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ADDENDA and CORRECTIONS

None

(ALL TIMES IN THIS BULLETIN ARE UTC)

SERIOUS INCIDENT

Aircraft Type and Registration:	Boeing 737-73V, G-EZKG
No & Type of Engines:	2 CFM56-7B20 turbofan engines
Year of Manufacture:	2004
Date & Time (UTC):	11 August 2010 at 1640 hrs
Location:	West of Nantes, France
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 5 Passengers - 144
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	60 years
Commander's Flying Experience:	17,950 hours (of which 13,430 were on type) Last 90 days - 236 hours Last 28 days - 82 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

During the climb the left BLEED TRIP OFF caution message illuminated. Shortly after completing the associated checklist procedure the right BLEED TRIP OFF caution message illuminated, followed by the cabin altitude rising at a high rate. The CABIN ALTITUDE warning horn sounded during the subsequent descent and an emergency descent was then initiated. The aircraft returned to London Luton Airport at FL080 without further incident.

Later the co-pilot stated that he had incorrectly selected the bleed switch to OFF instead of the pack switch to OFF when he completed the left BLEED TRIP OFF checklist. The right engine bleed was unable to meet the demand from two air conditioning packs and tripped off, resulting in the loss of cabin pressure.

History of the flight

The aircraft was performing a scheduled passenger flight from London Luton Airport to Lisbon International Airport, Portugal. The commander was the pilot flying. Before departure the commander discussed with the co-pilot and the cabin crew the aircraft's previous reported faults, which included several bleed air trips on the previous sector. As a result the Bleed Air Regulator was replaced and satisfactory engine ground runs were carried out prior to the aircraft being dispatched.

The takeoff and initial climb were uneventful, except that on passing FL100 the pilots observed that the left and right duct pressures indicated 15 psi and 40 psi respectively. As the aircraft was climbing through FL280 the left BLEED TRIP OFF caution message illuminated on the BLEED panel on the forward overhead panel and AIR COND illuminated on the System Annunciator; the commander requested the co-pilot to carry out the associated checklist. During this procedure the commander was distracted from monitoring the co-pilot's actions by ATC transmissions and a call from the cabin crew on the interphone, to which she responded "Standby".

After the checklist was completed, the crew discussed whether to cruise at their planned flight level or a lower one. As they had dispatched with the minimum fuel required, they elected to continue the climb to their flight planned level of FL390. A short time later, while still in the climb, the right BLEED TRIP OFF caution message illuminated. Upon looking at the overhead panel the commander observed that the cabin altitude was climbing at approximately 3,000 ft/min. She stopped the climb and asked the co-pilot to request an immediate descent from ATC. The commander alerted the cabin via the passenger address system to prepare for a rapid descent. Initially there was no response from ATC, but after a PAN call was transmitted ATC instructed the aircraft to descend and to transmit the appropriate emergency transponder code. At about this time the CABIN ALTITUDE warning horn sounded, so the crew donned their oxygen masks and initiated an emergency descent. The aircraft was now in the vicinity of Nantes, France.

After the aircraft levelled at FL100 and the checklist had been completed, the crew removed their masks and established that there were no injuries to the cabin crew or passengers. They then elected to return at FL080 to London Luton Airport, where they landed without further incident.

Co-pilot's comments

The co-pilot stated that he had incorrectly selected the bleed switch to OFF instead of the pack switch to OFF when he completed the left BLEED TRIP OFF checklist. Recorded data confirmed this. The bleed system was then configured with one engine bleed supplying two air conditioning packs. The right engine bleed was unable to meet the demand from two packs and tripped off, resulting in the loss of cabin pressure.

The co-pilot commented that within the given procedure (Figure 2), the words "BLEED TRIP OFF" may have caught his attention, because they appear several times in the checklist.

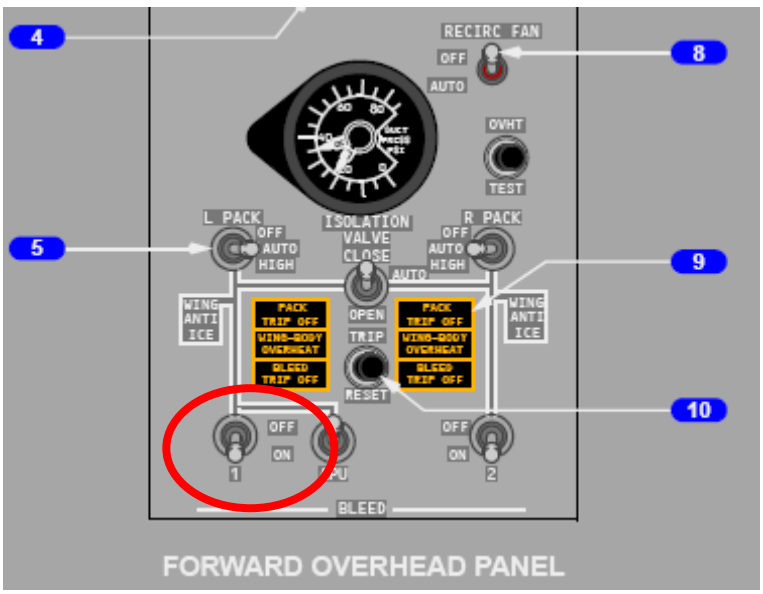
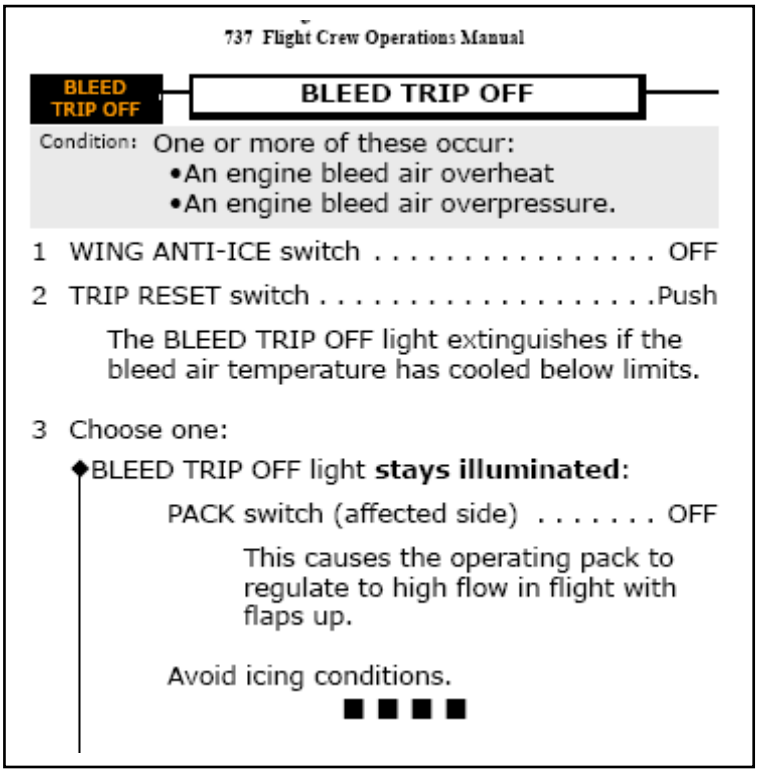


Figure 1

Bleed air section of Boeing 737-700 overhead panel.


737 Flight Crew Operations Manual

BLEED TRIP OFF

BLEED TRIP OFF

Condition: One or more of these occur:
- An engine bleed air overheat
- An engine bleed air overpressure.

1 WING ANTI-ICE switch . . . . . OFF

2 TRIP RESET switch . . . . . .Push

The BLEED TRIP OFF light extinguishes if the bleed air temperature has cooled below limits.

3 Choose one:

◆BLEED TRIP OFF light **stays illuminated**:

PACK switch (affected side) . . . . . OFF

This causes the operating pack to regulate to high flow in flight with flaps up.

Avoid icing conditions.

Figure 2

BLEED TRIP OFF checklist

Commander's comments

The commander commented that the co-pilot had conducted the BLEED TRIP OFF checklist alone in a "read and do", rather than "challenge and response" manner. She did not monitor the full procedure while issuing the "Standby" instruction to the cabin crew by interphone. She regarded this as a priority because she thought they might be concerned, following the discussion prior to departure, about potential pressurisation problems. She sought to reassure them and consequently was distracted from monitoring the co-pilot.

The commander added that the decision to continue the climb to FL390 with a single engine bleed source operating was influenced by a previous simulator training experience involving a similar scenario, in which it was strongly suggested that the appropriate course of action was to continue the climb.

Engineering information

As a result of this incident several components of the bleed system were replaced. The aircraft subsequently re-entered service with no reported reoccurrence of this fault.

Six passenger oxygen hoses became detached from their chemical generators when deployed automatically during this event. As a result, the operator has checked these components on all of its Boeing 737 aircraft and applied additional fastenings with the intention of preventing a reoccurrence, in accordance with a manufacturer's service letter which the operator considered relevant.

Safety actions

The co-pilot subsequently demonstrated to the operator his understanding of the BLEED TRIP OFF procedure and the consequences of selecting the bleed switch.

The operator recognised that a previous training experience influenced the commander's decision to continue the climb with a degraded pressurisation system. This observation was forwarded to their training management.

The commander underwent training which examined all technical and non-technical aspects of this event and explored management strategies to deal with threats and errors associated with it. She also conducted a supervised flight duty with a training captain to verify confidence and competence.

The operator advised its training pilots to consider the implications of offering unique responses to situations for which in practice there might be several acceptable solutions.

ACCIDENT

Aircraft Type and Registration:	Boeing 747-400SF, B-HKH
No & Type of Engines:	4 Pratt and Whitney 4056 turbofan engines
Year of Manufacture:	1991
Date & Time (UTC):	31 May 2010 at 0700 hrs
Location:	London Heathrow Airport
Type of Flight:	Commercial Air Transport (Cargo)
Persons on Board:	Crew - 3 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Failure of end attachment fittings of right wing gear support beam and damage to surrounding panels
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	36 years
Commander's Flying Experience:	7,660 hours (of which 1,694 were on type) Last 90 days - 73 hours Last 28 days - 15 hours
Information Source:	AAIB Field Investigation

Synopsis

The flaps were slow to retract when the crew selected them after landing. Subsequent inspection revealed damage to panels surrounding the inboard flaps on the right wing and that the outboard end fitting of the right wing landing gear support beam had failed. The manufacturer was aware of the potential for water ingress behind the main bushing in the end fitting to lead to corrosion, and subsequent cracking, and had issued an Alert Service Bulletin in November 2009 detailing inspection requirements and remedial actions.

History of the flight

The aircraft was operating a freight service from Delhi to London Heathrow. The flight and landing were reported as routine by the crew and analysis of the recorded flight data did not reveal any anomalies. During taxiing after landing the crew observed that the wing flaps were slow to retract and after shutdown a 'FLAP CONTROL' status message was displayed. This was recorded by the crew in the aircraft's technical log.

During post-flight inspections by an engineer, damage was identified to wing panels above and below the inboard flaps on the right wing and the flaps appeared out of alignment (Figure 1). Further investigation showed that the outboard end fitting of the wing landing gear support beam had failed. The aircraft was withdrawn from service for further inspection and repair.

