.

Witnesses saw the aircraft pitch up and enter a 'zooming climb'; a pitch attitude of 30º to 40º nose up was typically recalled. After reaching a height of approximately 100 ft to 200 ft, the aircraft began to roll to the right[1]. Some witnesses described this as appearing to be possibly an entry to a barrel roll, and all agreed that the aircraft appeared to be under control as the roll began. A witness on the south side of the airport considered it possible that the pilot intended to climb out with the aircraft inverted. However, once the aircraft had reached the inverted position, witnesses described seeing the nose pitch towards the ground and realised that something was wrong. Some recalled a noticeable yaw just before the pitching began, and one stated that this was "as though full rudder had been applied". Another witness, an experienced flying instructor who taught aerobatics, recalled that, as the aircraft began to roll, the airspeed seemed to be decrease noticeably and that, by the time it had rolled through 90º, the aircraft's attitude "was not appropriate for a barrel roll". The aircraft continued to roll and pitch rapidly until it struck the ground.

At 1845 hrs, there was a very brief transmission from the aircraft, in a voice recognisable to be that of the pilot, the nature of which indicated that he realised the aircraft was in grave danger.

The aircraft impacted the ground in a steep nose-down attitude, at relatively high speed. A severe fire broke out immediately and members of the Aerodrome Fire and Rescue Service, who had observed the accident from their facility, deployed and arrived on scene very promptly and extinguished the fire. The severe nature of the impact meant that this was not a survivable accident.

Weather

A special meteorological observation immediately after the accident stated that the wind was 250º/9 kt, visibility 10 km or more with no cloud below 5,000 ft and no cumulonimbus. The temperature was 21ºC, dewpoint 15ºC and the QNH (mean sea level pressure) was 1016 hPa.

The pilot

The pilot had received conversion training on the Yak-52 in Ukraine in 1992, including training in aerobatics and

Footnote

[1] Some witnesses recalled the aircraft rolling to the left but analysis of the available evidence suggests that the roll was to the right. The Yak-52 rolls more rapidly to the right than left, and right is thus the preferred direction for a rolling manoeuvre.

formation flying. This training had included eight hours dual flying and 35 minutes solo time. He did not, however, fly a Yak-52 again until 2004 after purchasing a share in G-LENA, when he received a one hour dual familiarisation training flight before flying the aircraft solo.

Another member of the group which owned G-LENA, who was a former military fast-jet pilot and instructor, carried out a 'spin and aerobatics' check with the pilot in October 2005, and a currency check in January 2006. The flights included erect and inverted normal spins, erect flat spins to the right, loops, barrel rolls and stall turns to the right. He stated that neither flight gave him any cause for concern and that all manoeuvres were flown "perfectly competently, but without much flair". He described the pilot as "competent but slightly lacking in confidence" and, when discussing the circumstances of the accident, stated that he felt that "it would be very out of character for him to perform a low level pass, followed by a low level manoeuvre".

Another experienced military pilot and instructor, who had flown with the pilot, described him as a "solid and safe aviator". He added that he would not have expected him to fly unauthorised aerobatic manoeuvres at low level.

The chief flying instructor at G-LENA's base commented that the pilot liked to fly aerobatics "at considerable height", and that any low level aerobatic manoeuvre would have been "completely out of keeping with his character".

The passenger

The passenger held a National Private Pilots Licence (NPPL), and had 1,545 hours flying experience on single and twin-engine piston aircraft. A friend of the passenger, with whom he had flown extensively around Europe, commented that he was "a very competent and able pilot, very calm and relaxed", and that he was not likely to "want to throw an aeroplane about or anything like that". A personal friend, who had been on motorcycling and skiing holidays with the passenger, remarked that he was "a very cautious man" and "very stable and careful".

Recorded data

The aircraft was in VHF radio communication with ATC at Bournemouth, and recordings covering the period of the flight were available for the investigation.

Bournemouth Airport's radar is not recorded, and therefore no data was available to assist with the investigation. NATS, a provider of air traffic control services throughout the UK, does record radar data from its network of radar heads. However, coverage in the Bournemouth area proved to be very poor; the accident flight was not recorded.

A portable GPS receiver was on board the aircraft at the time of the accident but, despite exhaustive efforts by the AAIB, other investigative organisations and the unit's manufacturer, meaningful data was not recovered from this unit.

Two CCTV cameras captured images of the aircraft as it flew past the flying club prior to pulling up into the final manoeuvre. Analysis of these images was carried out by the National Imagery Exploitation Centre. This indicated that, before pulling up into a climb, the aircraft had flown level at a height estimated to have been about 50 ft, and that its mean ground speed at that time was 340 ±35 kph[2] (183 ± 19 kt). The aircraft's

Footnote

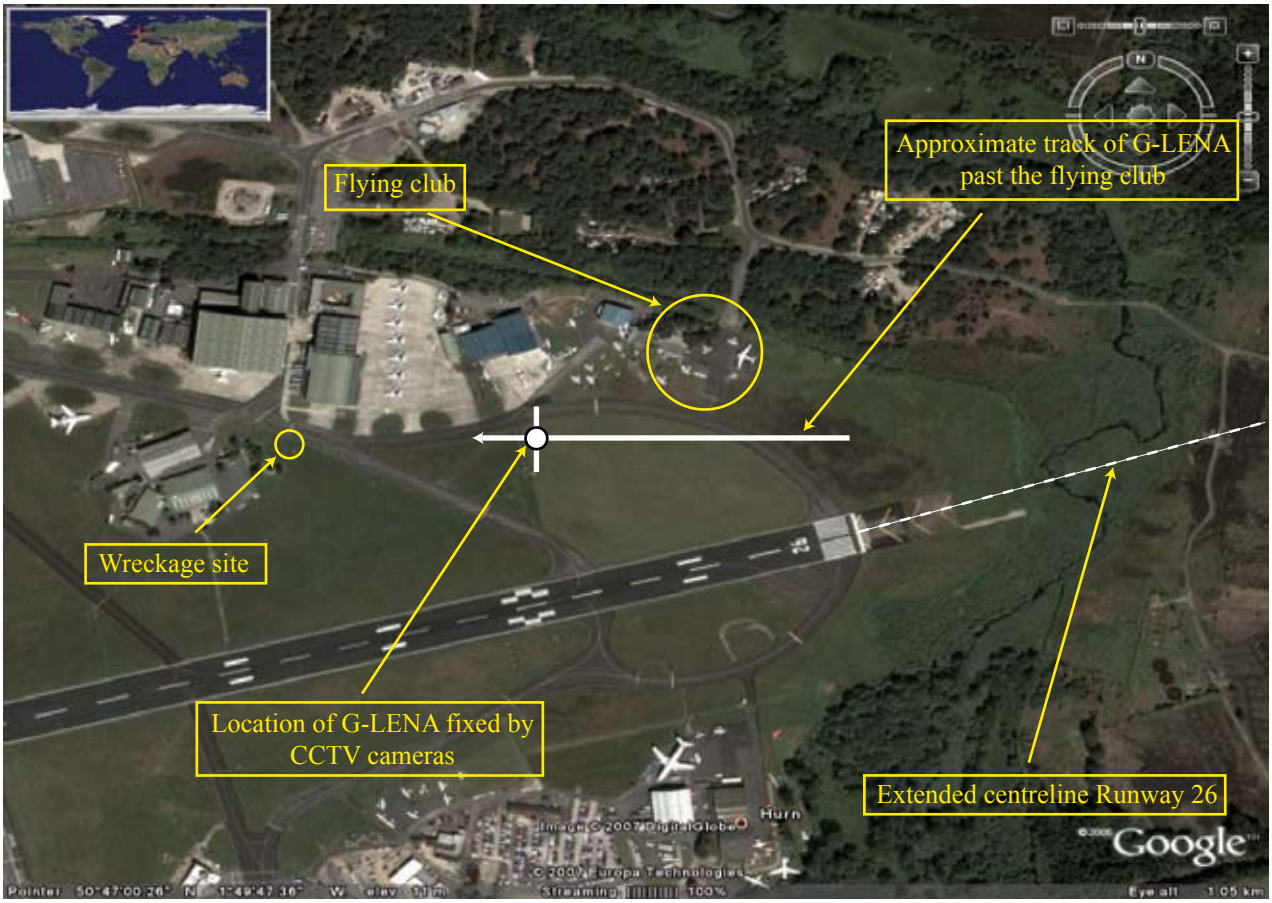
[2] The Yak-52 is typically fitted with an airspeed indicator calibrated in kph, and Yak-52 pilots commonly refer to speeds in these units.

position over the ground was determined at one point, illustrated in Figure 1, when two images from different cameras were captured at the same time; this supported witness information that the aircraft was to the north of the runway centreline as it flew past the flying club.

Relevant Yak-52 details

The aircraft is an all metal two-seat, tandem, single-engine low-wing monoplane, originally designed and manufactured as a military basic training aircraft in the Eastern bloc. Yak-52 aircraft are now relatively commonplace[3] in the UK and are often used for aerobatic flying and training. The aircraft is cleared to operate up to load factors of +7g and -5g.

The never-exceed speed (V_{NE}) of the Yak-52 is 420 kph (227 kt) and its design manoeuvring speed (V_A) is 360kph (194 kt). Its published stalling speed, with power off in 1g normal flight, is 105 kph (57 kt), and in inverted flight is 140 kph (76 kt). One highly experienced aerobatic pilot who flew G-LENA regularly, stated that the inverted power-off stalling



Google Earth™ Mapping Service/Europa Technologies

Figure 1

Diagram illustrating accident site location, Runway 26 threshold area, estimated track of G-LENA and location of the flying club in relation to the accident site

Footnote

[3] There are approximately 70 Yak-52 aircraft on the UK register. (March 2007 data)

speed of the aircraft was closer to 160 kph (86 kt). The available evidence regarding the final moments of the flight was discussed with several other experienced Yak-52 display pilots. They considered that to decelerate from the high-speed run-in to a power-on inverted stall, in a properly controlled fashion, would result in a much greater climb than the few hundred feet mentioned by witnesses.

Accident site

The wreckage of G-LENA was examined on-site both on the night of the accident and the following day. The aircraft had struck the ground on a grassed area between a taxiway and some commercial buildings, Figure 1.

The wreckage site was compact and, although the fuselage and wings were lying flat and the correct way up on the ground, it was clear that the aircraft had impacted in a very steep nose-down attitude, estimated at 80° below the horizontal. The engine, which had become detached from the fuselage in the impact, lay embedded in the ground at this attitude and it was evident that the remainder of the aircraft had rebounded slightly before falling back onto its underside. The impact occurred on a heading of 170°M and the general character of the wreckage indicated that the aircraft's speed had been moderately high and that it had not been in a spin at the time it struck the ground.

Initial wreckage examination

The complete aircraft was present at the accident site which indicated that there had been no pre-impact structural failure of the airframe. The distribution of fragments of the wooden propeller over a wide area to the north of the impact site strongly suggested that the engine had been running at high power. The landing gear and the flaps were in the retracted position at impact.

The structure between the engine and the rear of front cockpit had been completely disrupted in the impact and a severe fire had destroyed much of this region. The wings had remained attached to this damaged structure and, apart from crushing of both leading edges, they were relatively undamaged and had only been superficially affected by the post-impact fire. The rear cockpit was more intact and had been less affected by fire than the front cockpit. The fuselage aft of the rear cockpit, including the empennage, was largely undamaged either by impact forces or fire.

A small, short-handled flat-bladed screwdriver was found lying on the floor of the rear cockpit; it had been damaged in the fire and some of the plastic handle material had melted[4]. This was removed and subjected to particular scrutiny, as a previous accident to a Yak-52 (G-YAKW, 5 January 2003, AAIB Bulletin 10/2003) was caused by just such a screwdriver becoming jammed in the elevator controls at the rear of the aircraft. The aircraft crashed after a vertical manoeuvre, fatally injuring both occupants. (Following this accident, a barrier was required to be fitted behind the rear cockpit on all UK registered Yak-52 aircraft, under Mandatory Permit Directive (MPD) 2004-006, issued by the CAA in April 2004, to prevent debris travelling down the fuselage. G-LENA was fitted with such a barrier.)

It was noted that a small zipped bag, fitted in the rear cockpit, had burnt through in the fire. Members of the syndicate which owned G-LENA reported that no tools were routinely kept in the aircraft.

Footnote

[4] Such a tool is necessary to carry out the pre-flight check on the Yak-52.