Figure 1

Rear view of aircraft, showing misalignment of inboard flaps

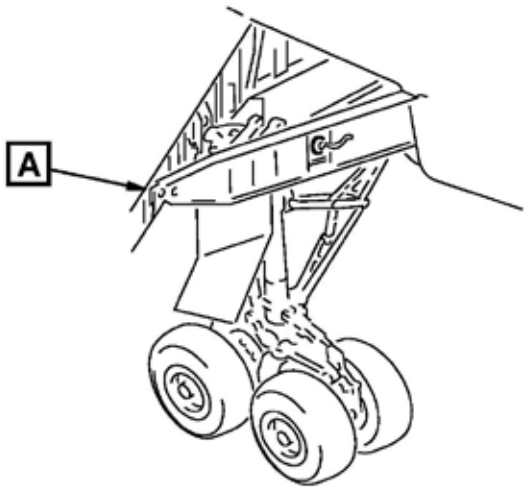
Other aircraft damage

Following the failure of the outboard fitting, the wing support beam was able to move slightly within the 'gate' fitting, which caused damage to panels above the beam and hydraulic pipes beneath the beam. The inboard flap track is partly mounted on this beam and its movement caused misalignment of the right inboard flaps, leading to damage of the adjacent fairing panels when the flaps contacted them during retraction.

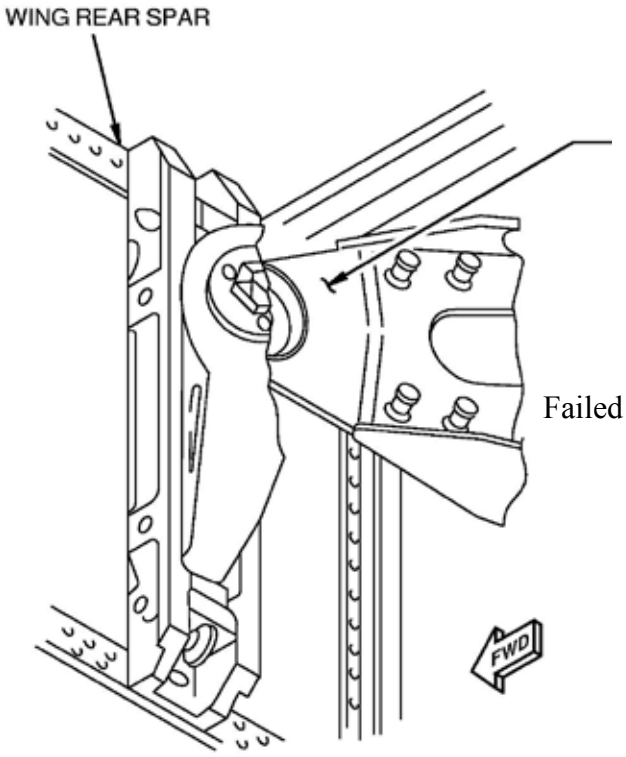
Description of failed components

The outboard end fitting on this aircraft consisted of two high strength steel plates fastened to the wing landing gear support beam by seven bolts (Figure 2). The end fitting is used to attach the beam to the rear wing spar using a gate fitting assembly. The design of the fitting specifies that the mounting holes in the plates are lined with bushings and all parts are plated to prevent corrosion. The bushes are a tight interference fit and installed with sealant to prevent moisture ingress.

Both fittings on the right wing had failed due to cracks radiating from the main bore of the fittings (Figure 3a and 3b). Significant areas of corrosion were apparent in the bore close to the cracks.



LEFT WING LANDING GEAR (WLG)
(RIGHT WLG OPPOSITE)



LEFT WLG GATE FITTING
(RIGHT WLG GATE FITTING OPPOSI

A

Figures by courtesy of Boeing

Figure 2

Illustration showing location of failed component
(left wing shown but actual failure on right wing)

Figure 3a

General view of failed forward fitting, right wing

Figure 3b

General view of failed aft fitting, right wing

The fittings on the left wing were inspected using the inspection technique detailed in the manufacturer's Alert Service Bulletin (747-57A2331) and the forward fitting was found cracked (Figure 4).

Examination of failed components

The failed components from the right wing were removed from the aircraft and taken to a specialist forensic metallurgical laboratory for detailed examination. Extensive corrosion was found in the main bore of the fittings. This had allowed the initiation and the development of cracks which had propagated extensively through a 'fatigue' mechanism before separation occurred. It was not possible to determine how long the failure had taken to propagate before final failure occurred. There was no evidence to suggest that the material properties played a part in the failure and the end-plate material appeared to comply with the design specification. There was evidence of cadmium on both the fitting and the main bush. There was evidence in the main bore of the fitting of smearing of the bush material on the fitting, indicating that the bush had rotated in the fitting in service.

The cracked forward fitting from the left wing was returned to the manufacturer for examination. Detailed analysis confirmed that the parts had been manufactured to specification apart from the large bushing, which showed no evidence of the plating which is now required. However, up to September 1989 it was not required that the bushing should be plated and it is possible that this fitting was manufactured before this date. The

Figure 4

Close up of forward fitting, left wing,
showing bushing, corrosion around main bore and crack

manufacturing records that would have confirmed this had not been retained. Evidence did show that the large bushing had rotated in the fitting and as a result the sealant was dislodged allowing moisture ingress into the joint.

Aircraft history

This aircraft was delivered as a passenger-carrying aircraft to the original operator in January 1991. At the end of 2005 it was transferred to the current operator who converted the aircraft to a freighter configuration, in accordance with a manufacturer-designed scheme and it resumed flying operations in July 2006. It had flown a total of 69,040 hours and 12,861 cycles at the time of the accident.

Previous type history of similar issues

The aircraft manufacturer had been aware of corrosion in the end fittings of wing landing gear support beams in earlier production aircraft of this type. This issue was addressed in a Service Bulletin (747-57-2244) which became the subject of a Federal Aviation Administration (FAA) Airworthiness Directive (89-15-07). These provided inspection, rework and terminating action for the end fittings. The revised design was incorporated into subsequent production aircraft, including this one.

More recently the manufacturer had become aware that the problem was recurring and in November 2009 issued Alert Service Bulletin 747-57A2331. This superseded the terminating action described in 747-57-2244 and included detailed instructions for inspecting the end fittings and, dependent on the findings, instigated repeat inspections or rework of the end fittings to improve corrosion resistance. Timescales for the completion of these tasks were given dependent on the configuration of the aircraft. This particular aircraft required initial inspection within 8 years of construction or within 18 months of the issue of the bulletin, whichever was the later; the latest compliance date in this case was therefore May 2011.

Maintenance history

The last inspection of the end fittings, before the accident on 31 May 2010, was a detailed visual inspection conducted as part of a '2C' check, in February 2009. The inspection found the fittings to be in a satisfactory condition.

The investigation team identified that the sealant applied externally to the seven attachment bolts appeared to have been replaced at some stage in the aircraft's life. Despite an extensive search of the current operator's electronic aircraft records, and the previous operator's paper records, the record of this work could not be found.

Discussion

The outboard end fittings of the right wing gear support beam failed due to cracks, propagating from corrosion pits in the main bore of the fitting, reaching a critical length. The manufacturer had been aware of a similar issue on earlier production aircraft of the same type and had instigated design improvements which were incorporated into later aircraft, including B-HKH. These improvements included better corrosion protection in the form of plating to all parts, sealing and an increased interference fit of the bush within its bore to prevent rotation.

There is evidence to indicate that the main bush in both wing fittings had rotated and it is likely that this movement broke the fillet of sealing compound, which allowed moisture ingress into the joint, leading to the corrosion.

The manufacturer's current Service Bulletin (747-57A2331) details inspection procedures and either rework or replacement schemes to remedy and upgrade any deteriorated fittings that are identified.

Safety Actions

Following this accident, the manufacturer issued a multi-operator message to inform operators of the event and to recommend that they perform the inspections detailed in SB 747-57A2331. Using the results of these inspections the manufacturer will review the inspection thresholds and make adjustments if required.

The FAA has given contingent approval for the above SB and a Notice of Proposed Rulemaking (NPRM) to mandate the SB is expected to be issued shortly.

INCIDENT

Aircraft Type and Registration:	Boeing 757-204, G-BYAT
No & Type of Engines:	2 Rolls-Royce RB211-535E4-37 turbofan engines
Year of Manufacture:	1994
Date & Time (UTC):	15 February 2010 at 1800 hrs
Location:	Stand 28, Glasgow International Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 8 Passengers - 230
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damaged recirculation fan
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	60 years
Commander's Flying Experience:	18,000 hours (of which 13,000 were on type) Last 90 days - 23 hours Last 28 days - 11 hours
Information Source:	Field Investigation

Synopsis

Shortly after arriving on stand at Glasgow International Airport, and after passenger disembarkation had commenced, the flight and cabin crews noticed an acrid smell throughout the aircraft. The senior cabin crew member then ordered an evacuation over the passenger address system. The cabin crew deployed the emergency evacuation slides at both rear doors and a total of 43 passengers exited the aircraft using these slides. Four passengers received minor injuries. The flight crew were not aware that an evacuation had been initiated until after the event.

The electrical burning smell was traced to the right recirculation fan.

History of the flight

G-BYAT landed at Glasgow International Airport after an uneventful flight from Funchal, Madeira. Shortly after coming onto stand, after passenger disembarkation had commenced, via door L2, the flight crew became aware of an acrid smell that appeared to be getting stronger. The co-pilot left the cockpit briefly, to identify whether the smell was also present in the forward galley; it was and was increasing in intensity, but there was no visible smoke in the cabin. The co-pilot returned to the flight deck and informed the commander, who turned off the APU and the Utility busbars to isolate electrical power to the galleys, before completing the relevant elements of the Smoke Removal checklist from the Quick Reference Handbook. The fire services were then requested via the ATC ground controller. At this

stage it was apparent to the flight crew that the smell was dissipating.

At the same time the senior cabin crew member (SCCM) and other cabin crew members were aware of the smell. She went into the flight deck and confirmed with the flight crew that the odour was also apparent there.

The SCCM then returned to the forward cabin and contacted all the crew using the Alert Call on the cabin interphone. They confirmed that there was a pungent burning smell throughout the cabin; there was no smoke, but the smell was strongest in the rear of the aircraft. However, the flight crew did not respond to this call.

The SCCM returned to the flight deck to update the commander, and while the flight crew acknowledged her presence, she did not convey her concerns on the need to evacuate the passengers as the flight crew were busy dealing with the incident. She considered that she needed to disembark the passengers as quickly as possible and so, as there were no steps at the rear of the aircraft, when she returned to the cabin she announced, in a calm manner, over the passenger address system: "Please evacuate the aircraft as quickly as possible. Leave all hand baggage behind." The cabin crew at the rear doors re-armed their doors and deployed the slides. A total of 43 passengers used the slides, with four of them receiving minor injuries.

Once the cabin crew had checked the cabin was clear of passengers, they were directed off the aircraft, via the airbridge at door L2, by the AFRS who had boarded the aircraft via the airbridge wearing breathing apparatus. The passengers who had evacuated the aircraft were assisted at the foot of the slides by the AFRS and airport personnel.

After the evacuation a number of comments were made by passengers concerning an apparent lack of assistance and direction given to them outside the aircraft. The airfield operator considered this was due to some agencies not being initially informed of the incident. In addition, there were reports of passengers, coming down the slides, colliding with those in the process of leaving the bottom of the slides.

Following the event the operator's maintenance engineers traced the problem to the right recirculation fan, which was described as "barely running and giving off the burning smell". The unit was replaced, following which the air conditioning packs and fans were run with no further smell of burning. There was no other damage to the aircraft.

SCCM comments

Following the event, the SCCM commented that the whole incident, from the initial smell to the time of the evacuation, happened very quickly. She added that given similar circumstances, with no rear steps in place and with the very distinct smell of burning in the rear of the aircraft, she would again consider initiating an evacuation.

Operations Manual

Part B of the operator's Operations Manual includes the following in the section on evacuation drill, dealing with the command for evacuation and leaving the aircraft:

> ***'On evacuation command***
>
> - *In most circumstances the evacuation command will be initiated by the Commander. This will immediately cause the cabin crew to put into action their evacuation drill. If communication is impossible with the*

pilots and the situation is life-threatening to passengers and crew (e.g. breaking up of the aircraft, an uncontrollable fire in the cabin or ditching), the ICM will initiate the evacuation. However circumstances may also dictate that any cabin crew member initiates the evacuation if faced with a similar situation."

Leave aircraft

- *Cabin crew should leave the aircraft once all passengers have evacuated, or if at any time the area becomes too dangerous to remain inside.*
- *Cabin crew to take control of groups of passengers and move them away from the aircraft upwind (using megaphones).*
- *Attempt to keep passengers together.'*

Examination of the recirculation fan

Conditioned air supply for the aircraft is provided by two air conditioning packs and is distributed to various zones via a 'mix manifold' where it is mixed with recirculated, filtered air, which is supplied by the left and right recirculation fans. The fans have different part numbers, with the right fan being designated as the 'main' unit. The slower-running left unit is operated as a back-up. The left and right recirculation fans are powered from the left and right Utility buses respectively, via a 20 amp circuit breaker. The right hand fan has a 3-phase motor, running at a nominal 11,400 rpm and drawing a maximum of 13 amps per phase. A diagram of the assembly is shown at Figure 1.

Following removal of the defective unit, which had the Part Number 606772-3, it was found that the impeller/motor assembly could be turned by hand, although it was 'notchy' in operation and would not run freely. Accordingly, it was examined, under AAIB supervision, at the manufacturer's UK overhaul facility.

Initially, the unit was placed on a test rig but the fan turned only briefly before the 68 amp rig circuit breaker tripped. The unit was disassembled and it was clear that the rear rotor bearing had failed (Figure 2). The radial play that had occurred at this end of the shaft had resulted in contact between the rotor and stator, which had resulted in smearing of the segments and the consequent generation of debris, mostly in the form of black dust.

Examination of the bearing components indicated that the fibre bearing cage had disintegrated and that there was no evidence of grease with which the bearing had been packed. Fragments from the bearing grease shield were found, which suggested that this may have come loose, leading to the escape of the grease and the subsequent bearing failure. Circumferential score marks on the external surface of the bearing outer race indicated that it had been spinning within its housing; this may have occurred as a result of friction generated within the bearing during the break-up process. It was also noted that grease had started to run out from the otherwise intact front bearing (ie fan end), indicating that the unit had been running in a hot condition.

It was observed that the electrical wiring within the fan assembly appeared to be in good condition, with no evidence of burning or charring. Thus the burning smell that led to the evacuation of the aircraft was likely to have been caused by burning grease. The unit was equipped with a thermal cut-out that would shut it down in the event of an overheat condition. This was checked and it was found that the unit cut out at

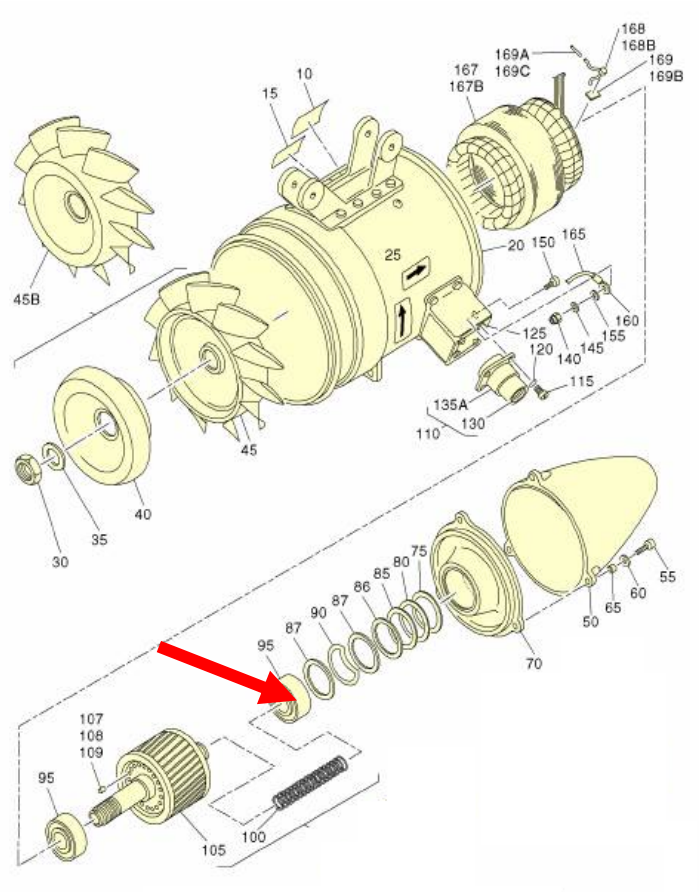


Figure1

Exploded view of the recirculation fan; position of failed bearing indicated

Figure 2a

View of rotor and failed bearing

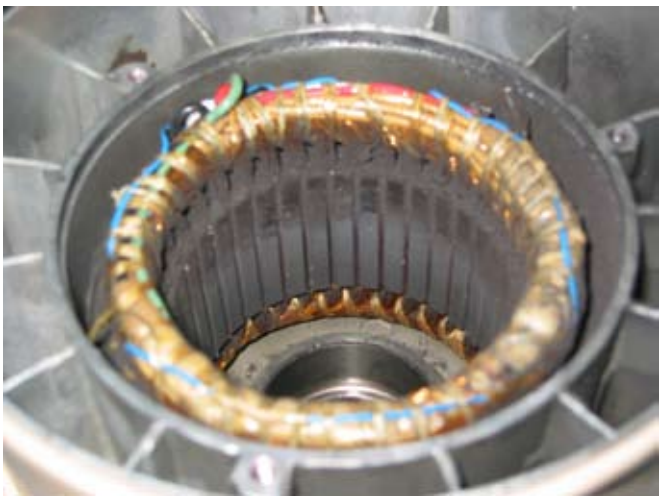


Figure 2b

View of contact damage from rotor

a temperature of 156.6ºC and, during cooling, reset at 145ºC. This compared with the manufacturer's specifications of a maximum of 154ºC and a minimum reset temperature of 126ºC.

History of the recirculation fan

The recirculation fan in this incident had most recently been inspected during a 'C' check in January 2010, 189 flying hours earlier. This was a scheduled check, which included a general clean together with fore and aft bearing replacement.

The airline had experienced a number of similar failures with recirculation fans, which also equip their Boeing 767 fleet. The reasons for some of the failures were not always apparent from the available documentation, although it was clear that bearing failures had occurred in some cases. The fan manufacturer noted that the latest revision of the Component Maintenance Manual (CMM) now includes bearings from an alternative manufacturer as an option. This new bearing has a retaining pin with a larger diameter, which is considered to be potentially more robust than the old component. The operator intends to use the new bearing during overhauls, when they become available in 2011.

Discussion - evacuation

In this particular case, it is clear that the member of the cabin crew who initiated the evacuation was concerned that the situation in the cabin was potentially life threatening. However, the flight crew were not incapacitated and it is evident that verbal communication with them would have been possible had the member of cabin crew persisted.

Safety actions

Following this incident, the aircraft operator issued a Cabin Crew Notice reminding cabin crew of the circumstances when an evacuation can be initiated without it being ordered by the commander, and of the cabin crews' responsibilities for the evacuated passengers.

In response to the concerns of passengers, and others, of an apparent lack of assistance and direction given to passengers outside the aircraft, the airport operator has reviewed and amended the accident and incident communications process for Customer Services Duty Managers. This now ensures that all agencies, including all resident aircraft operators and handling agents, are informed automatically of any accident or ground incident.

SERIOUS INCIDENT

Aircraft Type and Registration:	Boeing 757-236, G-OOOZ
No & Type of Engines:	2 Rolls-Royce RB211-535E4 turbofan engines
Year of Manufacture:	1992
Date:	22 June 2009
Location:	En-route from Boa Vista, Cape Verde, to Manchester
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 8 Passengers - 230
Injuries:	Crew - None Passengers - None
Nature of Damage:	Engine fuel pipe ruptured
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	45 years
Commander's Flying Experience:	12,100 hours (of which 6,580 were on type) Last 90 days - 195 hours Last 28 days - 40 hours
Information Source:	Field Investigation, delegated by GPIAA, AAIB metallurgical examination of the ruptured pipe and extensive testing by the engine manufacturer

Synopsis

Approximately two hours into the flight, during a routine fuel check, the flight crew noticed a discrepancy in the fuel contents between the left and right tanks. They identified a fuel leak from the right engine, which was then shut down. The aircraft diverted to Porto Santo and landed without further incident. The passengers disembarked normally.

An investigation was initiated by the Gabinete de Prevenção e Investigação de Acidentes com Aeronaves (GPIAA) in Portugal. However, as the United Kingdom was the State of the Operator and the State of Design of the engine, the investigation was delegated to, and conducted by, the AAIB.

The cause of the fuel leak was a rupture in a section of flexible fuel pipe between the fuel cooled oil cooler (FCOC) and the High Pressure (HP) engine fuel pump. A redesign of the pipe is proposed by the manufacturer.

History of the flight

The flight was planned from Boa Vista, Cape Verde, to Manchester. At approximately 1820 hrs, passing reporting point BIMBO, approximately 202 nm north of Lanzarote, the crew carried out a fuel check which showed a fuel total 300 kg below the planned fuel quantity expected at this stage of the flight. The previous fuel check, 51 minutes earlier, had shown the fuel contents as

slightly higher than planned. The co-pilot, who was the Pilot Handling (PH), re-checked the fuel calculations, and at this point noted that the centre tank contents had reduced to zero, an hour earlier than expected. The right fuel tank quantity also began reducing at a rate of around 300 kg per minute.