Detailed examination

The wreckage of the aircraft was transported to the AAIB facility at Farnborough, where, within the limitations imposed by the disruption and fire damage associated with the front cockpit, a detailed check of the integrity of the flying controls was carried out. No evidence of disconnections was found. However, close examination of the roll control system in the wings revealed indicators consistent with the right aileron being in the trailing edge up position and the left aileron in the down position at the time of impact, ie a roll input to the right. Several of these indicators are shown in Figures 2 to 5.

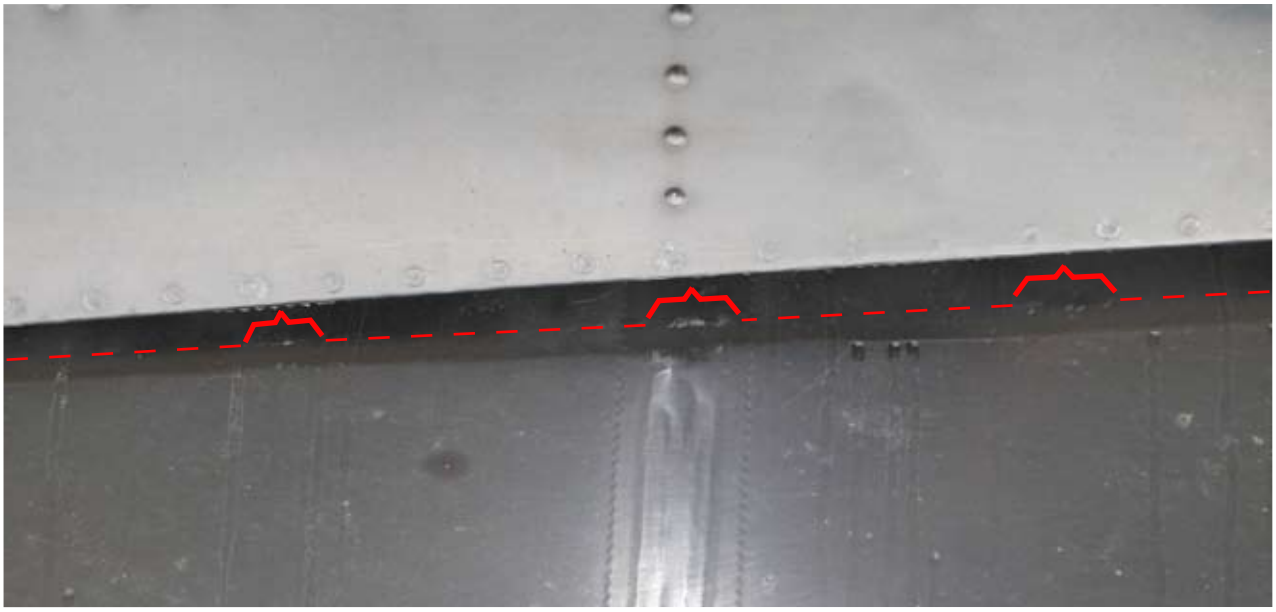


Figure 2

Witness marks on top surface of right aileron from shroud edge made when aileron trailing edge was up

Figure 3

Witness marks of right aileron inboard edge against wing structure with right aileron trailing edge up

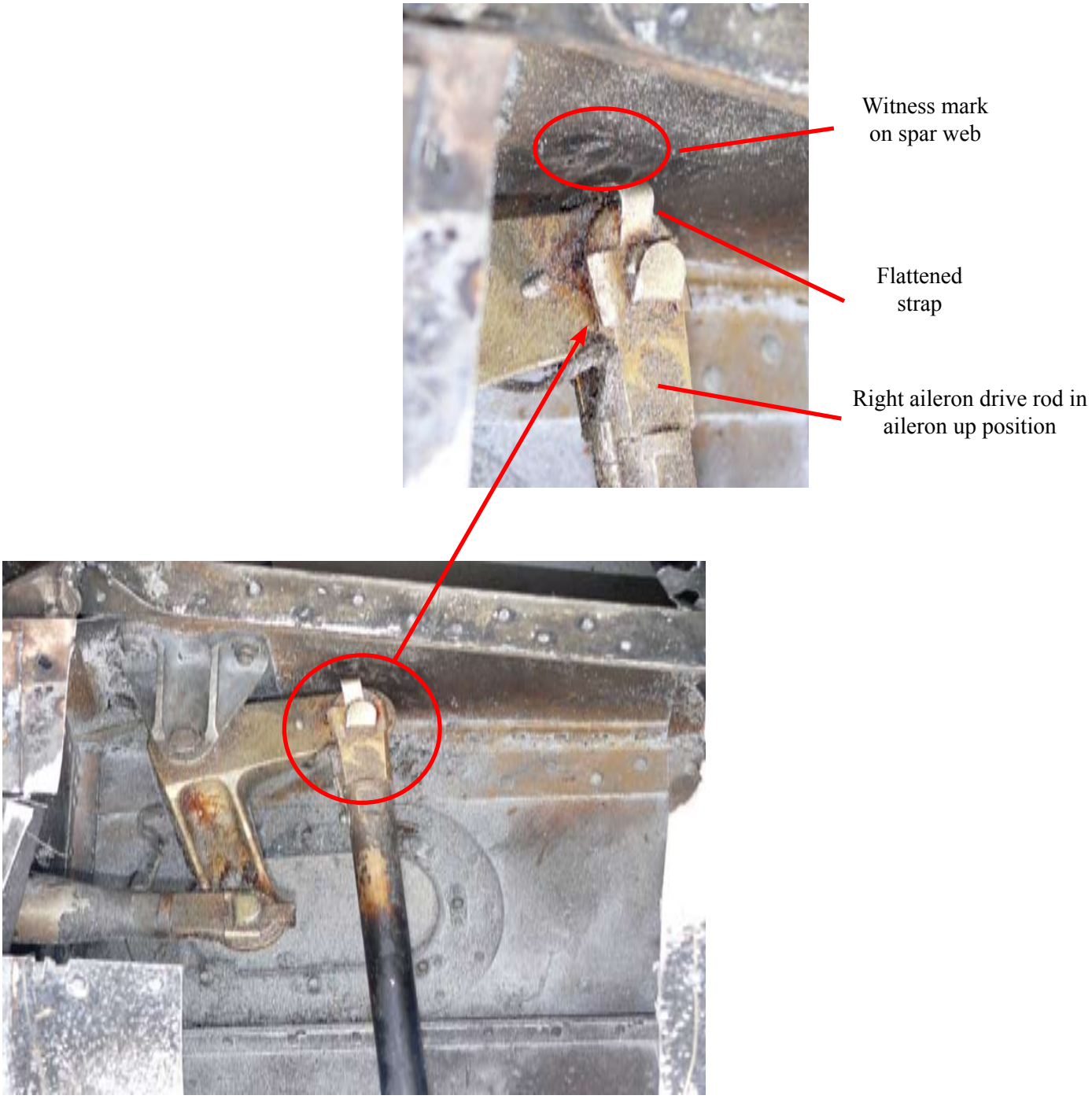


Figure 4

Right aileron drive bellcrank in aileron trailing edge up position.
Note witness marks against rear face of the wing spar and flattening of safety strap (inset picture)

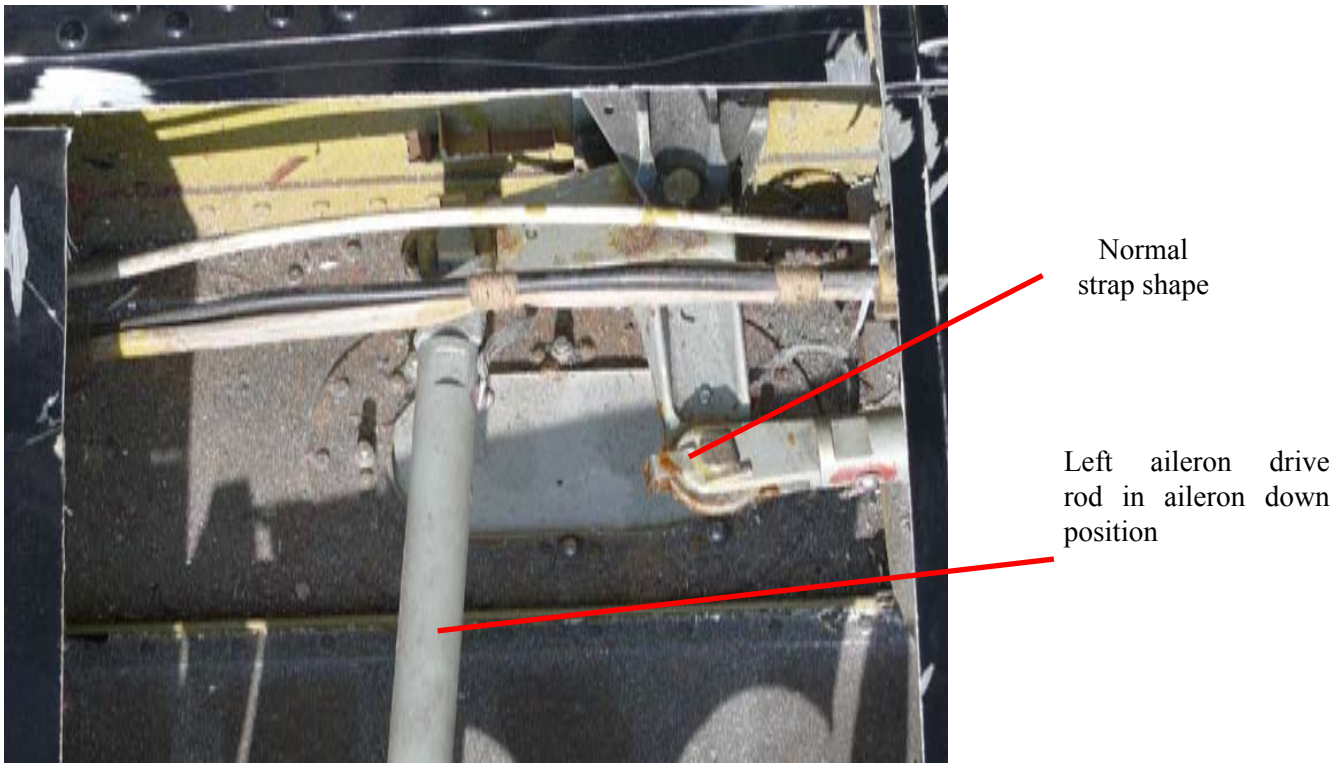


Figure 5

Left aileron drive bellcrank in aileron trailing edge down position

The aileron control linkages in the wings, shown in Figures 4 and 5, were locked in the right roll position by crush damage in the fuselage.

The screwdriver, which had been found in the rear cockpit, was examined for signs of damage consistent with interference with any of the flying control mechanisms. No identifiable mechanical damage was found, although plastic material from the aircraft had melted over part of the handle, rendering any damage in that area impossible to see.

Occupant harnesses

G-LENA was equipped with seven-point seat harnesses in both cockpits, each comprising two shoulder straps, a crotch strap and dual lap straps. When all are employed, the two shoulder straps, which have slotted metal fittings at their free ends, are inserted on to the tongues of the upper lap belt buckle. When the lap belt is fastened, the shoulder straps are secured. The single crotch strap locates similarly on the lower lap belt buckle. When all belts are assembled, the harness is adjusted to restrain the occupant securely.

Several of the harness attachment points to the aircraft's structure, in both cockpits, were found to have failed in overload; these failures were consistent with being occasioned during the impact, Figure 6.

The front cockpit harness fittings were found indicating that the lap straps and the shoulder straps were in place, Figures 7. The crotch strap had not been used.

The harness in the rear cockpit, however, was found with the two lap belts fastened, but neither the two shoulder straps nor the crotch strap had been inserted, Figure 8.

Figure 6

Example of seat belt attachment overload

Figure 7

Front cockpit upper lap strap fittings, as found, showing shoulder straps secured to the lap strap

Figure 8

Rear cockpit dual lap-strap buckles, as found

It had not been necessary for the emergency services to release the seat belts during victim recovery operation, due to the failures of the attaching structure and melting of the belt fabric.

The possibility that the unsecured shoulder straps might have fallen behind, or been positioned behind, the rear seat was considered. Had this been the case, their potential to interfere with the rudder and elevator controls was examined. The rudder control cables and elevator mechanism in this area are mounted on a fuselage frame in the lower part of the fuselage. G-LENA was fitted with an oil tank for a smoke generation system; this was located on a shelf behind the rear seat approximately level with the passenger's head. This effectively formed a barrier to the straps being placed over the top of the seat, but a gap did exist between the sides of the seat back and the fuselage skin on each side. Tests were conducted on another Yak-52, to examine the potential for the unsecured shoulder straps to enter these gaps and hang down, possibly interfering with the flight controls. The tests indicated that the straps would have to be deliberately inserted through the gaps: they would not naturally fall behind the seat. It was determined that the straps, as adjusted on G-LENA, were long enough to touch the flight control mechanisms.