The flight crew checked the Quick Reference Handbook (QRH), and a visual inspection of the engine, carried out by the co-pilot from the cabin, did not reveal anything unusual. The right engine fuel flow was normal, however the right fuel tank contents were still reducing. A FUEL CONFIG message was displayed on the Engine Indicating and Crew Alerting System (EICAS), indicating a fuel imbalance. A second visual check of the engine by the co-pilot confirmed that fuel was leaking from the underside of the right engine nacelle.

The crew declared a MAYDAY and requested a diversion to Porto Santo (PXO) and they shut down the right engine as the aircraft descended through FL280. They informed the cabin crew and passengers of the situation and requested emergency services for their arrival at PXO.

The crew carried out a VOR approach to Runway 36 in good weather conditions and brought the aircraft to a stop on the runway without difficulties. No fire or abnormalities were noted by the AFRS personnel in attendance and the aircraft taxied to its stand. A fuel imbalance of 3,300 kg was noted at shutdown.

Post-flight examination revealed a rupture of a Low Pressure (LP) fuel pipe between the FCOC and the HP engine-driven fuel pump.

Engineering description

The fuel pipe, located on the right side of the engine (Figure 1), comprises an assembly of three rigid stainless steel tubes connected together by two flexible segments. The flexible segments have an inner core made of polytetrafluoroethylene (PTFE), within a closely fitting double-layer braided stainless steel sheath, enclosed within an outer silicone rubber sleeve to provide fire

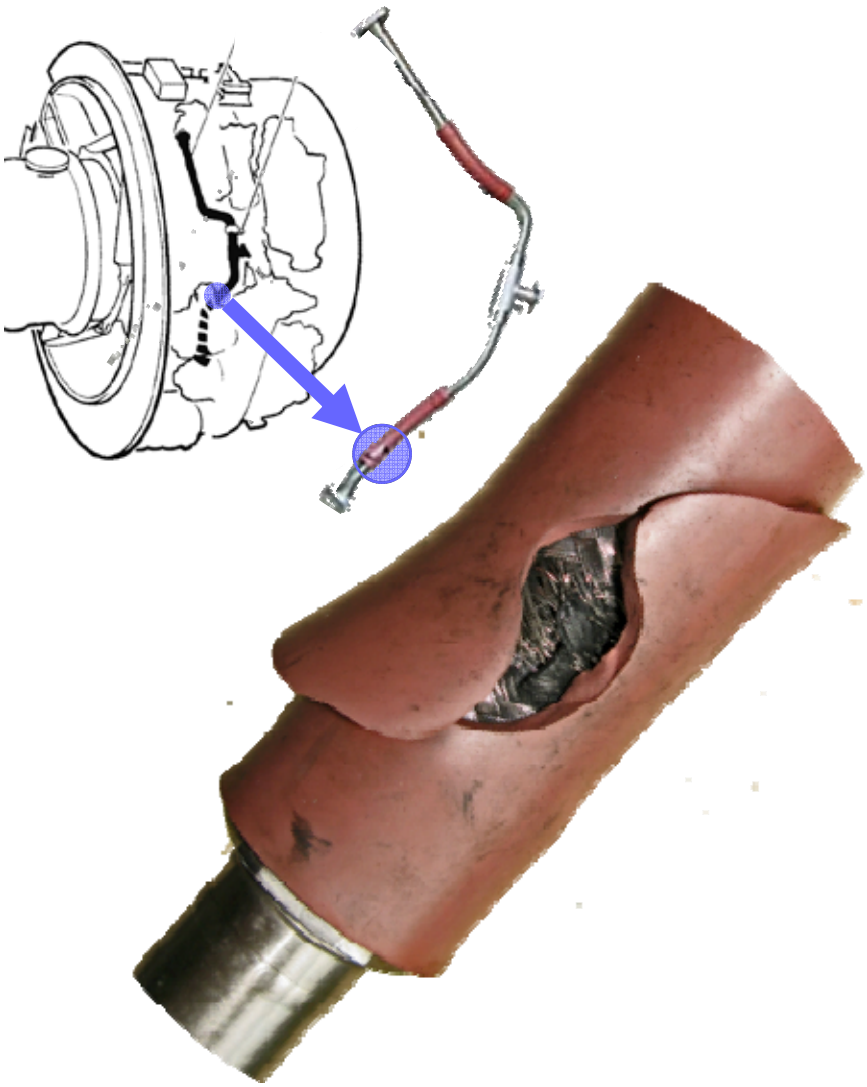


Figure 1
LP fuel pipe failure – G-OOOZ

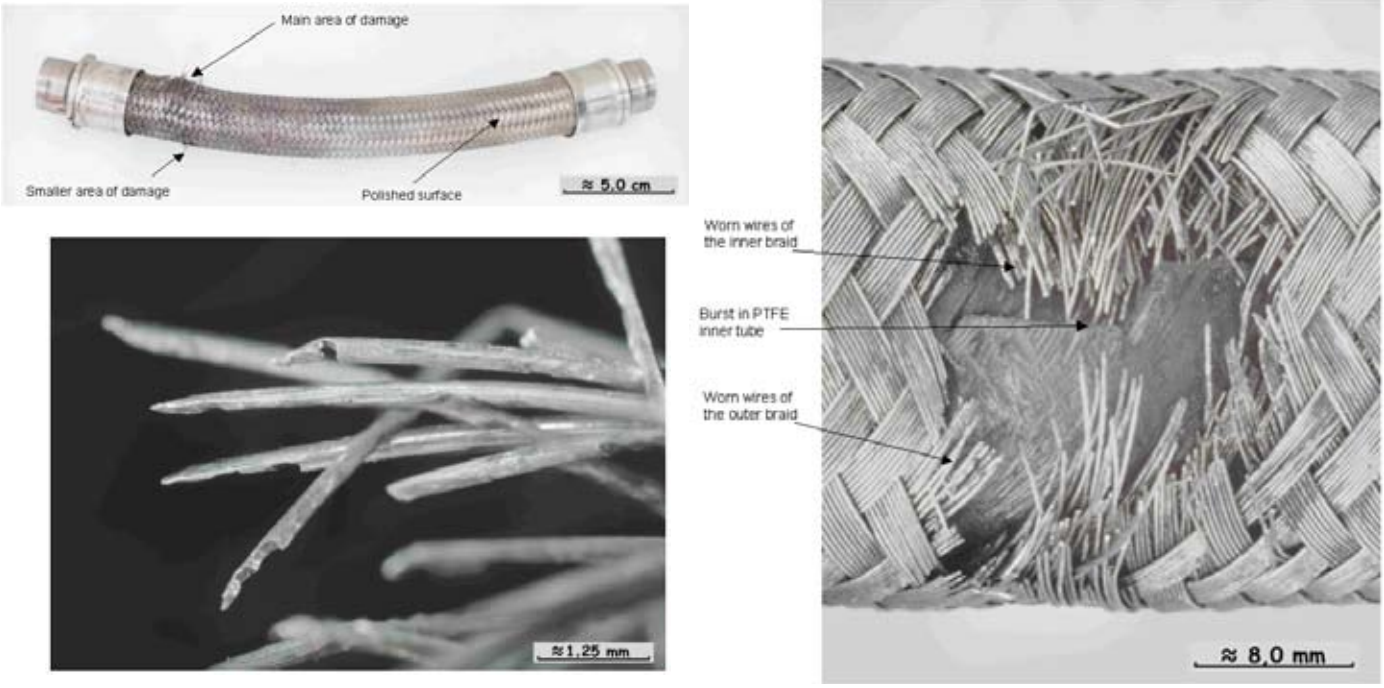
protection. The braiding consists of a weave of two strands; there are nine wires in each strand in the outer braid and eight wires in each strand in the inner braid.

In this design of flexible hose, pressure-induced hoop stresses in the wall of the inner PTFE tube are reacted primarily by the stainless steel braid; this type of design is common on a variety of applications operating at pressures significantly greater than those involved in this case.

The rupture in the segment of flexible hose had occurred close to the HP fuel pump inlet. The HP fuel pump has a gear-type design and there are two types of pump available which can be fitted to the engine, with different numbers of gear teeth.

Detailed analysis

Microscopic inspection of the rupture site revealed a pattern of localised but extensive inter-braid fretting in both the inner and outer braids. The stainless steel braid wires were worn and notched; the damage had been caused by relative movement between overlaying strands. In many cases this process had completely severed the wire strands (Figure 2). It was evident that the resulting loss of hoop integrity had left the inner core of the pipe unsupported, allowing the inner tube wall to rupture and burst through the compromised region of braid. Damage, probably caused by relative movement of the braid, was apparent to the outer surface of the PTFE core tube, sufficient to cause significant weakening.



Images courtesy Rolls-Royce

Figure 2

Detail of fuel pipe failure

Wear of the braid wire was evident throughout the length of the lower flexible hose; there was no evidence of similar wear on the upper flexible hose section.

Design history

At the time of the entry into service of the B757 in 1983, the design standard was a rigid pipe. In 1994 a tube with two flexible sections and simple flanged end fittings was introduced; in-service experience with tube failures at high operating hours (approximately 18,000 to 22,000 hrs) resulted in a recommended life of 15,000 hrs being introduced by Non Modification Service Bulletin (NMSB) 72-E355 in June 2004. Further failures, occurring below 15,000 hrs service, but high operating cycles, resulted in NMSB 73-E355 being revised in March 2009 to recommend a cyclic life limit of 4,750 cycles.

There is a repair approved by the engine manufacturer, Field Repair Scheme (FRS) 6887, which involves replacement of both flexible hose sections.

The engine manufacturer identified 11 previous events since June 1999, five of which had led to in-flight engine shutdowns. The failed tube from G-OOOZ had completed 5,986 hrs and 1,657 cycles, significantly below the current recommended life for the component. It was an original part and had not been subjected to rework.

Manufacturer's testing

The engine manufacturer proposed a series of engine runs on their test bed in order to investigate the effect of vibration and fuel pump pressure ripple levels on the fuel lines. Engine runs were carried out on both types of fuel pump in order to determine the magnitude and peak of any vibrations and pressures, and also whether there were particular engine running conditions which produced these peak levels. One of the pumps used in the test was that removed from G-OOOZ following the incident.

The results showed that the HP fuel pump created a 'pump ripple' in the operational speed range (85% to 95 % N3) and which decayed with axial distance from the fuel pump inlet. The pump ripple was present with either pump but the two pumps created different fundamental frequencies based on the number of gear teeth. The fuel pump from G-OOOZ produced the highest levels of pressure ripple, indicating that the wear mechanism would have been accelerated.

The pressure peak harmonics recorded during the test were found to be coincident with the peak acceleration data recorded in the fuel tube assembly. This confirmed that the maximum fuel tube vibrations occurred as a result of the fuel pump pressure harmonics (pressure ripple) effects.

Summary and safety action

The testing confirmed that the fretting which had led to the failure of the pipe was a result of high-frequency vibrations driven by the HP fuel pump pressure ripple. Extended time spent in the critical N3 speed range could accelerate the wear and the effect of an individual pump could cause additional variability in the time to failure.

From the history of previous events the associated risk assessment predicts an event rate of up to 1.5 per year, which would include minor leaks discovered on the ground. A hardware redesign has been initiated by the manufacturer with a design definition planned before the end of May 2011.

ACCIDENT

Aircraft Type and Registration:	AS355F1 Ecureuil II, G-BPRI
No & Type of Engines:	2 Allison 250-C20F turboshaft engines
Year of Manufacture:	1982
Date & Time (UTC):	23 October 2010 at 1422 hrs
Location:	Abridge Golf Course, Essex
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Tail rotor, tail rotor gearbox, tail rotor drive train and bottom vertical stabiliser damaged
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	48 years
Commander's Flying Experience:	5,928 hours (of which 423 were on type) Last 90 days - 46 hours Last 28 days - 15 hours
Information Source:	Aircraft Accident Report Form submitted by the operator

After confirming that the surrounding area was clear, the pilot started the helicopter's engines. Shortly after starting the second engine, he noticed a golf cart on his right side that was "travelling at some speed, clearly out of control". The cart passed behind the helicopter, sustaining damage to its roof when it passed through the tail rotor disc, and continued for approximately 40 m before stopping. The pilot was told that a young child had climbed into the cart with an adult and had inadvertently stepped on the accelerator pedal. The pilot estimated that the cart had travelled 80 m before hitting the tail rotor. The occupants of the cart were unhurt.

SERIOUS INCIDENT

Aircraft Type and Registration:	Sikorsky S-92A, G-SARC
No & Type of Engines:	2 General Electric CO CT7-8A turboshaft engines
Year of Manufacture:	2006
Date & Time (UTC):	9 July 2010 at 0950 hrs
Location:	Harris Hills, Isle of Harris, Scotland
Type of Flight:	Aerial Work
Persons on Board:	Crew - 4 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	47 years
Commander's Flying Experience:	8,982 hours (of which 653 were on type) Last 90 days - 51 hours Last 28 days - 25 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

During a manually flown SAR mission, in mountainous terrain, the aircraft entered IMC. While attempting to exit these conditions on a pre-briefed escape heading with the autopilot coupled, the autopilot entered an unexpected mode that resulted in the aircraft not responding as intended. The autopilot was disconnected and the flight continued manually without further incident.

History of the flight

While carrying out a manually flown SAR mission in mountainous terrain the helicopter entered IMC. The commander, who was the pilot flying, called for the autopilot HDG (heading) mode of the automatic flight control system (AFCS) to be engaged while turning onto the pre-briefed escape heading. This was selected by the co-pilot on his mode select panel but it did not engage. The commander then asked for ALT (barometric altitude hold) mode and the minimum safe altitude to be selected in the altitude pre-select window. Initially, the co-pilot selected RADALT (radio altimeter hold) mode briefly, then selected ALT as requested. The co-pilot then selected HDG mode and set the heading bug to the helicopter's current heading. The commander then asked for the ALTP[1] mode, which the co-pilot attempted to select several times without effect.

Footnote

[1] ALTP climbs the aircraft to the altitude selected in the altitude pre-select window.

Suddenly, while still in IMC, the autopilot appeared to enter a hover mode, which stopped any climb and increase in speed as the helicopter tried to enter a hover. The helicopter then adopted an approximately 15º nose up attitude with a small amount of bank, and descended. The crew saw HOV (automatic hover velocity) mode annunciated at the top of the Primary Flight Display (PFD) and the PFD went into the hover reference page. At this point a gap in the cloud revealed a hill in front of and below the helicopter. The co-pilot called for an immediate climb. The commander, who was flying with sole reference to instruments, immediately decoupled the autopilot and initiated a climb. He then called for HDG mode, which the co-pilot selected, and ALTP mode, which the co-pilot was again unable to engage.

The helicopter subsequently entered VMC over lower terrain. The SAR mission was completed and the helicopter returned to base without further use of the automatic flight control system modes.

Operator's comments

The helicopter manufacturer has assisted the operator in resolving issues highlighted by this event. Initially, the heading mode selection may not have engaged because the airspeed was below the lower capture limit of 50 kt. Additionally, cockpit design for the newer S-92A SAR variant of this helicopter is being reviewed, with regard to switch positioning and nomenclature, in order to reduce the opportunities for incorrect switch selection at times of high crew workload.

Safety action

Following this incident the operator took the following actions to standardise cockpit switch operation:

Autopilot engagement procedures have been standardised to include clear commands and execution instructions. This process has been incorporated into the revised Operations Manual and is being enforced during airborne and simulator training.

In recognising the occasionally sub-optimal switch locations and markings in the S-92A, the operator has adopted what it refers to as the "Locate, Mark, Select" principal which in both the helicopter and simulator, requires positive identification of any switch to ensure that, when activated, the result is as intended. The operator has also conducted flight tests in VMC to gain a better understanding of the AFCS modes that might have been engaged during this event.

ACCIDENT

Aircraft Type and Registration:	Auster 4, G-ANHS
No & Type of Engines:	1 Lycoming O-290-3 piston engine
Year of Manufacture:	1942
Date & Time (UTC):	17 September 2010 at 0754 hrs
Location:	RAF Cottesmore, Rutland
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Collapsed landing gear and damage to wing struts
Commander's Licence:	Private Pilot's Licence
Commander's Age:	45 years
Commander's Flying Experience:	481 hours (of which 187 were on type) Last 90 days - 23 hours Last 28 days - 10 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Whilst joining the circuit to land, the pilot selected the fuel selector from the belly tank to the main tank for landing as required by normal procedures. The engine immediately faltered and appeared to cut out; reselecting the belly tank had no effect. He declared an emergency with Cottesmore Tower and was immediately cleared to land on Runway 22. The aircraft landed heavily and the landing gear collapsed, but both occupants were uninjured and able to vacate the aircraft normally.

The pilot reported that the fuel tanks still contained approximately 7 gallons of fuel and that he suspected an airlock may have developed during the change in tank selection. He also commented that after the engine failure, the rate of descent appeared to increase markedly when the propeller stopped rotating.

ACCIDENT

Aircraft Type and Registration:	Avid Speedwing Mk 4 Flyer, G-LORT
No & Type of Engines:	1 Rotax 582 piston engine
Year of Manufacture:	1992
Date & Time (UTC):	10 April 2010 at 1534 hrs
Location:	Field at Holne, Newton Abbot, Devon
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Serious) Passengers - N/A
Nature of Damage:	Serious damage to forward fuselage structure and landing gear
Commander's Licence:	Private Pilot's Licence
Commander's Age:	59 years
Commander's Flying Experience:	1,182 hours (of which 14 were on type) Last 90 days - 2 hours Last 28 days - 2 hours
Information Source:	AAIB Field Investigation

Synopsis

While cruising at approximately 1,900 feet, the pilot noticed the engine coolant temperature rising rapidly. He reduced the engine speed from 5,100 to 4,000 rpm but about 15 seconds later the engine stopped suddenly, without being preceded by any rough running. The pilot attempted to carry out a forced landing into a field but stalled the aircraft at a height of about 15 feet just short of the field. An examination revealed that the engine had seized in flight due to overheating. The overheating was probably caused by a loss of radiator coolant.

History of the flight

The Avid Speedwing Mk4 is a homebuilt aircraft operated under a Permit to Fly. It has a tailwheel configuration with a high wing and a maximum takeoff weight of 463 kg. The pilot had bought the aircraft in 2009 and had completed a conversion course on to the type in April 2009 under the LAA coaching scheme. In May 2009 he suffered two engine failures and carried out two successful forced landings. The engine was removed and deemed beyond economical repair so a new Rotax 582 engine was fitted in October 2009. The pilot did not fly during the winter and then carried out an uneventful flight on 18 March 2010. On 10 April 2010, after carrying out a pre-flight check which included removing the engine cowling, he departed for a flight to

Eaglescott, which was uneventful. After stopping for a coffee he performed another pre-flight check (this time without removing the engine cowling) and carried out a further flight, to Bodmin. After refilling the fuel tank at Bodmin and carrying out another pre-flight check (also without removing the engine cowling) he departed for Clutton Hill Farm. The weather was CAVOK with a light variable wind from the east and north-east.

While cruising at approximately 1,900 feet, 30 nm east of Bodmin, the pilot noticed the coolant temperature gauge needle rise rapidly to the vertical position (approximately 200°F indicated). He reduced the engine speed from 5,100 to 4,000 rpm, which reduced the coolant temperature over a period of about 15 seconds, but then the engine and propeller stopped suddenly, without being preceded by any rough running. The pilot did not attempt to restart the engine and altered course to the south-east to find a field for a forced landing; the terrain elevation was approximately 500 feet. As he approached his selected field from the south-west he noticed a hedge at the southern end of the field but expected to clear it. However, the aircraft stalled just short of the hedge and the aircraft hit the ground hard, causing the main landing gear to collapse and the forward fuselage structure to buckle; it stopped with no ground roll. The pilot estimated that the aircraft "fell" about 15 feet at a speed of less than 55 mph. The pilot was wearing a lap strap and shoulder harness, but suffered a broken left forearm and a fractured right eye socket and cheekbone, which the pilot attributed to his body rotating to the left and the right side of his head striking the instrument panel.

Aircraft examination

The aircraft was examined on site by the LAA inspector who had carried out the engine installation. He noted that the engine turned freely and that there were a number of spots of coolant on the engine. The left radiator had a hole in it and was oozing coolant and a number of coolant hoses had been disrupted on impact. He reported that the ground beneath the fuselage was damp – possibly from coolant leakage. He did not see any evidence of coolant on the tail surfaces or brace struts.

Engine examination

The aircraft was recovered to the AAIB where the engine was examined and stripped with the assistance of two engineers from a Rotax agent. The examination revealed that the piston, in the forward ('power takeoff'[1]) cylinder, had scoring marks on opposing sides of its walls (Figure 1). The walls of the 'power takeoff' cylinder were similarly scored and this damage was consistent with the piston having seized during operation. The piston and cylinder walls of the aft ('magneto') cylinder were undamaged. There was no evidence of detonation on the piston surfaces, which

Figure 1

'Power takeoff' piston showing vertical scoring marks consistent with piston seizure

Footnote

[1] The cylinder closest to the propeller flange is referred to as the 'power takeoff' cylinder, while the cylinder closest to the magnetos is referred to as the 'magneto' cylinder.

indicated that an excessively lean mixture was an unlikely factor. There was sufficient oil in the engine and no evidence of oil pump failure or noticeable lack of oil surrounding the pistons. According to the engineer from the Rotax overhaul organisation, the evidence of scoring on opposing sides of the cylinder was consistent with overheating from insufficient cooling by the liquid cooling system. In his experience piston seizure from inadequate lubrication would have resulted in scoring around the entire circumference of the piston, which was not the case here. The piston-to-cylinder wall clearances were measured and were within specification.