Immediately forward of the tank, the shoulder straps attachment fitting to the airframe was found in place and, although the upper section of these straps had been burnt away, residual molten material remained attached to the right side of the dual fitting. In addition, the metal fittings at the ends of the two rear cockpit shoulder straps were found in the general debris recovered from the cockpits. One was attached to a relatively long section of the left strap, which had suffered fire damage at is uppermost end and the other to the lower section of the right strap, which was severely burnt. Examination of the area behind the rear seat, which had been affected to a relatively small extent by the post-crash fire, failed to reveal any evidence that the shoulder straps had been located in that area at the time of the accident.

However, further testing demonstrated that it was possible for the buckle on an unsecured crotch strap to interfere with the roll control mechanism beneath the rear seat, as a significant gap exists between the aft end of the rear cockpit floor and the seat. Here, it is possible and relatively easy for the strap buckle to become trapped between the pitch control rod[5] and fixed structure, and jam the control when either a right or left roll signal is applied, Figures 9 and 10. This jam has the potential to maintain a right or left roll input to the ailerons and prevent the input being cancelled or reversed. A gap also exists in the front cockpit, but tests showed that it would be significantly more difficult for the crotch strap to migrate to the flight control linkage area below the front seat. However, there was a potential for the strap to interfere with the controls in this area.

Detailed examination of this area in G-LENA revealed co-incident areas of damage and minor scuffing to the paint of the structural members and the pitch control rod, in the location that the strap buckle naturally adopts, should it migrate to this area, Figures 11 and 12.

A similar situation could have existed if the small screwdriver have become lodged in this area. However, the possibility that it could jam the roll system to the same extent as the buckle, was not established.

The pin which secured the top of the hinged seat back in the rear cockpit was identified in the wreckage and

Footnote

[5] The pitch control rod moves for and aft in response to pitch commands, but also laterally at its forward end as roll inputs are made.

Figure 9

View of structure beneath rear seat position of a similar aircraft to G-LENA showing controls with right roll applied

Figure 11

Crotch strap from G-LENA positioned in a similar manner to that shown in Figure 10. Paint damage was present to the upper and lower edges of the longitudinal structural member and on the upper section of the flap actuator casing. (Pitch control rod omitted)

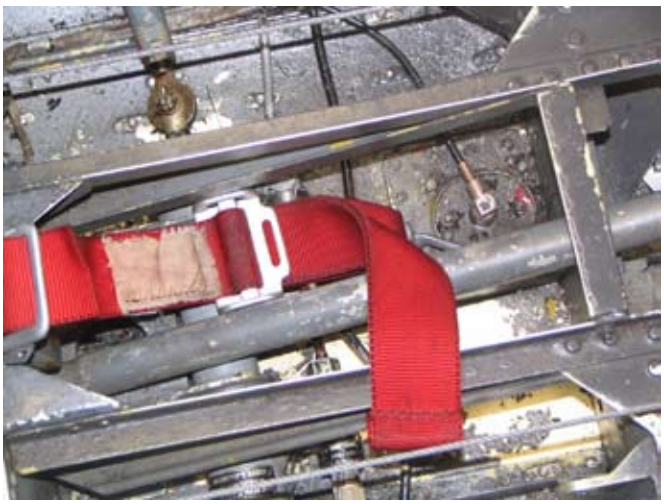


Figure 10

View showing crotch strap buckle jammed between the pitch control rod and fixed structure on a similar aircraft to G-LENA, with left roll being demanded but with the control stick positioned to the right

Figure 12

Paint damage to the pitch control rod in the area co-incident with the buckle location shown in Figure 11

witness marks showed that it was in place at the time of the accident.

Maintenance history

The aircraft's technical documentation was in order and it was noted that G-LENA had received a 50 hour check earlier on the day of the accident.

Pathology

Post-mortem examinations of the pilot and passenger were carried out by a specialist aviation pathologist. No evidence of any pre-existing medical condition in either person was identified and toxicological examination revealed no abnormalities. The cause of death was given as resulting from multiple injuries occasioned during an aircraft accident. The pathologist assessed the peak deceleration experienced by the occupants had been in excess of 200g.

Amongst 16 observations made by the pathologist when commenting upon the injuries sustained by the passenger, under the heading *'Fresh Injuries, Trunk',* three were considered to be relevant and are reproduced below:

'6. Across the front of the chest……. three well defined circular ring abrasions in a straight horizontal line……..; the central one approximately in the middle of the chest measures 110mm in diameter and each abrasion either side of this measured 80 mm in diameter. It is highly likely that these injuries originated from impact with aircraft instruments.

11. In the right quadrant of the abdomen, overlying the right costal margin, an abrasion measuring 150mm x 50 mm , oriented 10 to 4 0'clock; this possibly could have been caused by impact with the top of the control column.

13. In the right lower quadrant of the abdomen, a horizontal abrasion measuring 180mm x 20mm possibly caused by the harness lap belt.'

The location and nature of the injuries described above would be consistent with the passenger being seated normally, and with the control column positioned to demand a roll to the right, at the time of impact.

The possibility that the pilot and/or passenger had been affected by g loads during the pull-up prior to the loss of control was considered. Therefore, the pathologist was asked to comment on the possible physiological effects of positive g on the occupants. His observations are as follows:

'G induced loss of consciousness (g-loc) occurs in response to sustained levels of positive g. The loss of consciousness results from depletion of oxygen in the brain, largely due to impairment of the blood supply to the brain as a result of the effects of increased g on the circulation. Since the brain has a finite reserve of oxygen, g-loc will only occur if g is sustained; this is largely independent of the rapidity of onset of g, although whether an individual experiences visual symptoms prior to loss of consciousness can be influenced by the rate. While it is difficult to be precise about the levels and timing of g exposure in the final manoeuvre preformed by G-LENA, it would seem likely that the initial pull-up to a pitch angle of 30-40 degrees would not have lasted for more than a few seconds. Even if the maximum g-level to which the aircraft is stressed, +7g, had been attained in this manoeuvre, that level of g would need to be sustained for approximately 5-6 seconds to produce the potential for incapacitation. It

seems highly likely that the peak level of g sustained during the pull-up manoeuvre would have been significantly less than 7, and also that it would have been sustained for considerably less time than 5 seconds. In summary, it is felt that although the possibility of incapacitation due to positive g cannot entirely be excluded, it is highly unlikely to have been a causative or contributory factor in the accident.'

Additional information

The CAA publishes a series of Safety Sense Leaflets (SSLs), one of which, Leaflet 23, is entitled *'Pilots – it's YOUR decision'*. One paragraph of this highlights the problem of the temptation which may be felt by pilots to fly in a manner to impress passengers or bystanders. Part of the paragraph states:

'Audiences: are you impressing anyone?

In the review of fatal accidents, more than half of the low flying and aerobatic accidents involved an 'audience' – seldom at a formal air show, but more often to impress friends on the ground, at the clubhouse, or even passengers taken for a flight..'

The text from the SSL mentions *'the review of fatal accidents'* and this is a reference to the CAA *'Review of General Aviation Fatal Accidents 1985-94'*, published as CAP 667.

The SSL 23 paragraph referred to specifically relates to handling and judgement issues. However, the margins for error are considerably reduced with very little time available to the pilot should a handling or technical difficulty arise.

Analysis

Engineering issues

Witness recollections were that the engine note was constant throughout the aircraft's final approach and up to the moment of impact. This, together with the aircraft's relatively high speed and the severe nature of the damage to the propeller at impact, all support the view that there had not been a loss of engine power prior to the accident.

Within the limitations imposed by the considerable impact and fire damage, the examination of the wreckage resulted in no evidence being found of pre-existing malfunction or failure, which might account for the accident. Witness descriptions of the entry to the final roll suggest that the aircraft was under control up to that point, and therefore no control jam or restriction was likely to have been present at that time. Flight control continuity was established as far as was possible and, therefore, whilst it is considered highly improbable that a malfunction of the aircraft precipitated the loss of control, this possibility cannot be completely ruled out.

In summary, the aircraft appeared to have been serviceable prior to the accident.

Operational issues

It was reasonably certain from witness evidence that the passenger in G-LENA did not wish to experience aerobatics on the flight. Although the pilot was capable of flying aerobatic manoeuvres, no evidence was discovered that he intended to do so. It was not established what occurred during the flight but, after takeoff, the aircraft was seen to gain speed at a low height following which a 'zoom climb' was performed before departing to the southwest. Towards the end of the flight, the aircraft approached the airfield from the southeast and the pilot

requested a low approach and go-around, for which permission was given by ATC.

When an aircraft is cleared by ATC to carry out a low approach and go-around, this is understood to mean that the aircraft will perform an approach at normal approach speed, in the landing configuration and along the runway extended centreline, as if to land. This would then be followed by the application of power to climb away either along the runway centreline or just to one side of it; the aircraft would not actually touch down. G-LENA made a low, high-speed, approach to the right of the runway centreline, across the front of the flying club where the passenger's family and friends were gathered, with the landing gear and flaps retracted, before pulling up. This was, therefore, not consistent with normal aviation practice for a low approach and go-around. However, having completed the fast low run, it would be natural to expect the aircraft to climb to a safe height prior to joining the circuit to land. The aircraft was seen to do this, but in a manner described by witnesses as a zoom climb, pitching up abruptly to an attitude of 30º to 40º.

The opinion of several experienced Yak-52 display pilots was that, to decelerate from the observed high-speed run-in to a power-on inverted stall, in a properly controlled fashion, would result in a climb of considerable height, more than the few hundred feet mentioned by witnesses. Therefore it is considered unlikely that an inverted stall occurred.

It is notable that the aircraft's speed during the run-in, determined as 340 kph (183 kt), was close to its design manoeuvring speed (V_A) of 360 kph (194 kt), the speed below which the application of full control deflection in any one axis will not cause damage to the aircraft. In the absence of any evidence to support the possibility that a malfunction precipitated the pull-up and roll to the right, and with the aircraft being flown at a speed below V_A, it is almost certain that that both the pull-up and the initiation of the roll to the right were intentional. However, there are various possible reasons why the roll continued to the right until the aircraft struck the ground, and these are considered below:

- There was no evidence of any pre-existing medical condition in either the pilot or passenger to suggest incapacitation. This conclusion is supported by the fact that the pilot made a short transmission shortly before the impact. Some forms of full or partial incapacitation may be brought on by 'g forces', such as those experienced during sustained positive g manoeuvres. However, medical opinion was that, although the possibility of incapacitation due to positive g cannot entirely be excluded, it is highly unlikely to have been causative or a contributory factor in the accident. Therefore, pilot/passenger incapacitation was not considered to be a causal factor in this accident.

- Both the pilot and his passenger were qualified and experienced aviators. The pilot was known as a generous and selfless individual, and indeed, had undertaken to carry the flight out at his own cost. The purpose of the flight was to provide a pleasant and novel birthday experience for the passenger, with the passenger having declared that he did not wish to experience aerobatics. However, it is likely that the passenger, who held a valid NPPL, may well have been offered the opportunity to handle the aircraft for some of the time during the flight. Therefore, the possibility

that the aircraft might have been flown by the passenger rather than the pilot, at the end of the flight, was considered. It could not be established whether the passenger would have accepted an opportunity to fly the low approach and go-around but, had he done so, it would have been out of character, and very unlikely for him to attempt, or be allowed to attempt, any unusual manoeuvres at low level or an abrupt pull-up at high speed. Moreover, he would have been aware that his shoulder harness and crotch strap were unfastened and, in light of this, would probably have flown the aircraft in a sedate manner, maintaining positive g. Therefore, it is considered very unlikely that the passenger was flying the aircraft immediately prior to the accident.

- The available evidence indicated that no aerobatics were to be performed during the flight. The passenger had expressed his desire not to experience aerobatics, and the pilot had removed the parachutes from the aircraft and replaced them with cushions. In addition, friends of the pilot were of the opinion that it would have been out of character for him to perform aerobatics at low level with or without a passenger. Nevertheless, the aircraft was seen to perform two pull-ups, one just after takeoff and one just before the accident and, although a pull-up from a relatively high speed may not be classified as 'aerobatics', these manoeuvres were inconsistent with the passenger's stated desire for a pleasurable flight and that he did not wish to experience aerobatics. The CAA SSL 23 highlights the temptation for pilots to fly in a manner which could 'impress', and identifies factors relevant in fatal accidents in the past. Low flying involving an audience, seldom at a formal air show but more often to impress friends on the ground at the clubhouse, or even passengers taken for a flight, are factors which have been identified. However, the balance of evidence suggests that it was highly unlikely for the pilot to have attempted an aerobatic manoeuvre after the final pull-up, having already requested the low approach and go-around "and then join downwind right to land", although this possibility could not be completely dismissed.