Radiator examination

The radiator in this model has a capacity of 2.75 litres, but only 0.4 litres of coolant were recovered from the radiator and overflow bottle. There was clear evidence of impact damage to the radiator, its fittings and hoses, which would have resulted in much of the coolant loss. It was therefore not possible to pressure-test the system to examine for possible pre-impact leaks. The coolant level in the overflow bottle was below the 'minimum cold' red line; it was just under ¼ full, but should have been at least ⅓ full. This level was probably a reliable 'pre-impact' indication as the aircraft did not turn over. The red line on the overflow bottle was not initially visible, as it was covered by a circular strap bracket retaining the bottle (Figure 2). It was only when the bottle was pushed upwards into its correct seating position that the red line became visible (Figure 3). The pilot considered that he would have noticed if the bottle had not been correctly seated prior to the first flight of the day, and believes it more likely that the bottle slipped in its bracket during the impact.

Apart from the incorrect position of the overflow bottle, the radiator installation was found to be in accordance

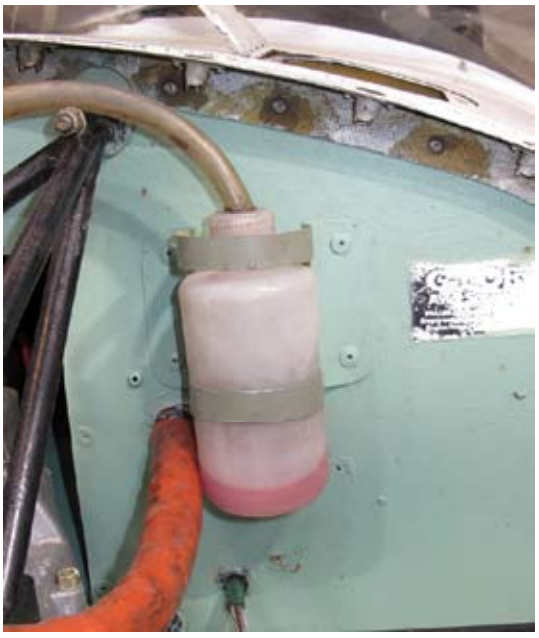


Figure 2

Radiator overflow bottle in the as-found position with the as-found coolant quantity

Figure 3

Radiator overflow bottle after being pushed up into its correct seating position (red 'minimum cold' line visible)

with the build manual for the Avid Speedwing Mk4[2], but was different to the installation described in the Rotax installation manual. The Rotax installation manual describes an installation with a single radiator and does not describe how to install a dual radiator system. The Rotax manual also depicts an expansion chamber that is significantly larger than the one fitted to G-LORT (Figure 4). In the G-LORT dual-radiator installation the coolant flows from the top of the right radiator ('RT') to the top of the left radiator ('LT') as depicted in Figure 4. The Rotax agent engineer suggested that with this installation and the small expansion chamber it might not require a significant coolant loss before the air gap was large enough in the upper connecting hose to stop the coolant flowing from the right radiator to the left radiator. The LAA were contacted regarding this installation and they confirmed that it was installed in accordance with the Avid build manual for the type, and that the LAA had approved the type based on successful in-service experience. They were not aware of any particular cooling issues on this version of the type. The builder of the aircraft stated to the LAA that he had not experienced any overheating problems with G-LORT.

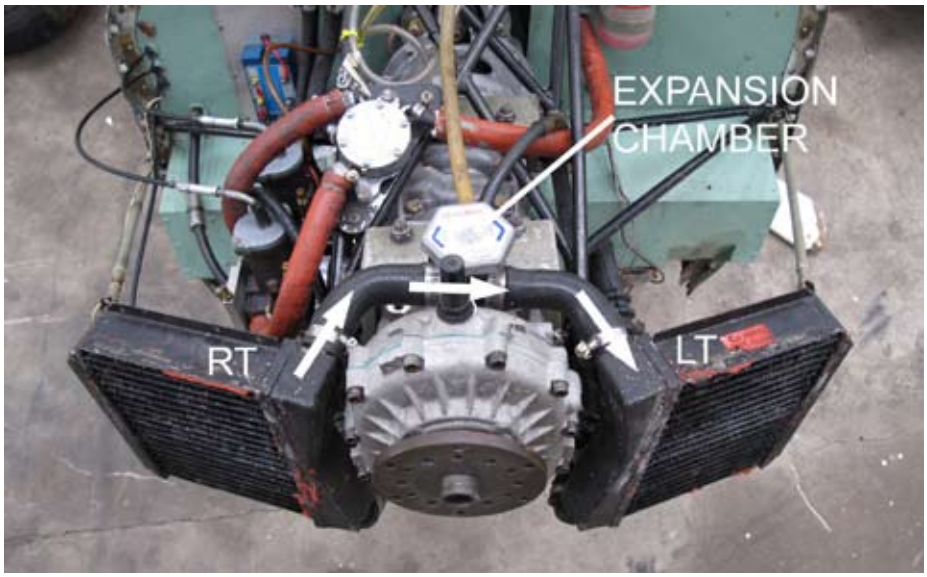


Figure 4

Dual radiator installation on G-LORT; white arrows show direction of coolant flow

The thermostatic valve inside the radiator was removed and placed in water at 80°C whereupon it started to open immediately. It started to close when the water temperature had dropped to 60°C. This was in accordance with its nominal operating temperature of 65°C.

The radiator filler cap was of the correct type with a vent pressure of 90 KPa (13 psi). An inspection of the radiator pump and its impeller did not reveal any anomalies.

Coolant temperature sensor and gauge examination

The coolant temperature sensor and temperature gauge were removed from the aircraft and tested together. At a water temperature of 196°F (91°C) the gauge was indicating about halfway between the 100° and 180° marks (Figure 5). The scale on the gauge did not appear to be linear so it was not possible to determine what the two marks between 100° and 180° represented, but it was apparent that the gauge was under-reading by about 40°F to 60°F.

The pilot reported that during normal operation the gauge had never indicated more than just over the 100°F mark. He had been advised that the needle must be "off the stop" but that a low reading was "OK". The Rotax 582 operator's manual lists the minimum coolant temperature as 150°F (65°C) and the maximum

Footnote

[2] Rotax mod 99 was embodied

as 175°F (80°C). These figures are consistent with the gauge under-reading by about 40°F to 60°F when it was indicating just over the 100°F mark. During the accident flight the pilot saw the gauge needle rise rapidly to the vertical position, which is about the 200°F mark. Therefore, the coolant temperature had probably risen to about 240°F to 260°F, well above the maximum operating limit. The coolant temperature is measured at the cylinder head block.

Figure 5

Coolant temperature sensor and gauge test
(91.3°C = 196°F)

Coolant level checks

In order to check the coolant level on this engine installation, the engine cowling must be removed, which involves removing about 25 screws. The pilot stated that he removed the engine cowling and checked the coolant level in the radiator prior to his first flight to Eaglescott and that it was about ½″ below the radiator filler cap, and although he could not recall checking the level in the overflow bottle, he believes he would have noticed if it had been below the red line. Prior to departing Eaglescott, and prior to departing Bodmin, he did not re-check the level in the radiator or the overflow bottle. The pilot stated that he did not notice any water dripping beneath the engine at any stage.

Analysis

The evidence from the scored 'power takeoff' piston was indicative of the piston having seized due to overheating. This evidence was consistent with the pilot's report that the engine stopped suddenly after a rapid rise in coolant temperature. The pre-impact coolant level quantity in the radiator could not be positively established due to multiple leaks suffered following impact, but the coolant level quantity in the overflow bottle was below the minimum required. This may have been an indication that the radiator was suffering from a leak, because if the level in the radiator was reducing due to a leak, then replacement coolant from the overflow bottle would have been sucked in. The design of the dual radiator installation, with the small expansion chamber, meant that it was probably less tolerant of a coolant leak than the Rotax-recommended installation - meaning that a smaller loss of coolant was necessary to stop the flow. The amount of coolant that would need to be lost, in the G-LORT installation, to stop the flow was not established. There were no defects with the radiator pump or thermostatic valve so the most probable cause of the engine overheating was a loss of coolant. It could not be established where the coolant leak occurred, when it started, the leakage rate, or why it was not noticed.

The fact that the coolant temperature gauge was under-reading by 40°F to 60°F was not picked up, even though it was indicating well below normal minimum operating temperature in flight. If this problem had been fixed, and if the temperature gauge had been marked with the minimum and maximum limits, then it is possible that the temperature exceedence would

have been noticed sooner, providing the option of a precautionary landing under power. In the event the engine stopped, and although the aircraft had sufficient height for a successful forced landing, the pilot stalled the aircraft just short of his intended field. The pilot candidly admitted that his lack of currency on type was probably a contributory factor.

Conclusions

The engine seized in flight due to overheating and the pilot attempted to carry out a forced landing into a field but stalled the aircraft at a height of about 15 feet just short of the field. The engine probably overheated due to a loss of radiator coolant from an unidentified leak.

ACCIDENT

Aircraft Type and Registration:	Cessna 182N Skylane, G-AXZU
No & Type of Engines:	1 Continental O-470-R piston engine
Year of Manufacture:	1969
Date & Time (UTC):	4 September 2010 at 1345 hrs
Location:	Errol Airfield, Grange, Perthshire
Type of Flight:	Aerial Work
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Serious damage to leading edge of left wing and slight dent to right wing strut
Commander's Licence:	Private Pilot's Licence
Commander's Age:	47 years
Commander's Flying Experience:	493 hours (of which 22 were on type) Last 90 days - 10 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

During a crosswind landing the aircraft departed the runway surface to the left and struck a fence, bush and metal pole.

History of the flight

The pilot was a 'Jump Pilot' and was using the aircraft to take skydivers into the air for the local skydiving club. Runway 05 was in use which was 700 m long and 46 m wide with a loose asphalt surface. The pilot reported that, during the course of the day, he carried out three uneventful flights, each time landing on Runway 05 with about an 8 kt direct crosswind from the right. During the fourth flight he returned to the airfield and flew an approach to Runway 05 with a similar crosswind. He used the same full flap setting, the same approach speed and the same into-wind crab technique as on the previous three landings. Just prior to touchdown he applied left rudder to align the nose with the runway and applied right aileron to maintain the centreline. The aircraft touched down normally and after a very short time it began to slew towards the left. As with the previous landings the pilot did not apply the brakes because of the runway's loose asphalt surface and uneven patches. He allowed the aircraft to slow without brakes while applying right rudder pedal and into-wind aileron to regain the runway centreline. However, the aircraft continued to slew to the left, ran through a wire fence, and hit a bush and vertical metal

pole with its left wing before coming to rest. The pilot shut down the engine and vacated the aircraft unassisted via the right door.

Pilot's assessment of the cause

The pilot could not explain why the aircraft had veered off the runway. He reported that he had used the same techniques successfully on the previous three landings in similar conditions. At no time did he notice any wind gusts or see the windsock indicating a gust. He concluded that there must have been some failure which affected the directional controllability of the aircraft. However, the aircraft was examined by an insurance loss adjustor who did not find any faults with the rudder system, nosewheel steering system, braking system or the tyres.

ACCIDENT

Aircraft Type and Registration:	DH60G Gipsy Moth, G-ATBL
No & Type of Engines:	1 de Havilland Gipsy 1 piston engine
Year of Manufacture:	1933
Date & Time (UTC):	9 September 2010 at 1400 hrs
Location:	Black Acre Farm Strip, near Holt, Wiltshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Left lower spar cracked, tears to fabric of both wings, propeller dented, engine cowling bent
Commander's Licence:	Private Pilot's Licence
Commander's Age:	46 years
Commander's Flying Experience:	3,800 hours (of which 2 were on type) Last 90 days - 32 hours Last 28 days - 10 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot commenced his takeoff run at near the maximum all-up weight on Runway 18 of the 480 m long private grass strip which slopes down to the south. The reported surface wind was 240° to 250° at 10 kt, gusting to 15 kt. Just after getting airborne within a third of the available length, he encountered some turbulence and sink, and felt that the aircraft was not climbing as well as it should. He decided to abort, closed the throttle and landed back on the runway. However, he was unable to stop the aircraft before it rolled into a hedge off of the end of the strip, causing some damage to the aircraft. The pilot, who was wearing a full harness and helmet, and the passenger, who was wearing a lap strap and helmet, were unhurt.

ACCIDENT

Aircraft Type and Registration:	Extra EA300L, G-DUKK
No & Type of Engines:	1 Lycoming AEIO-540-L1B5 piston engine
Year of Manufacture:	2000
Date & Time (UTC):	19 June 2010 at 1501 hrs
Location:	Methley Bridge, Castleford, West Yorkshire
Type of Flight:	Aerial Work
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Fatal) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	31 years
Commander's Flying Experience:	3,600 hours (of which 70 were on type) Last 90 days - 33 hours Last 28 days - 13 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft flew into the ground during a flying display. The pilot had not followed the display routine that he normally practised and initiated recovery from a flat spin at a height lower than required. The pilot was fatally injured on impact. The engineering investigation concluded that the aircraft was serviceable prior to the accident.

Two Safety Recommendations have been made as a result of this investigation.

History of the flight

On the day of the accident the pilot planned to perform three flying displays. The weather conditions were suitable, although the strong wind would make display flying more challenging. The sequence of manoeuvres, which formed the pilot's display, was written on a card which was kept in a holder on the top of the aircraft instrument panel, where it could be seen easily by the pilot in flight. The manoeuvres, which formed the pilot's display, varied in complexity and included a Muller Tower[1], with a two-turn flat spin, followed by a half cloverleaf. The first two displays were close to Sherburn-in-Elmet, where the aircraft was based, and took place at approximately 1200 hrs without incident.

Footnote

[1] The Muller Tower, Zwilbelturm, or Spiral Tower is attributed to Swiss and European aerobatic champion Eric Muller, who is thought to have invented it in 1974. From a right roll on a vertical up line, a tumble is begun that resembles an inverted ascending spin. The controls are reversed to accomplish a transition to an upright flat spin as the aircraft reaches apogee and starts to descend.

During these displays the pilot appeared to follow the sequence of manoeuvres shown on his display card. The third display was at Methley boatyard, 7 nm south-west of the airfield, and was planned to take place at 1500 hrs.

In the break between the displays the pilot refuelled the aircraft and had a snack with friends; he was observed to be in good spirits and looking forward to the last display, which his family and friends would be attending. He did comment though that he was feeling a little tired, and that the wind had made things a little more difficult for him during his earlier displays. He also sent several text messages with his phone to friends who were aerobatic pilots. In these messages he indicated that he was not happy with all aspects of the displays he had just flown, specifically his Muller Tower manoeuvre. The pilot then returned to his aircraft and was seen to get airborne at around 1450 hrs.

Shortly before 1500 hrs the aircraft performed a flypast and commenced its display at the boatyard. The display started with the aircraft flying past the crowd on its side, a manoeuvre known as a knife-edge pass. It then performed an inverted flypast, during which the pilot could be seen waving to the crowd. The aircraft's subsequent manoeuvres were not in the sequence shown on the pilot's display card. After several standard aerobatic manoeuvres the aircraft performed a vertical manoeuvre which the pilot may have intended to be a Muller Tower. The aircraft fell out of this manoeuvre into a dive, which was followed by the aircraft pulling up to the vertical and rolling right once more. The evidence indicates that this was also intended to be a Muller Tower. The aircraft then made five descending turns in a flat spin before it was seen to recover from the spin into a steep dive. The aircraft was now very low, and it flew into the ground. Witnesses rushed to the scene but it was immediately apparent that nothing could be done to assist the pilot. There was no fire.

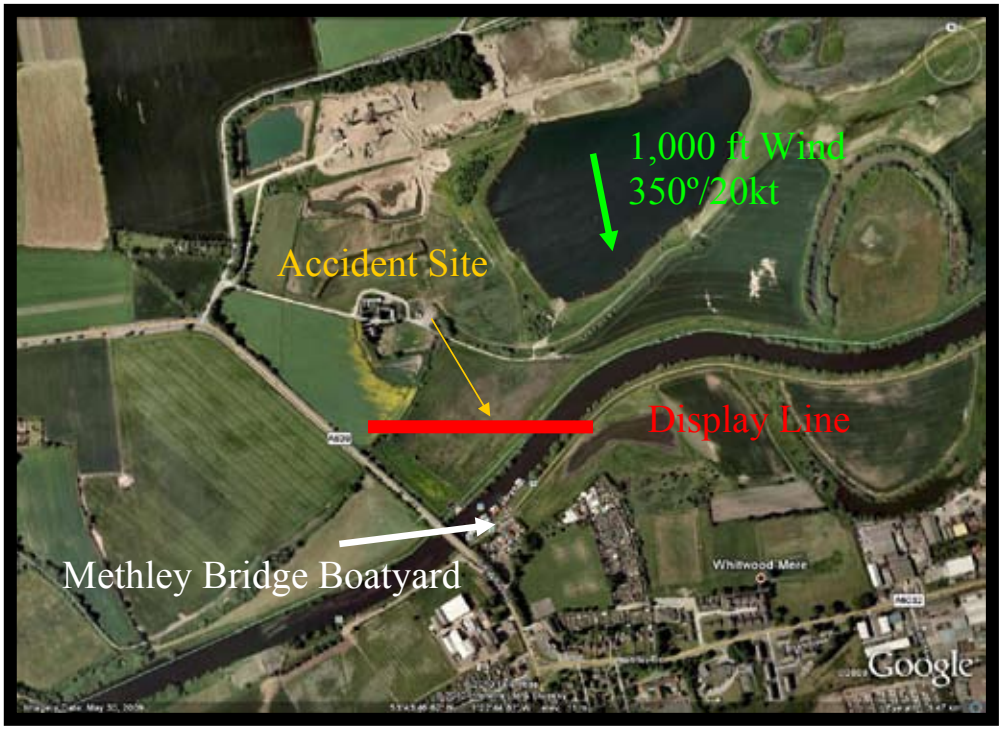


Figure 1

Location of the display line and accident site

Medical and Pathology

The post-mortem report concluded that the pilot died of a severe head injury caused by his head striking the instrument panel of the aircraft when it crashed. The pilot's head struck the instrument panel because his shoulder harness mounting had failed; however, the pathologist considered that the accident may still have proved fatal even if the shoulder harness had not failed. Toxicology revealed no evidence of drugs or alcohol and the carbon monoxide levels found were considered normal.

Witness evidence

There were many witnesses to the accident, and a great deal of photographic and video evidence. Photographic evidence indicates the accident occurred at 1501 hrs.

One witness, who knew the pilot well and had seen his display several times before, commented that the flypasts seemed lower than normal, and that the flat spin was performed at a lower height than normal, the pilot normally performing only two or three turns before recovering.

An analysis of the photographic and video evidence confirmed that, after the inverted flypast, the sequence of the manoeuvres flown was unlike those shown on his display card. Furthermore, the sequence flown was not depicted on any of the pilot's discarded display sequence cards recovered after the accident.

Video and photographic evidence

The National Imagery Exploitation Centre (NIEC) was given 278 photographs and three video clips, taken by witnesses to the accident. The NIEC were asked to ascertain, where possible, the aircraft's height and speed at certain points throughout the Muller Tower manoeuvre. It was unable to identify accurately any speeds for the aircraft before it entered the manoeuvre. It did determine that the aircraft entered the final manoeuvre at a height of 230 ft (+/- 30 ft), and that it reached a maximum height of 1,770 ft (+/-300 ft).

A sequence of photographs showed the aircraft in a flat spin, showing when pro-spin control inputs[2] were removed and the correct spin recovery control inputs (right rudder and neutral aileron) were made (Figure 2). The NIEC established that the aircraft was at a height of 690 ft (± 150 ft) when the spin recovery was initiated.

Aircraft information

The Extra EA300L is a two-seat aerobatic aircraft powered by a 300 hp Lycoming AEIO-540-L1B5 piston engine, driving a three-bladed constant speed propeller. The airframe is of steel-tube construction, and the wings, fin and tailplane are manufactured from composite material. It has a maximum takeoff weight of 950 kg and a V_{NE} of 220 kt. G-DUKK was fitted with an optional smoke system which when activated injects paraffin oil into the exhaust to generate a trail of smoke for display purposes.

Each seat on G-DUKK was equipped with a five-point harness which consisted of two shoulder harnesses, two lap straps and a crotch strap. The two shoulder harnesses of the rear seat were attached to a horizontal steel tube behind and above the rear seat back.

Maintenance history

The aircraft's last maintenance was an annual inspection on 24 May 2010, when the airframe and engine had accumulated 316 hours. No significant maintenance,

Footnote

[2] To maintain the aircraft in a left flat spin, left rudder is held with right aileron.

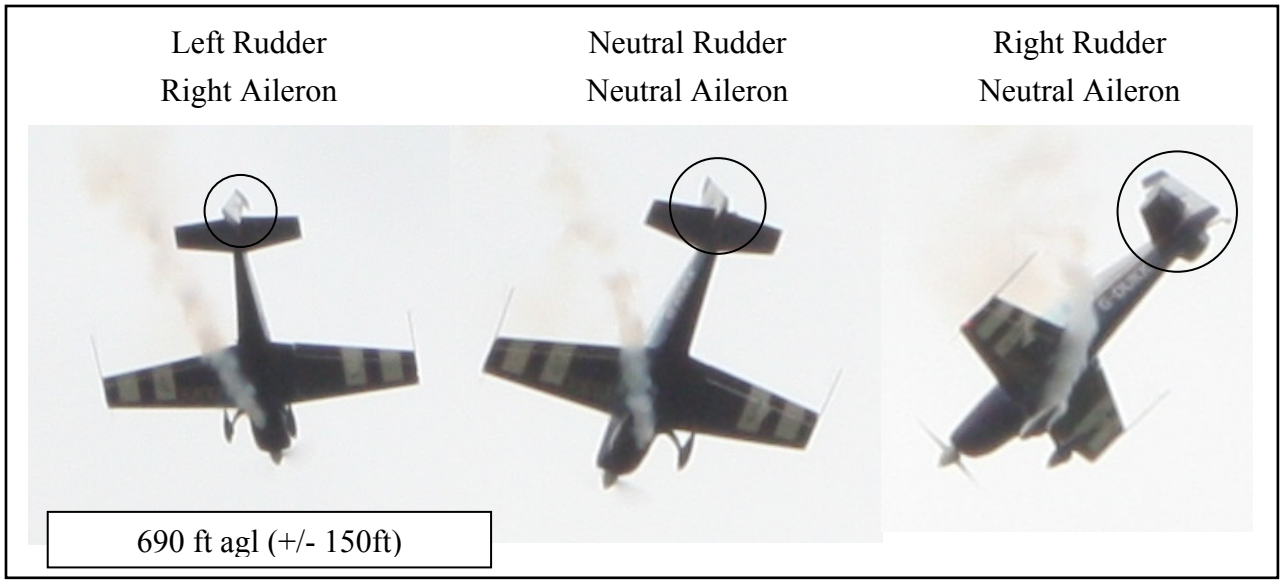


Figure 2

G-DUKK spin recovery initiation from a left turning flat spin
All three pictures taken within one second
(photographs courtesy Paul McCormick)

other than normal annual inspection items, was carried out during this maintenance input.