- In the positive g pull-up manoeuvre, the passenger, who was not experienced in, and appeared to be apprehensive of, aerobatics, may well have felt discomfort, particularly if such a manoeuvre had not been expected. It is possible that such discomfort might be mitigated by, for example, clasping the aircraft's structure or controls in an attempt to feel more secure. Also, without the restraining effects of the crotch and shoulder straps, the possibility is raised that the passenger might have slumped over the control column or 'submarined' to an extent through the lap straps during the pull-up, and interfered with the flight controls. However, this is considered unlikely because of the upright nature of the seating position in the Yak-52, the fact that the aircraft was progressively adopting a nose high attitude and that a similar manoeuvre was seen at the start of the flight with no apparent unusual consequences.

  Also, as witnesses gained the impression that the pull-up and initial part of the roll were under control, it seems likely that any inadvertent interference with the flight

controls would have occurred later in the roll, possibly as the aircraft began to adopt the inverted attitude. It is possible that if positive g was not maintained in such circumstances, an occupant who was not properly secured by a shoulder harness might fall toward the canopy, particularly if the lap belts were not fastened tightly. It is possible, even probable in this situation, that the occupant might grab at anything to hand, or restrict the movement of, or make an input to, the flight controls at a critical time, precluding a safe recovery of the aircraft to normal flight. However, the findings from the post-mortem examination of the passenger indicated that, at the moment of impact with the ground, he was almost certainly seated normally, with the lap strap positioned around his lower abdomen.

Witness recollections of a noticeable yaw prior to the final pitching motion suggested that an inverted stall or a significant control input, or both, occurred. It was not established with any certainty, but it was considered that the yaw could have resulted from the passenger's feet being inserted through the negative g straps on the rudder pedals, leading to an inadvertent rudder input as the aircraft became inverted.

Therefore, whether it was the pilot's intention to roll the aircraft in the climb, or make a turn to the right to join the circuit, the potential for the passenger to become displaced from the normal seated position and inadvertently interfere with the flight controls at a critical time, was considered possible but, in consideration of the post-mortem evidence, fairly unlikely. However, the possibility that the passenger may have felt insecure during the aircraft's final manoeuvres, as he was not fully strapped in, and may have inadvertently interfered with the flight controls, could not be fully dismissed.

- The origin of the short screwdriver found in the rear cockpit was not established. It may have been left in the aircraft, without the pilot's knowledge, after the maintenance action earlier that day, or it may have been placed on board the aircraft by the pilot, possibly in the small zipped stowage bag in the rear cockpit. A small-bladed, tool is necessary to carry out the pre-flight inspection of the Yak-52, and some pilots use a screwdriver similar to that found. The screwdriver found in the wreckage of G-LENA was above the remains of the rear cockpit floor, in a position where it would not have interfered with the flying control mechanisms in flight. Towards the rear of the cockpit a gap existed between the floor and the rear seat, through which this screwdriver could have passed. Had it done so in flight, then there would have been the potential for it to have lodged close to the pitch control rod and possibly restrict the operation of the roll circuit. No witness marks were identified indicating contact between the screwdriver and the structure beneath the seat. This, and the screwdriver's small size, indicate against the possibility that the screwdriver caused a restriction in the roll circuit at a critical moment in the flight, although this possibility cannot be fully dismissed.

- It was established that the two loose shoulder straps in the rear cockpit were very unlikely

to have restricted the operation of the flight controls, by falling down behind the passenger's seat. The remains of the two straps and their end fittings were recovered from the cockpit debris, with no evidence that these straps were in the area behind the seat at the time of the impact and subsequent fire. Had they been behind the seat, it would only have been possible for the straps to interfere with the rudder and elevator controls. Any such interference would most likely cause a restriction to the operation of the elevator control, rather than making any a positive input to the roll system. Therefore, it was concluded that it was very unlikely for the two unsecured shoulder straps to have precipitated an uncommanded roll input or restrict the roll circuit's operation.

- The tests carried out on the similar aircraft, however, revealed that it was possible for the buckle on the rear seat crotch strap to become trapped between the pitch control rod and fuselage structure. This would most likely happen once a significant roll input had been made, either to the left or right, thereby restricting the movement of the roll control system back to neutral or an opposite direction input. A restriction of this nature would be consistent with the continuous roll to the right seen by witnesses just prior to the accident. Evidence identified from the wreckage and the post mortem examination of the passenger, all indicated that the roll circuit was probably positioned to demand a roll to the right, at the time of impact. Although not determined positively, there was evidence to suggest that the buckle of the unsecured crotch strap might have become trapped between the structure and the pitch control rod beneath the rear seat, after the roll to the right had been initiated. Had it done so, then it would have been difficult if not impossible for it to have become free, particularly in the very limited time available to the pilot whilst the aircraft manoeuvred at low level. To release the buckle, the pilot would have had to make a further right roll input and induce negative g; this would not have been an intuitive action, particularly at such a low height and with the aircraft already rolling rapidly to the right.

The report on the earlier accident to G-YAKW contained the following Safety Recommendation:

> ***'Safety Recommendation 2003-71***
>
> *The CAA should require the Yak-52, and aircraft of a similar design operating on the UK register, to have fitted a method of preventing loose articles migrating to a position where they could interfere with the operation or jam flight controls.'*

In response to this recommendation, the CAA issued MPD 2004-006, requiring a barrier to be installed behind the rear cockpit to prevent debris travelling down the fuselage where it could become lodged in the elevator controls. However, no such barriers were required to be installed to protect other areas where control runs are vulnerable to becoming restricted by foreign objects. As the roll control mechanism on the Yak-52 is vulnerable to being jammed by loose objects, and as the investigation determined that a restriction of this circuit was a possible factor in the accident, the following Safety Recommendation is therefore made:

Safety Recommendation 2007-053

It is recommended that the Civil Aviation Authority review their response to AAIB Safety Recommendation 2003-71 with the intention of minimising the possibility of loose articles becoming jammed in any of the flight controls of Yak-52 aircraft on the UK register.

Conclusion

It was not positively established why control of the aircraft was lost as the aircraft rolled to the right, passing through the inverted attitude, after a fast run-in at low level and a pull-up. It was concluded that the pull-up, or 'zoom climb', after being given clearance by ATC for a low approach and go-around, was most probably a deliberate action by the pilot, similar to the initial zoom climb performed after takeoff. In the absence of any aircraft malfunction being identified, it was also concluded that the initiation of the roll to the right was probably intentional, but that a restriction and/or an uncommanded input, or inputs, to the flight controls occurred, which precluded a safe return to normal flight. The most likely cause of any restriction of the controls was that a buckle on the unsecured crotch strap may have become jammed in the flight controls. The fact that the passenger's shoulder and crotch straps were unsecured was considered a possible contributory factor, which could have led to the passenger feeling insecure and affecting the controls during the final part of the flight.

ACCIDENT

Aircraft Type and Registration:	Bolkow BO 208C Junior, G-ATXZ
No & Type of Engines:	1 Continental O-200-A piston engine
Year of Manufacture:	1966
Date & Time (UTC):	23 September 2006 at 1420 hrs
Location:	Tatenhill Airfield, Staffordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to the propeller, nose landing gear, engine exhaust, carburettor airbox and lower engine cowling
Commander's Licence:	Private Pilot's Licence
Commander's Age:	45 years
Commander's Flying Experience:	144 hours (of which 57 were on type) Last 90 days - 1 hour Last 28 days - N/K
Information Source:	AAIB Field Investigation

Synopsis

After conducting a short local flight the pilot flew the aircraft back to the departure airfield to carry out some 'touch-and-go' landings. During the climb out from the second takeoff, following a normal touchdown and landing roll, the nose landing gear fell away from the aircraft. A metallurgical examination revealed fatigue crack growth in the nose landing gear outer tube. It was not possible to establish the length of time that the fatigue cracking had been present prior to the final failure. The nose landing gear had been fitted to the aircraft as a replacement item some 51 airframe hours prior to this accident.

History of the flight

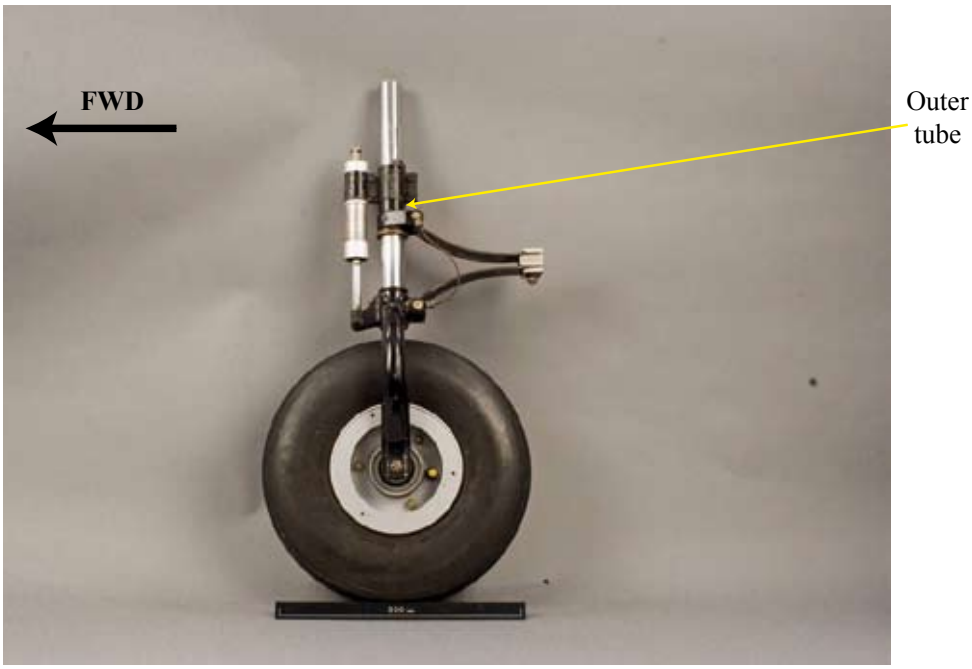
After conducting a short local flight the pilot flew the aircraft back to the departure airfield to carry out some 'touch-and-go' landings. During the climb out from the second takeoff, following a normal touchdown and landing roll, the pilot was informed by ATC that the nose landing gear (NLG) had fallen away from the aircraft. The pilot decided to land back at the airfield and informed ATC of his intentions. ATC cleared all aircraft from the circuit and runway. The landing was on the main landing gear with the fuel, magnetos and battery master switched off and the engine closed down but with the propeller slowly windmilling. The pilot held the aircraft's nose up, clear of the surface, as long as possible but as the speed decayed the nose dropped and the aircraft weathercocked

into wind, left the runway and entered the grass area at the side, where it came to rest.

Engineering examination

The detached NLG assembly (Figure 1) was taken to the Materials and Failures Department, Qinetiq, for metallurgical examination.

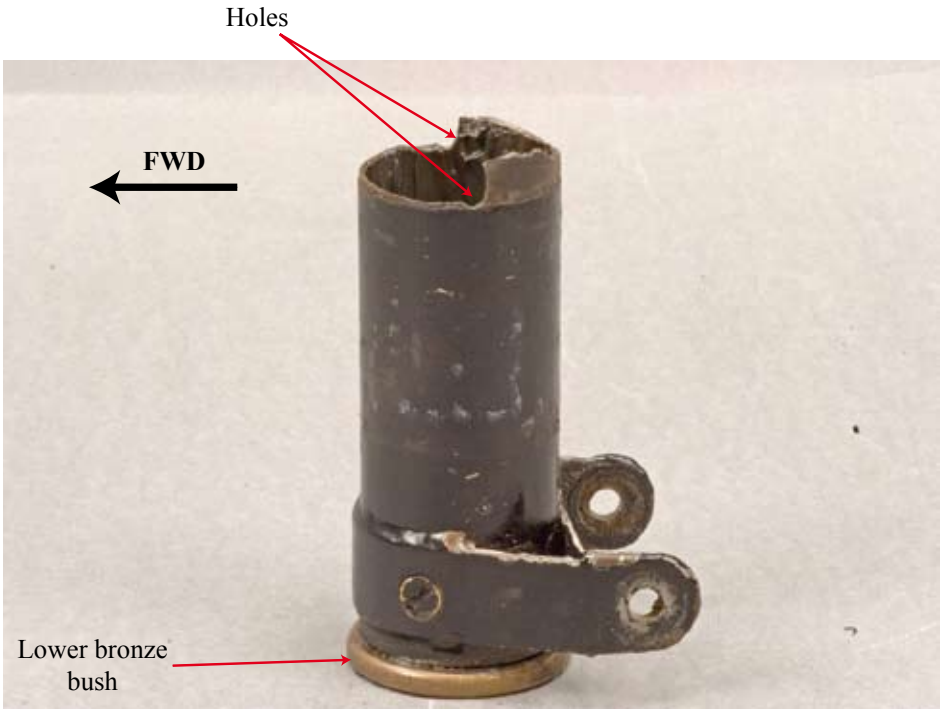
The outer tube had fractured between two holes that were located on either side of the tube in the area between the two bronze bushes (Figure 2). It was noted that the internal surface of the tube was well greased. Visual examination of the fracture surface showed that it was masked by grease and corrosion deposit. The majority of the fracture appeared to be angled at 45º, which is characteristic of overload failure in thin walled plate and tube. Adjacent to the holes, some areas of flat fracture were observed. After cleaning, examination of the tube showed an area on the forward section where paint had been removed and a small indent was visible from damage that had occurred prior to the application of the paint. The surrounding tube surface exhibited light grinding marks suggestive of local



Courtesy of QinetiQ

Figure 1

Section of NLG that detached from the aircraft



Courtesy of QinetiQ

Figure 2

Fractured outer tube removed from NLG

blending-out of corrosion-affected areas indicating that the tube had been in use prior to the last coat of paint being applied.

The cleaned fracture surface was examined in a scanning electron microscope (SEM). Unfortunately it was so severely corroded, and had suffered post-failure mechanical damage, that little surface detail was visible. Within the areas of the flat fracture, parallel markings were observed, which could have been possible striations or 'beach marks'. However, due to the degree of corrosion, it was not possible to confirm this. To summarize, areas of flat, fatigue-like crack growth were observed adjacent to the side holes. Outside these areas the fracture surface was typical of overload failure. The rear section showed less corrosion damage so it is assumed to have failed last, allowing the NLG to detach from the aircraft. It was not possible to establish the length of time that the fatigue cracking had been present prior to the final failure.

Previous accidents

In February 2005 the aircraft was involved in a landing accident (AAIB Bulletin 6/2005) where the NLG collapsed. Following this accident major repairs were carried out which included the replacement of the NLG. The accident that is the subject of this report occurred 51 airframe hours after this repair.

In August 2005, 13 airframe hours after the accident in February, the aircraft had another landing accident which deformed the fore/aft brace strut between the NLG leg and engine firewall. The NLG was inspected, although not checked for cracks, and the brace strut repaired. Following inspection by a Popular Flying Association (PFA) Inspector, the aircraft was cleared for flight.

Nose landing gear history

The replacement NLG that was fitted to the aircraft, following the accident in February 2005, was supplied by an aircraft parts supplier in England who had sourced it from a specialist Bolkow parts supplier in Germany. The NLG outer tube had been repaired and released with a 'JAA Form One' by a JAR 145 approved organisation, also in Germany, in 2001. The worksheet associated with this repair did not indicate that any inspection for cracking had been carried out. The NLG outer tube had previously been fitted to Bolkow 208 registration D-EMFU, but enquiries with the German aviation authorities and UK-based aviation insurance databases did not reveal any reported incidents or accidents to this aircraft. It is not known when, where or by whom the replacement NLG was assembled using the repaired outer tube and no release certificate has been located, although none was required as G-ATXZ was operated on a Permit to Fly.

Airworthiness Directive and service instructions

In May 1972 Messerschmitt-Bolkow-Blohm (MBB) issued Service Bulletin (SB) No 208-32/20-1 which was upgraded to an Airworthiness Directive (AD) No 72-92 by the Luftfahrt-Bundesamt of the Federal Republic of Germany. The SB/AD required that at 100 hour intervals the outer tube of the nose landing gear leg be visually examined internally by a mirror and a light for evidence of cracking in the area between the two bronze bushes. There is currently no requirement to carry out this examination following a reported heavy landing or when damage has occurred to the NLG. The following safety recommendation is therefore made:

Safety Recommendation 2007-038

It is recommended that the European Aviation Safety Agency (EASA) review the inspection requirements of Airworthiness Directive No 72-92 to ensure the continued airworthiness of Bolkow BO 208 nose landing gears.

Other information

As of February 2007 there were 18 Bolkow BO 208 aircraft registered in the UK, seven operated on a Permit to Fly, maintained to PFA requirements, and 11 operated on a Certificate of Airworthiness, maintained to CAA requirements. Aircraft operated on a Permit to Fly do not require 'JAA Form One' release certificates for any replacement parts fitted whereas aircraft operated on a Certificate of Airworthiness do require this. It is important that this inconsistency should not result in a reduced level of airworthiness, therefore:

Safety Recommendation 2007-039

It is recommended that the Civil Aviation Authority review the airworthiness category under which UK-registered Bolkow BO 208 aircraft are operated.

ACCIDENT

Aircraft Type and Registration:	Cameron N-90 Balloon, G-INSR
No & Type of Engines:	Cameron Super Mark 4 twin burners
Year of Manufacture:	1998
Date & Time (UTC):	8 September 2006 at 1745 hrs
Location:	Wood Dalling, Norfolk
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - 1 (Serious) Passengers - 1 (Minor)
Nature of Damage:	No damage to balloon
Commander's Licence:	Private Pilot's Licence (Balloon)
Commander's Age:	43 years
Commander's Flying Experience:	54 hours (of which 46 were on type) Last 90 days - 9 hours Last 28 days - 4 hours
Information Source:	AAIB Field Investigation

Synopsis

While landing the balloon in a relatively strong wind, the pilot was thrown from the basket. His leg became entangled in the balloon parachute ripline and as the balloon became airborne again, he was carried into the air, hanging below the basket. At approximately 30 feet agl, the line unravelled itself and the pilot fell to the ground. The balloon descended with the two passengers on board pulling on the ripline, and landed without further incident. One safety recommendation has been made.

History of the flight

The decision to fly this early evening flight was taken earlier that afternoon after the pilot had checked the relevant meteorological forecasts. He then telephoned his balloon club's co-ordinator who arranged for the balloon and several of the club's members to meet the pilot at a public house car park. This is one of the club's regular launch sites and the pilot was familiar with operating from this location. After the pilot had completed his initial safety checks, the two passengers climbed into the basket and the pilot briefed them on safety procedures. One of the passengers had flown several times before with him but the other was introduced as a new club member and it was to be his first flight. The safety briefing included where the passengers should position themselves, what they could and could not touch and how they should prepare for the landing. On conclusion of the brief, the passengers vacated the basket whilst the balloon envelope was

attached and inflated. The pilot and passengers then reboarded and the balloon took off at 1653 hrs. The passenger on his first balloon flight recalled that "it was still windy as the balloon and basket were blowing about and the [ground] crew were endeavouring to keep it steady for departure". The pilot reported that it "is usual on inflation for the balloon to move around until it is fully pressurised".

After takeoff the balloon climbed to approximately 2,000 feet agl and followed a mean track of 290° at 11 kt. The flight continued uneventfully for an hour and the pilot then made preparations for landing. A landing field was selected and the passengers adopted their briefed landing positions when the balloon was approximately 50 feet agl. At this point the pilot had to arrest the balloon's descent briefly as they were heading for a small copse of trees in the middle of the landing field, the rest of which was covered in short stubble. On passing over the trees, he pulled on the red rope (ripline) that opens the 'parachute' valve in the top of the envelope to allow air to escape and the descent to continue. The basket touched down on its front corner which had the effect of pitching the basket rapidly forward and the pilot, who was in the usual position of holding onto the red rope with both hands, was ejected out of the basket. He landed on the ground ahead of the basket and was then run over by it as it continued to drag across the field. As it did so, the ripline wrapped itself around his right foot and he was briefly dragged along the field before the basket became airborne again with the pilot hanging beneath it. At a height of between 20 and 40 feet the line unravelled itself from the pilot's foot and he dropped to the ground, landing on his back. He remained conscious and shouted to the passengers "pull on the red rope". The passengers heard this, pulled the ripline and the basket descended and struck the ground. It was pulled onto its side by the envelope before coming to rest. The passengers were able to vacate the basket and turn the gas burners off before checking on the condition of the pilot who was lying approximately 100 metres away.

Using mobile telephones, the retrieval crew and emergency services were directed to the field and the pilot was taken to hospital where he remained for six weeks. One of the passengers also required treatment for a cut sustained during the second landing.

Meteorology

Prior to the flight, the pilot contacted the Met Office and obtained the 'UK Low-Level Spot Wind Chart' (Form 214), the 'Forecast Weather Below 10,000 feet' (Form 215) and the 'Airmet Balloon Forecast' for the relevant area. These forecasts stated that a moderate and stable south-easterly flow would affect the area with isolated cloud at 2,000 feet amsl and excellent visibility. The surface wind was forecast to be 080º/5 to 8 kt.

The pilot carried GPS equipment on board the balloon which displayed and recorded the groundspeed of the balloon. This recorded groundspeeds (which can be considered windspeeds) during the initial part of the takeoff of less than 5 kt. The data does not precisely depict the time of the first touchdown, but during the last three minutes of the flight, the maximum recorded groundspeed is 11.7 kt with an average over the same period of 8 kt.

Flight status

The passenger taking his first balloon flight had joined the balloon club as a result of responding to a radio charity auction. In November 2005 a local radio station invited listeners to bid for a donated event using the phrase:

'Take to the skies in the (company) hot air balloon. If it is your first flight you will receive a champagne reception on landing and you will be presented with a First flight certificate.'

The passenger was told that his bid had been successful and sent a letter explaining that the balloon sponsor was:

'pleased to donate membership of the Balloon Club from 1 November 2005 which will include a flight for one person in our sponsored hot air balloon, to be taken during the membership.'

Although the passenger originally believed he had bid for a commercial balloon flight, he accepted that what he had actually purchased was membership of a private balloon club which included one flight.

Any flights taken by club members are technically private flights and as such do not require the balloon operator to hold or comply with an Air Operators' Certificate (Balloons). Pertinent differences between private and commercial flights are that pilots flying privately are not required to hold a commercial pilot's licence and they are also not required to use a pilot restraint harness.

The CAA publication CAP 611 '*Air Operators' Certificate: Operation of Balloons*' states that in order to operate public transport balloons, an operator must include instruction on:

'The use of pilot restraint harnesses that are fitted to all company balloons. Instructions must state that such harnesses must be worn and attached before the balloon quick release restraint is released, worn throughout the flight, and not released until the end of the flight when the balloon has come to a complete and final standstill.'

The British Balloon and Airship Club (BBAC) training manual section 15.3 states that:

'A pilot restraint, as used in public transport balloons, could be very useful.'

Balloon details

Issue 10 of the Cameron Hot Air Balloon Manual Section 2.2 states:

'1. Balloons must not be flown free in surface winds greater than 15 kt.

2. The balloon must not be flown in meteorological conditions which could give rise to erratic winds and gusts of 10 kt above the mean wind speed.'

This balloon was not fitted with turning vents which are side vents that allow the balloon to rotate. Turning vents are particularly useful for balloons with rectangular baskets (as in this case) to allow the longer side of the basket to be aligned perpendicular to the landing direction.

Analysis

This flight was conducted within the balloon's weather limitations and the pilot held the required qualifications to fly with the balloon club members. Despite this, a situation developed where the balloon became airborne without a qualified pilot on board, hazarding the passengers and seriously injuring the pilot.

Although the landing wind was close to the operating limits, there was no reason why the pilot would not have been able to control a landing under these circumstances and if he had remained in the basket, it is likely that there would have been no injuries. Without turning vents, landing on the forward edge

of the basket is always a possibility and therefore consideration needs to be given towards keeping the occupants in the basket. The passengers have their hands free to hold the grab handles inside the basket but the pilot is likely to be holding onto the parachute ripline with both hands and is consequently more vulnerable to being thrown out. As previously stated, commercial balloon operations require the pilot to wear a restraint harness and this would have prevented the pilot's ejection in this accident. After this accident, the BBAC issued a safety newsflash recommending that on all flights the pilot should wear a suitable harness with the means to fasten himself securely into the basket. The newsflash emphasised that the harness does not have to be attached for the duration of the flight but recommends attaching it to the basket, if required, as part of the pre-landing checks.

Follow-up action

This incident was discussed at a meeting of the private balloon club committee on 8 October 2006. The minutes of the meeting recorded the following;

> *'We have learned a lot from the recent accident and the following procedure will be put into place. A harness will be bought for the pilot to be worn by him on all flights and clipped onto a secure fastening on the basket when coming into land. All crew will have special emergency training to include: pulling the parachute out, making sure the gas is off and safe, emergency radio procedures. We will have practical sessions ... and draw up some written reminders.*
>
> *It was also discussed that there should always be a trained crew member in the basket with a new passenger to help the pilot and take charge in an emergency. Crew briefing from now on will always include reminders of the emergency procedures.'*

Safety Recommendation

As a result of this accident, the following Safety Recommendation is made:

Safety Recommendation 2007-47

It is recommended that the CAA, in conjunction with the BBAC, encourages pilots on all private balloon flights to wear suitable harnesses with the means to fasten themselves securely into the basket when required.

ACCIDENT

Aircraft Type and Registration:	Schleicher ASW 20L glider, BGA 4354
No & Type of Engines:	None
Year of Manufacture:	1979
Date & Time (UTC):	23 September 2006 at 1032 hrs
Location:	Keevil Airfield, Trowbridge, Wiltshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Fatal) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	BGA glider pilot's certificate
Commander's Age:	67 years
Commander's Flying Experience:	1,116 hours (of which 215 were on type) Last 90 days - 7 hours Last 28 days - 3 hours
Information Source:	AAIB Field Investigation and information provided by the British Gliding Association

Synopsis

The right wingtip of the glider made contact with the ground as it became airborne at the start of a winch launch, causing the glider to yaw and then roll uncontrollably to the right. The winch cable was not released from the glider, which continued to roll, coming to rest inverted. The British Gliding Association (BGA) has reiterated its advice to pilots encountering similar circumstances and emphasised the need to commence the launch with their left hand on the cable release control.

History of the flight

Members of the resident gliding club were conducting winch launch operations from the edge of the asphalt Runway 13 at Keevil, near Trowbridge in Wiltshire. BGA 4354, an ASW 20L single seat glider, was being flown by an experienced glider pilot who had 215 hours experience on the type.

BGA 4354 was launched with the assistance of a wing walker whose main function was to hold the glider wings level until the pilot was able to do so using the aerodynamic controls. Prior to the launch the pilot and wing walker carried out 'release checks' to ensure that the winch cable would release correctly[1], either if pulled backwards off the glider's tow hook or if the

Footnote

[1] Section 2.11 of the gliding club's Flying Order Book entitled *'Release checks'* states *'The glider release hook is to be checked before the first flight of the day to ensure that it releases under tension and that the back release mechanism works in the correct manner'.*

cable release control in the glider cockpit was operated. The wing walker stated that this check was completed satisfactorily.

At the start of the first attempted launch the glider overran the winch cable - a situation which can arise when a glider moves forward faster than the cable due to a momentary winch stall, insufficient winch acceleration or rough ground which then causes the glider to accelerate erratically. This winch launch was aborted to avoid any possibility of the cable becoming entangled with the wheel or another part of the glider. The cable was re-engaged and a second launch attempted from the position to which the glider had rolled following the first attempt – some 50 m ahead of its original start position.

At the start of the subsequent launch the wing walker found that he had to push down on the glider's left wing in order to keep its wings level. He continued to hold the wing, running along the hard runway surface to the left of the glider until he could no longer keep up with it. When he let go of the wingtip the glider became airborne almost immediately but rolled to the right. The right wingtip struck soft ground to the right of the runway causing the glider to yaw and roll rapidly to the right, pitch nose down and somersault inverted. The tail broke off at the base of the vertical stabiliser, causing the top of the cockpit canopy to bear most of the subsequent ground impact. The pilot, who was restrained by a four-point harness, received severe injuries to his unprotected head when the canopy disintegrated.

The winch-driver stated that the glider appeared to drop its right wing as it became airborne. In accordance with his training he maintained power to continue the launch but, when the bank angle of the glider reached 90 degrees and its nose started to drop, he cut the power and applied the winch brake. The winch cable remained attached to the glider throughout the accident sequence.

Members of the club present at the launch site ran to the glider and attempted to return it to its upright position in order to assist the pilot. An air ambulance arrived shortly afterwards. The pilot, who was taken by air to hospital in Bristol, remained unconscious and died of his injuries four days later.

BGA investigation

The investigation was initially conducted by the Safety Member of the Gliding Club but, in accordance with established procedures, was continued by the AAIB following the pilot's death.

Winch information

The winch which towed BGA 4354 performed normally during the accident launch and has been used successfully since the accident without modification. There was no evidence that this winch or its operation had an adverse effect on the accident launch.

Aircraft information

The Schleicher ASW 20 is an FAI[2] 15 m class glider, built from a composite fibreglass structure. It was designed in Germany and first flew in 1977 (see Figure 1). The ASW 20L is a modified version that can be fitted with optional wingtip extensions which extend the total wingspan from 15 m to 16.59 m. BGA 4354 was manufactured in 1979 and was fitted with the wingtip extensions at the time of the accident. The last annual maintenance inspection of the aircraft was completed on 20 March 2006; at this time the aircraft had logged 932 hours.

Footnote

[2] FAI, Fédération Aéronautique Internationale, responsible for ratifying aeronautical records.

The aircraft's flight controls consist of a cable-operated rudder and an elevator, ailerons, and airbrakes, all operated by push-pull rods. The aircraft is also fitted with flaps operated by push-pull rods and an associated cockpit lever with six detent positions. A mechanical mixing unit between the wings enables partial flap movement to augment aileron control when the control stick is moved laterally. All flight control push-pull rods have 'hotelier' connections that enable simple disconnection to permit wing and tailplane removal for transport.

Figure 1

ASW 20 glider without wingtip extensions

Cable release control

The cable release control was located to the left of the aircraft centreline, at the base of the instrument binnacle and ahead of the control column. An adjacent control, used to adjust the rudder pedals, was located just to the right of the aircraft centreline. The two control handles terminated in spherical knobs approximately 30 mm in diameter and were identical except that the cable release control was yellow and the rudder pedal adjustment control was brown (see Figure 2). Both controls were designed to operate when pulled. A more detailed description of these controls is given under the heading 'Additional information'. The Safety Member of the Gliding Club considered that during a winch launch there was no need for a pilot to place his left hand anywhere other than on the cable release control.

Figure 2

Yellow cable release control on BGA 4354

Variable flap setting

There are six flap settings. Starting from the most forward position and progressing aft there are four takeoff positions: 1 (-12º), 2 (-6º), 3 (0º), 4 (+9º) and two landing positions: 5 (+35º) and 'Landing' (+55º). Increasing the positive deflection reduces stall speed but also reduces aileron effectiveness.

The use of a negative flap setting has been found to improve directional control at low speed (below approximately 20 kt), which is useful during aero-tows that produce relatively slow acceleration. The greater acceleration produced by a winch launch usually results in adequate control almost immediately. The flight manual stated that flap position 3 should be used for launch.

Pilot experience

The pilot first flew solo in a glider in 1984. He held a 'full silver badge', indicating that whilst operating gliders he had achieved a gain in height of 1,000 m or more, a flight on a straight course of 50 km or more and a flight of at least 5 hours duration. The BGA recorded him as having made a 'gold badge' distance claim, indicating that he may have carried out a flight of 300 km or more. He was an Assistant category instructor, enabling him to give gliding instruction as specifically authorised by the Chief Flying Instructor of the gliding club.

The pilot was in good practice. Since the beginning of 2006 he had flown 102 hours in the course of 214 flights, 204 of which were winch launches. Of these, 42 flights were conducted in BGA 4354, 36 of which were winch launches.

Meteorological information

Data recorded by the gliding club weather station indicated an average wind from 115º at approximately 10 kt. Lyneham, 12 nm north-north-east of Keevil, was the nearest station providing information to the Met Office. The reported wind there at 1050 hrs was from 110º at 12 kt. The next nearest reporting station was Boscombe Down, 17 nm south-west of Keevil, where the reported wind at 1050 hrs was from 120º at 13 kt.

The ASW 20L flight manual stated that the maximum crosswind component for operation of the glider was 13.5 kt.

Aerodrome information

Keevil is an airfield from the second world war era, located at the northern edge of Salisbury Plain, beneath a series of hills forming a ridge on its south-eastern boundary. The site is operated by the Ministry of Defence for the training of air mobile units. The main runway, Runway 21, is maintained in good condition for occasional use by military transport aircraft. Use of the site as a heavy equipment drop zone has rendered the grass areas unusable for aircraft movements. Consequently, glider operations are restricted to Runway 21/12 and the untended Runway 13/31, which is partially overgrown. The remaining runway is in poor condition and seldom used.

The gliding club maintains several winch vehicles and a coach which serves as a mobile office. On flying days, the coach is positioned beside the launch point for the use of members involved in flight operations. The main club facilities are accommodated in a collection of Nissen huts on the southern edge of the airfield and do not overlook the Runway 13 launch point, where the accident occurred. The control tower, an original structure near the club buildings, is not manned.

Aircraft wreckage examination

An engineering officer of the Gliding Club examined the aircraft at the accident site. Before disassembling the aircraft he confirmed that the wings were secure, the rudder pins were both inserted correctly and that all 'hotelier' control connections were correct and secure. The disassembled aircraft was then recovered to the AAIB for a detailed examination.

The aircraft's right wing had failed due to an overload at a location 2.4 m inboard from the wingtip, measured with the wingtip extension fitted. The right wing airbrake was in the extended position and bent almost 90º aft. The tail section of the aircraft had failed over its entire circumference 0.35 m forward of the lower leading edge of the vertical tail. The aircraft's cockpit canopy had shattered into multiple pieces. There was surface damage to the upper side of the horizontal tail and the

upper rudder hinge pin was bent and had detached. The remainder of the aircraft's structure was relatively intact, apart from damage to the left wing root and compression damage to the upper fuselage skin, aft of the canopy.

All control push-pull rods were examined and could be moved freely except in those locations where impact damage had occurred. There was no evidence of any pre-impact control rod or rudder cable failure. Inside the right wing, close to the outboard failure point, there was an imprint on the upper wing skin from a bolt which forms part of the right aileron bellcrank. This imprint probably occurred during the impact sequence and is consistent with a bellcrank position that would result in an aileron deflection of 15º to 27º trailing edge down (commanding roll to the left). Full aileron deflection was measured at 31º trailing edge down.

After the accident the flap control lever was reported to have been found between positions 4 (+9º) and 5 (+35º); however, it may have moved during the impact sequence.

Cable release hook operation

The cable release hook mechanism was examined and operated normally, moving freely when the control knob was pulled. The force required to pull the control knob to the point of approximate cable release was measured at 18 lb, and a pull to full hook retraction was measured at 22 lb. These measurements were made without a tow cable attached. The force of a tow cable on the hook could increase the pull force required to release it, but it was not feasible to test for this difference. The angle of pull can also increase the pull force, although angles of up to 30 degrees from straight had no noticeable effect on pull force. The current EASA Certification Specifications for gliders state in CS 22.711 and CS 22.143(c) that the force required to release the tow cable must not exceed 20 daN (45 lb) with a cable under load attached.

The EASA requirements do not specify what shape or size the cable release control needs to be but specifies in CS 22.781 that:

> *'The towing cable release control must be so designed to be capable of operation by a gloved hand exerting the force specified in CS 22.143(c).'*

The certification of the ASW 20L predated EASA requirements.

Harness attachment failure

The aircraft was fitted with a four-point shoulder and lap strap safety harness with each of the four ends attached to a fitting that was secured within the fibreglass structure by a pin. The fitting from the left lap strap had separated from the aircraft structure as a result of a failure of the fibreglass skin that retained the pin (see Figure 3). The steel pin had also bent which indicated that the limit load of the pin was exceeded. The aircraft manufacturer was consulted regarding this failure and they stated that the lap strap was designed to withstand a maximum deceleration of -4.015g with a 1.33 fitting factor and assuming a pilot mass of 115 daN (117 kg). The design limit load of each lap strap fitting was thus 307 daN [3]. The manufacturer carried out tests on this fitting type which demonstrated that it could withstand a load of 460 daN without any damage to the pin, fitting or surrounding structure (a safety factor of 460/307 = 1.5). In this accident the pin was deformed so it probably experienced a load in excess of 460 daN during the accident sequence.

Footnote

[3] To satisfy this requirement the lap strap must withstand a load of (115 daN) x (4.015g) x 1.33 = 614 daN. This load is shared between the two lap strap fittings so each lap strap fitting has a design limit load of 307 daN.

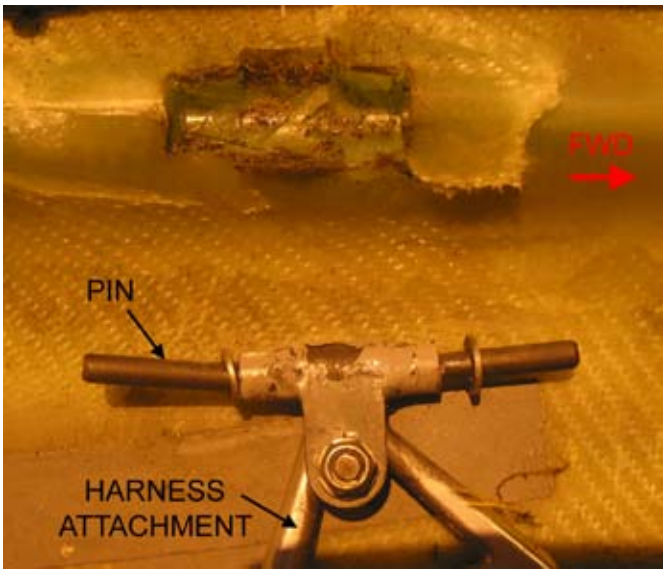


Figure 3

Overload failure of pin from left lap strap attachment

Medical and pathological information

The pilot possessed a *'Declaration of Medical Fitness to Fly'*, signed by his general practitioner, which certified that there was nothing in the pilot's medical history which prevented him from meeting the standard required for flight with passengers or when solo. This document satisfied the requirements relevant to operation of a glider and was valid until 16 September 2007.

An autopsy conducted on behalf of the coroner indicated that the pilot had died of head injuries.

Survivability

The pilot died as a result of severe head injuries caused by the aircraft striking the ground upside down on its canopy. The vertical tail would normally act in a manner similar to a roll-over bar and prevent canopy impact, but in this accident the force and orientation of impact was sufficient to break the tail structure. The remaining loads were absorbed by the upper fuselage skin structure and the canopy leaving the pilot's head unprotected. The canopy and skin structure would not have provided significant energy absorption, and the pilot was not wearing a safety helmet. The left lap strap attachment failure might have reduced the pilot's head clearance but it was not possible to establish if the head injury would have been less severe had the lap strap not failed. It could also not be established how securely the pilot had adjusted his shoulder and lap strap harnesses prior to the launch.

Published guidance

The issue of a wing drop during launch has been the subject of guidance material produced by the BGA and several articles published in UK gliding magazines. The consensus is that even gentle contact of the wingtip with the ground can result in considerable asymmetry, which leads very quickly to a roll that cannot be recovered using aerodynamic controls. Consequently, pilots are taught to release the cable immediately if the wing tip makes any contact whatsoever with the surface during a launch. Any control difficulties that might follow from this action are considered preferable to a developed roll under tow.

BGA Instructors' manual

The BGA Instructors manual, current at the time of the accident, contained the following guidance:

> *'During the ground run the ailerons and rudder need to be used independently of each other. Once the glider has lifted off, independent use of the controls must stop.*
>
> *Release the cable immediately if a wing goes down or anything else goes wrong during the ground run, eg. an overrun. Keep the left hand near to the release knob, or, depending on its position – for example if applying left aileron will make it awkward to reach – actually take hold of it.*

The demonstration might include patter such as the following:

- *As the cable tightens, ensure your left hand is close to, or on the release*
- *As the glider moves forward, keep the wings level using the ailerons. Large deflections may be needed initially*
- *If a wing goes down, release'*

BGA leaflet 'Safe winch launching'

In October 2005, the BGA published a guidance leaflet entitled *'Safe winch launching'*. The leaflet was accompanied by a letter addressed to BGA instructors, chairmen and managers requesting that the guidance contained in the leaflet be circulated, discussed and followed. Table 1, below, shows the guidance offered for the 'Ground Run' stage of the launch:

The issue of safe winch launching and the existence of this guidance were highlighted in the December-January 2006 edition of the bi-monthly *'Sailplane & Gliding'* magazine, produced by the BGA. The February-March 2006 issue of the same magazine included an article entitled *'Time for lateral thinking'* which explored the mechanics of a wing drop during launch. In the cited example there was a crosswind of approximately 10 kt from the right. The launch was being conducted from a frozen worn grass surface which sloped gently upwards to the right. The pilot was an instructor who had briefed the student:

'If a wing goes down despite the application of aileron, you will pull the release and abort the launch'

The instructor conceded in the article that he was "not particularly good at remembering" to place his hand on the release control. As the launch commenced he became aware that the glider was turning right and the right wing had touched the ground. The instructor was able to release the winch cable shortly afterwards and the glider was landed safely, having turned more than 90º to the original direction of launch.

The April-May 2006 issue of *'Sailplane & Gliding'* included an article entitled *'Six eventful seconds'* describing an actual occurrence, accompanied by photographs showing the flight of a glider which experienced a wing drop during a winch launch. The pilot reported that on his first attempt to operate the cable release control his gloved hand slipped off the control and that the pull force required was higher than he expected.

STAGE	HAZARD	AVOIDANCE
Ground Run	Wing touches the ground, glider cartwheels or ground loops violently.	• Start the launch with your hand on the release. • If you cannot keep the wings level, release immediately.

Table 1

Ground Run launch guidance

Additional information

Report by the Safety Member of the Royal Air Force Gliding and Soaring Association

The Safety Member of the Royal Air Force Gliding and Soaring Association (RAFGSA) who attended Keevil shortly after the accident on a previously arranged visit, submitted to the AAIB a comprehensive written discussion of the control ergonomics of the accident aircraft. He had previously conducted three winch launches in BGA 4354 and had over 20 hours flying experience on this type of glider.

During his visit to Keevil he had measured the position of the release knob with respect to the control column on an ASW 19 glider, in which the layout of the control-column and cable release is almost identical to an ASW 20. The release knob was approximately 30 mm left of the cockpit centreline and the control panel was approximately 60 mm forward of the control column. The cable release knob had a diameter of approximately 30 mm. On another similar aircraft the cable release knob had been replaced with a T-shaped grab handle to which a pull force could more readily be applied.

With the left hand resting at the left side of the cockpit, it would be difficult to reach for the cable release in a single uninterrupted movement, as might be necessary to abort the launch. Access to the cable release control would be further restricted by any leftward movement of the stick, which would be the instinctive reaction to a roll to the right. Regardless of the shape of the release control the rapid use of the cable release control could only be achieved if the left hand was already on that control.

Figure 4 shows full left deflection of the control column in the ASW 19 using the right hand. During launch and in flight the right hand would usually be holding the hand-grip of the control column, but in this picture it is shown lower than usual to avoid obstructing the camera view. With the right hand on the hand-grip and with the control column deflected fully left, the pilot's right arm would obstruct his view of the cable release knob.

Figure 4

Full left deflection of control column in similar configuration ASW 19

In Figure 5, the yellow cable release knob is only visible to the right of the control column because the control column is being held by the left hand, which would not usually be the case during the launch or in flight.

Figure 5

Cable release visible with full left control deflection

In order to release the cable in flight, with the control column deflected fully left, the pilot would need to reach around the front of the control column with his left hand and pull the release control at an angle to the control panel. The difficulty of reaching around the control column would require the pilot to apply this force using the strength of his wrist rather than through a direct pull using the strength of his arm. The shorter the length of protruding cable the greater the angle and the greater the problem. Additionally, whereas the pilot should ideally be able to grip the control with his full fist, a short protruding cable might inhibit the pilot from doing so. Cable length is limited to prevent the knob fouling the control column (a problem which is reported to arise on some other glider types) and in the case of BGA 4354 it was approximately 15 mm (visible in Figure 2 and shorter than on the similar configuration ASW 19 shown in Figure 5). The Safety Member of the RAFGSA considered that this combination of factors may have reduced significantly the pilot's ability to operate the cable release control in response to the right wing drop.

It was not possible to establish whether the pilot of BGA 4354 had attempted to release the cable or if his hand had been on the cable release control at any time during the launch.

Operation of cable release control - other pilots

Several glider pilots stated that they preferred not to place their hand on the release control until later in the launch to avoid the possibility of accidentally releasing the cable whilst close to the ground.

The resident Safety Member of the Gliding Club stated that, although it is normal practice for a glider pilot to keep his left hand on the release handle throughout a launch, he noticed that in the course of four consecutive launches he flew on the day after the accident, he forgot to do so on one occasion. He considered that the risks associated with a wing drop during launch outweighed those of accidentally releasing the cable whilst close to the ground.

Analysis

The damage to the aircraft was consistent with the witness descriptions of the aircraft having first struck the ground with the right wing, and then rolling to the right and coming to rest inverted. There was no evidence of any pre-impact structural failure or any pre-impact problem with the flying controls that might have contributed to the right roll. The left lap strap attachment fitting failed because its design load was exceeded but it was not possible to establish what effect this might have had on the survivability of the accident.

No official meteorological information was recorded at Keevil. However, information recorded at Lyneham and Boscombe Down indicated that surface wind at the time of the launch was probably close to the unofficial data recorded by the gliding club at Keevil, which was from 115° at 10 kt. This would have resulted in a crosswind from the left of the glider of no more than 3 kt, which is well below the limiting crosswind component. The benign wind conditions should therefore have posed no problems to this experienced pilot.

During the early stages of the launch the wing walker was holding down the left wing in an attempt to keep the wings level. The most likely reason for this would have been to counter an inadvertent input of right aileron by the pilot. In this case, the aileron input would then have caused the glider to roll to the right when the wing walker released the wing, allowing the wingtip to touch the ground. However, in this instance it was not possible to establish the actual mechanism of the wing drop.

In the article *'Time for lateral thinking'* the author suggested that any ground contact by the wing would initiate a yaw towards that wing, which would then precipitate a roll in the same direction. The investigation did not compare the effect of wingtip contact with the rough grass to the right of the runway to contact with the metalled surface of the runway itself. Consequently, it was not possible to determine what the outcome would have been had the launch been conducted with both wingtips over the runway. Although the effects would probably have been less pronounced, some asymmetry would certainly result from the contact of one wingtip with the ground.

The subject of wing drop during launch and the appropriate remedial action appears to be well understood and publicised in a manner accessible to most glider pilots. It is likely that the pilot of BGA 4354 was aware of the issues and of the recommended recovery technique. Although some pilots prefer not to have their hand on the release cable during launch, it is the belief of the Safety Member who initiated this investigation that this pilot would have been in the practice of doing so.

If it was the pilot's habit to rest his hand near to, rather than on, the release cable, the application of left aileron would probably have made it difficult to reach the release handle and operate it in the very short time available to regain control of the aircraft. Even if the pilot had his hand on the release control it is possible that he was unable to apply sufficient force to it to release the winch cable, especially if he was simultaneously applying full left aileron.

Conclusions

Eyewitnesses reported that the right wingtip of the glider made contact with the ground as the glider became airborne, causing it to yaw and then roll uncontrollably to the right. The winch cable was not released from the glider, which continued to roll, coming to rest inverted. The tail of the glider detached during the impact sequence allowing the cockpit canopy, which would otherwise have remained clear of the ground, to sustain

serious damage. The remaining loads were absorbed by the upper fuselage skin structure and the canopy leaving the pilot unprotected. The pilot received severe head injuries from which he later died.

Safety action

Safety action taken by the BGA

In April 2007 the BGA sent all gliding clubs a revised edition of the guidance leaflet entitled *'Safe winch launching'*. The BGA's view is that it is the pilot who is responsible for his pre-flight actions, which includes initiating the launch with the left hand on the release control. The advice for avoiding problems associated with a wing drop during the ground roll therefore remained unchanged. A memo entitled *'Supplement to BGA Safe winch launching'* leaflet, also promulgated in April 2007, reinforced this advice as follows:

> *'If the wing drops on the ground the glider may rotate about the wing tip and cartwheel. If the wing drops in every hundredth launch, there will be one wing drop accident in 800 wing drop incidents. This is a recipe for complacency and indeed it is experienced pilots who have the majority of wing drop accidents. After the wing has dropped the cartwheel can be so rapid that no recovery by releasing or other means is possible. This hazard must be anticipated and pre-empted by conducting the launch with the left hand on the release, and releasing immediately if it is not possible to keep the wings level.*
>
> *Leaflet advice:*
>
> - *Start the launch with your hand on the release.*
> - *If you cannot keep the wings level, release immediately.'*

A letter to all BGA gliding instructors, also dated April 2007, sought to address the preference of some pilots not to have their hand on the cable release control during the initial part of the launch:

> *'There is inevitably a healthy level of debate on winch launching techniques which should be encouraged to aid better understanding of what is a complex task. One point that really does need to be emphasised however is the need for the pilot to keep his/her left hand firmly on the release during the initial part of the launch.'*

Safety action taken by the Gliding Club

The gliding club at Keevil is conducting a trial in which the person assisting the launch (usually the wing walker) will, after checking that the cable is properly attached, look inside the cockpit to see if the pilot's hand is on the cable release control. If it is not, the assistant will ask "please can I see your hand on the release".

ACCIDENT

Aircraft Type and Registration:	X'Air V2(2) microlight, G-CBBH
No & Type of Engines:	1 Simonini Racing Victor II piston engine
Year of Manufacture:	2002
Date & Time (UTC):	7 April 2007 at 1130 hrs
Location:	Sutton Meadows, near Ely, Cambridgeshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to left main and nose landing gears, forward fuselage and windscren, propeller blade broken
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	32 years
Commander's Flying Experience:	121 hours (of which 119 were on type) Last 90 days - 8 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Shortly after takeoff, the engine began to lose power and the pilot was forced to land in a field. In attempting to avoid a ditch, the left main landing gear collapsed. It was established that the rear cylinder big-end bearing of the two cylinder 2 two-stroke engine had failed.

Sequence of events

Following a pre-flight inspection, in which no problems were found, the aircraft took off from Chatteris at 1115 hrs. On arriving at Sutton Meadows a short time later, the pilot lined the aircraft up on Runway 01 for a touch-and-go. The touchdown and subsequent takeoff were normal but at a height of approximately 150 ft, over the end of the runway, the engine began to lose power. The pilot had no choice but to land in a field immediately beyond the airfield boundary, which contained recently planted crops. On approaching the field, a large ditch became apparent, which the aircraft would enter if it continued straight ahead. In order to avoid this, the pilot turned the aircraft to the left, with the result that it touched down initially on the left landing gear, causing it to collapse. After a ground run of approximately 25 m, the nose wheel dug into the soft earth and the aircraft pitched forwards onto its nose, damaging the front of the fuselage 'pod' and breaking a blade of the now stationary propeller. The aircraft then settled back, coming to rest in a left wing low attitude.

The pilot turned off the master and ignition switches and both occupants, who were uninjured, left the aircraft without difficulty.

Examination of the aircraft

After the accident, it was observed that the engine could be turned by hand, but the pilot reported that it seemed "stiffer than usual", giving the impression that a partial seizure had occurred. A subsequent examination of the engine revealed that a failure of the rear cylinder big end bearing had occurred, with metallic debris distributed around the crankcase; no reason for the failure was apparent.

The Simonini is a two-stroke, water-cooled engine, of which, according to the British Microlight Aircraft Association, there are only eight examples operating in the UK. It relies upon the oil in the fuel/oil mixture for lubrication. The manufacturer specifies a two-stroke oil concentration of 2.5% by volume for leaded fuel and 3% for unleaded. The owners of G-CBBH ran the aircraft on motor gasoline, to which they added the requisite amount of oil.

Two fuel samples were taken from the aircraft several weeks after the accident: one was from the fuel line immediately upstream of the engine; the other was from the top of the fuel tank. Both samples were analysed and were found respectively to contain 3.2% and 2.3% of oil by volume. Only a small amount of fuel was collected from the fuel line and it may have been affected by a degree of evaporation, which could explain the difference in the two figures. Another factor may have been uneven mixing or, in the case of the tank sample, some settling of the oil. It is considered that the oil concentration would have to be significantly lower than these values to cause lubrication failure.

ACCIDENT

Aircraft Type and Registration:	BAE Systems Harrier GR9, ZG512
No & Type of Engines:	1 Pegasus Mk 105 turbofan engine
Date & Time (UTC):	13 July 2006 at 1555 hrs
Location:	3 km north-north-west of Oxford (Kidlington) Airport, Oxfordshire
Type of Flight:	Military
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Other - 1 (Minor)
Nature of Damage:	Aircraft destroyed
Commander's Licence:	None[1]
Commander's Age:	26 years
Commander's Flying Experience:	723 hours (of which 250 were on type)
Information Source:	AAIB Field Investigation in accordance with *Statutory Instrument 2005 No 2693*

Synopsis

The aircraft was flying from RAF Cottesmore, Rutland, to RAF Fairford, Gloucestershire, for the Royal International Air Tattoo, where it was to be on static display for the weekend.

During the flight the aircraft made a planned Practice Diversion to Oxford (Kidlington) Airport for a visual circuit to Runway 19. As the aircraft turned onto final approach, control was lost and the pilot ejected safely. The aircraft crashed on the A4620 road where it struck a passing car, causing minor injuries to the driver.

Foonote

[1] The Air Navigation Order Section 1, Part 4, paragraph 26.8 states: '*a person may act as a member of the flight crew of an aircraft registered in the United Kingdom without being the holder of an appropriate licence if, in so doing, he is acting in the course of his duty as a member of any of Her Majesty's naval, military or air forces.*'

Investigation

This accident was primarily investigated by a Royal Air Force (RAF) Board of Inquiry. Because of the proximity of the aircraft to a civil aerodrome at the time of the accident, and the provision of civilian ATC, the Chief Inspector of the AAIB initiated an investigation under the relevant regulations, *Statutory Instrument 2005 No 2693: The Civil Aviation (Investigation of Military Air Accidents at Civil Aerodromes) Regulations 2005*. This report is published under the provisions of those Regulations. The RAF Board of Inquiry was further assisted by an operations Inspector and an engineering Inspector from the AAIB.

Background information

The RAF operates Harrier aircraft in the UK from RAF Wittering, near Stamford, Lincolnshire, and RAF

Cottesmore (EGXJ), near Oakham, Rutland. The pilot was a squadron pilot at RAF Cottesmore.

Six days prior to the accident The pilot was selected to fly a Harrier GR9 to the Royal International Air Tattoo (RIAT) at RAF Fairford (EGVA), for a static display. He commenced planning three days before the accident. During the planning stage he spoke to Oxford (Kidlington) Airport (EGTK) ATC and Operations at least twice and discussed the joining and circuit procedures, as well as local ground features to avoid. One ground feature that was mentioned was Blenheim Palace, two kilometers west-north-west of Oxford Airport. The plan involved a low-level transit to Oxford Airport for a Practice Diversion, where the pilot would fly an approach to overshoot, before flying on to Fairford in accordance with the RIAT directives. The day before the flight the pilot spoke to the Manager Air Traffic Services at Oxford Airport, by telephone. She approved the pilot for a low approach and 'go-around'.

The sortie was correctly authorised by the Duty Authorising Officer (AO) at RAF Cottesmore. The pilot initially advised the AO, approximately two hours prior to takeoff, that he would require authorisation and briefed him on the sortie content. The AO asked questions about the plan drawing attention to the fact that the aircraft would be 'heavy' for the circuit at Oxford. The AO 'out-briefed' the pilot for the sortie approximately one hour before takeoff.

History of the flight

The aircraft took off from RAF Cottesmore at 1543 hrs, with 8,600 lbs of fuel and 500 lb of water on board, and left from the circuit towards the south-west. At about 20 nm from Cottesmore the pilot descended to low level and continued towards Oxford. The flight proceeded uneventfully until the aircraft was approximately 15 nm north of Oxford Airport. At this point the pilot made radio contact with Oxford ATC on the Approach frequency. Upon being informed that Runway 01 was in use he requested the surface wind: this was passed as 330º at 5 kt. As the wind was light the pilot requested Runway 19. This was approved as all other circuit traffic was holding above 2,000 ft aal in order not to conflict with the Harrier. The pilot then established radio contact with RAF Brize Norton, on the aircraft's second radio, as they were the controllers for the co-ordination of arriving aircraft into Fairford, and requested a transponder code and a radar service.

Once visual with Oxford Airport the pilot was transferred to the Oxford Tower frequency and was subsequently cleared to join for Runway 19 for a low approach and 'go-around'. Upon arrival at Oxford the aircraft had approximately 7,000 lb of fuel and 500 lb of water.

The pilot flew down Runway 19 at 500 ft aal and 430 kt. At the end of the runway the pilot turned right onto the downwind leg, turning to put his downwind track on the airport side of Blenheim Palace. The pilot rolled out downwind at 900 ft aal, decelerated and completed the downwind checks. He noticed that his downwind spacing was "tight" (in comparison with circuits normally flown at Cottesmore and Wittering), so he adjusted his heading by five degrees away from the runway and commenced the turn onto final approach. It was during this turn that control of the aircraft was lost.

The pilot ejected safely at a height of approximately 350 ft agl and landed in a paddock adjacent to a farm. The aircraft crashed on the A4260, the Kidlington to Banbury road, where a northbound car was struck.

Within a few minutes a police helicopter arrived on

the scene and the crew attended to the pilot, followed shortly by a civilian doctor. A civilian ambulance and paramedical team arrived and took the pilot to hospital in Oxford. He was later transferred to the Spinal Injury Unit at the Queen's Medical Centre, Nottingham.

Airport information

Oxford (Kidlington) Airport is a licensed airfield situated 6 nm north-north-west of the city of Oxford, approximately 11 miles north-east of RAF Brize Norton. Runway 01/19 is 1,319 m long. The airport has an Aerodrome Traffic Zone (ATZ), with ATC manned by civilian controllers. The circuit direction is variable, to provide separation between fixed- and rotary-wing aircraft. The fixed-wing circuit height is 1,200 ft aal.

Weather information

The Met Office provided an aftercast for the time of the accident. It stated that the visibility was 20-30 km, there were FEW SCATTERED cumulus clouds at 4,500 to 5,000 ft aal, and the QNH was 1026 mb. The temperature was 24º C, the dew point was 6º C and the surface wind was from 010º at 8 kt.

The car driver

The car driver stated that he was driving home from work northbound on the A4260 and, as it was a hot sunny day, he had the sunroof open. He heard the noise of a jet and, looking up through the sunroof, he saw "a huge, grey aircraft" above him. As it passed over him he felt the front of the car wobble and saw the bonnet "shaking from side to side". His car then spun quickly and the windscreen showered him with broken glass. The driver suffered scratches around his upper body and sustained a stiff back, as a result of which he was off work for several weeks.

Aircraft impact with the ground

The principal wreckage was confined within a very small area surrounding the point of impact on the boundary of a field adjoining the northbound lane of the A4260 Banbury Road, approximately 2.6 km north of Oxford Airport. The ejection seat and the remains of the canopy lay separately, some 100 m south-west of the main wreckage. All the aircraft's extremities were present in the main wreckage, indicating that it had been intact and complete, with the exception of the ejection seat and the canopy, at the time it struck the ground.

The distribution and orientation of wreckage, in relation to impact scars and other ground features, in conjunction with the pattern of break-up and damage, was consistent with a substantially flat attitude at impact at a high rate of descent, with a very low horizontal velocity and rotational momentum consistent with a significant yawing motion to the right.

A severe post-impact fire ensued, fed primarily by released fuel. This fire consumed much of the aircraft's structure and extensively damaged that which survived. At some stage during the ground fire, when the aluminium alloy structure in and around the main landing gear bay had partially melted, the landing gear emergency blow-down pressure vessel ruptured explosively, due to thermal over-pressure. This explosive event caused significant localised disruption of structure and projected debris over an area of the roadway to the south of the wreckage.

A separate ground fire spread across stubble in the field adjoining the impact point, but this was primarily wind-driven and was not fed significantly by fuel or other material from the aircraft's remains.

Vehicle damage

The car, driven by a member of the public, was on the road at the time the aircraft crashed and came to rest just off the eastern side of the road a short distance to the north of the wreckage. The vehicle exhibited extensive damage consistent with it having been in collision with the tail section of the aircraft. Tyre marks on the carriageway suggested that the driver had swerved to his right in an effort to avoid a collision. He was successful in avoiding a major collision but the car did suffer a glancing impact with the tail of the aircraft, which caused the driver to lose control of the vehicle.

Engineering investigation

The AAIB was actively involved in the engineering investigation of the accident, which included physical examination of the wreckage of the aircraft and analysis of the onboard recorded flight data. The examination of the aircraft and the data analysis showed no evidence of any technical defect that might have contributed to the loss of control and indicated that the aircraft was fully serviceable up to the point of the pilot's ejection.

Safety actions

The AAIB investigators assisted the RAF Board of Inquiry up to the conclusion of their Board investigation and the completion of their report. The AAIB investigators agreed with the Board's findings and were satisfied that the resulting safety lessons were being applied within the Royal Air Force.

FORMAL AIRCRAFT ACCIDENT REPORTS ISSUED BY THE AIR ACCIDENTS INVESTIGATION BRANCH

2005

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

Published November 2005.

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

Published December 2005.

2006

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

Published January 2006.

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

Published November 2006.

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

Published December 2006.

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.

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http://www.aaib.gov.uk