Accident site and initial wreckage examination

The wreckage of the aircraft was found upright in a flat field of tall grass, approximately 200 m north-east of Methley Bridge, Castleford (Figure 3). The aircraft had travelled a distance of just 3.9 m from its initial impact point to its final resting point, indicating a steep nose down impact, consistent with the video and still imagery. All three propeller blades had separated near their roots indicating that they had a high rotational energy at impact. The steel-tube airframe had sustained numerous overload failures, and the composite wing upper and lower surfaces were destroyed. The empennage had failed in bending overload due to the inertial forces at impact. There was no evidence of any pre-impact separations.

Video evidence of the aircraft just prior to impact revealed that at approximately 100 ft agl it was in a nose-down attitude of -40° (±5°), with a flight path angle of -53° (±5°) and a groundspeed of at least 100 kt (120 ±20 kt). The last available still image of the aircraft (Figure 4) shows the aircraft in a nose-down

Figure 3

Aircraft wreckage – the distance from nose impact point to nose resting point was 3.9 m.

attitude of -25° (±5°) just prior to impact. This image also revealed that the aircraft's smoke system was active until impact.

Detailed wreckage examination

The aircraft wreckage was recovered to the AAIB's facility in Farnborough for a detailed examination. An examination of the flying controls revealed that all failures were consistent with impact loads. There were no disconnections within the systems and no evidence of control restrictions. A detailed examination of the engine was not performed because the propeller had high rotational energy at impact and the video evidence revealed that there was engine noise and smoke up to the point of impact. There was no evidence of any pre-impact structural failures.

The rear seat instrument panel had suffered a severe impact consistent with the pilot's head injuries. This impact had destroyed the altimeter, such that it could not be tested but it was found set to 1019 mb - the correct QNH at the time of the accident. The airspeed indicator (ASI) was tested and found to under-read by 20 to 40 kt (for example, at an airspeed of 190 kt the ASI indicated 160 kt) however, such a large error should have been readily apparent to the pilot so it is probable that the impact disturbed the sensitive mechanical mechanism inside the ASI, thus introducing the error. The transponder was found set to '7000' but had been left in 'standby' mode.

The steel tubular frame above and behind the rear seat, to which the shoulder harnesses were attached, had failed in overload. The rear seat back attachment points had also failed, allowing the seat back to pivot forwards. The lap and crotch straps were still secured.

Figure 4

G-DUKK moments before impact – nose-down pitch angle estimated at 25° (±5°)
(photograph courtesy Paul McCormick)

The fuel selector was found set to the acrobatic[3] fuel tank. It was not possible to establish the quantity of fuel remaining because the fuel tanks had ruptured, but a fuel receipt indicated that the pilot had uplifted 49.7 litres (13.1 USG) prior to the accident flight. The refueller recalled that the pilot would normally fill the acrobatic tank (51 litre capacity) to the top and add 5 litres to each wing tank prior to a display flight. This would have been more than sufficient for the planned flight.

The aircraft load included the pilot (81 kg) and his parachute (7.5 kg). There was no baggage. The basic weight of the aircraft was 686 kg. Calculations showed that with any amount of fuel in the acrobatic tank, any amount of paraffin oil, and up to 10 litres of fuel in the wing tanks, the aircraft's weight and CG would have been within limits for aerobatics.

Footnote

[3] The aircraft manufacturer's Pilot's Operating Handbook uses the term 'acrobatic' to refer to aerobatic.

Crashworthiness regulations and impact g

The EA300 was type certificated to Federal Aviation Requirement (FAR) 23 Amendment 34 (2/1987) which states in section 23.561 under *Structure*, *Emergency Landing Conditions*:

> *'The structure must be designed to give each occupant every reasonable chance of escaping serious injury in a minor crash landing when – (1) Proper use is made of the belts or harnesses provided for in the design; and (2) The occupant experiences the ultimate inertia forces shown in the following table:'*

The table which follows states that for an aerobatic category aircraft these ultimate inertia forces are: 4.5 g upward, 9.0 g forward, and 1.5 g sideward. In 1988 Amendment 36 was introduced which required dynamic impact testing to be carried out with anthropomorphic test dummies. Amongst other requirements, a peak deceleration of 26 g needed to be demonstrated (in the forward direction).

The evidence from the accident site revealed that the aircraft had come to rest in a horizontal distance of just 3.9 m. The evidence from the video analysis indicated a final impact speed of at least 100 kt. This would have resulted in an overall deceleration during impact of at least -339 m/s^2, which is equal to 34.6 g. The peak g at impact would probably have been approximately double this value. This is considerably in excess of the 9g certification requirement for the EA300 and also in excess of the current 26g requirement for emergency landing conditions.

Meteorology

On the day of the accident there was an area of high pressure to the west of the UK, which maintained a northerly flow over Yorkshire. At 1500 hrs, in the area of the accident, the wind at 2,000 ft was from the north at 23 kt. At 1,000 ft the wind was 20 kt, and the surface wind was from the north at 17 kt. The surface wind remained stronger than would normally be expected because of a funnelling effect that occurs in that area when there is a northerly flow. The wind speeds recorded at 1500 hrs were approximately 5 kt lower than the wind speeds recorded at the time of the earlier displays. The visibility was more than 10 km and there were no clouds below 4,000ft.

Observation of the spin recovery manoeuvre

The investigation observed a sortie in an Extra EA300L which focused on the Muller Tower manoeuvre and the height required to recover the aircraft from a flat spin. The test aircraft entered the manoeuvre at a height of 4,000 ft at 180 kt. The aircraft achieved a maximum height of 5,400 ft and after five turns in a flat spin, passing 4,600 ft, the spin recovery was initiated. The aircraft achieved level flight at 3,600 ft, 1,000 ft below the height at which the recovery was initiated. Several more recoveries from a developed flat spin were flown, in which the aircraft consistently required 1,000 ft to recover to level flight.

Pilot information.

The pilot gained a PPL in December 1999. He was issued with a commercial pilot's licence in June 2003 and an instructor rating shortly after that. In March 2008, after attending an aerobatics course, the *'No Aerobatics'* limitation was removed from his instructor rating and in April 2008 he gained an ATPL (Aeroplanes). Around that time he started to fly aerobatics in G-DUKK. In June 2009 he was issued with a Display Authorisation (DA) for unlimited aerobatics to a minimum height of 300 ft, and flypasts to a minimum height of 100 ft. In

the remainder of 2009 the pilot flew at three organised displays. At the end of 2009 G-DUKK was sold and the pilot had no access to an aerobatic aircraft until April 2010, when the new owner of G-DUKK decided he would leave it at Sherburn-in-Elmet and gave his permission for the pilot to continue to fly, and display, his aircraft. The pilot then resumed practising his display routine and had flown the aircraft approximately 20 times since the change in ownership. The pilot's first public displays of the 2010 season were on the day of the accident.

The pilot worked as an airline pilot, and had been flying a part-time roster over the winter. He had not flown for the airline for a period of about six weeks until six days before the accident when he returned to a full-time roster. His first week back had consisted of three early starts, followed by a Licence Proficiency Check and an Operator Proficiency Check which were carried out over two days in a simulator near Manchester. The Type Rating Examiner who conducted the simulator check commented that the pilot had performed well. The available evidence indicated that, in the week prior to the accident, the pilot practised his display in G-DUKK at least five times. However, these practices were not observed by any of his colleagues who had aerobatic experience.

Display flying

The rules governing the conduct of civil air displays in the United Kingdom are given in the Air Navigation Order (ANO), '*The Rules of the Air Regulations'*. CAP 403 – '*Flying Displays and Special Events: A Guide to Safety and Administrative Arrangements*', published by the CAA, is, according to its introduction:

> *'intended as a code of practice and an indicator of best practice to provide guidance to ensure that the safety of both the participants and the spectators is not compromised.'*

Further guidance is given to display pilots in CAA Document No 743.

Civil flying displays within the United Kingdom are regulated by Article 162 of the ANO. When a flying display is at an advertised event, open to the public, Article 162 places responsibilities on both the organiser of the flying display (the Flying Display Director) and the participating pilots. For such an event the Flying Display Director must obtain the permission in writing of the CAA, and civil display pilots must hold a Display Authorisation (DA). At small flying displays - three individual displays or less - the pilot of a participating aircraft may act as the Flying Display Director. For the display at Methley Bridge the pilot was also acting as the Flying Display Director.

Before a Permission can be issued, the CAA must be satisfied that:

> *'A person is fit and competent as a Flying Display Director, having regard in particular to his previous conduct and experience, his organisation, staffing and other arrangements, to safely organise the proposed Flying Display.'*

Similarly, a pilot must satisfy the CAA that:

> *'He is a fit person to hold a DA and is qualified by reason of his knowledge, experience, competence, skill, physical and mental fitness.'*

To this end, the pilot is required to provide such evidence and undergo such tests and examinations as the CAA may require. In practice the CAA authorises certain people to conduct these tests on its behalf. These people are known as Display Authorisation Evaluators (DAEs). The CAA will normally refer any pilot who is seeking a DA to a DAE in his discipline and area.

For aerobatic DAs the DAE will assess the experience and the performance of the potential display pilot and recommend them for a specific category of aerobatic DA, depending on their experience. The categories are, by increasing complexity of manoeuvre, Standard, Intermediate, Advanced and Unlimited. There are no restrictions on the aerobatic figures, including autorotative figures, which a pilot flying in the '*Unlimited*' category may perform. If a pilot can perform only one or two aerobatic manoeuvres from a particular category, the pilot can be recommended for a lower category, but with the specific manoeuvres that the pilot can fly in the higher category approved individually. The DAE will also recommend a minimum height for the manoeuvres to be carried out.

On 24 June 2009, the accident pilot was assessed for a DA for the first time. The DAE recommended him for an Unlimited DA, with a minimum height of 100 ft agl for flypasts and aerobatics. On 29 June 2010 the CAA accepted the DAE's recommendation, but increased the minimum height for aerobatics to 300 ft, and issued the pilot with an Unlimited DA.

During the investigation the AAIB spoke to several DAEs who were approved to authorise aerobatic DAs. None witnessed the assessment of the accident pilot for his DA and could not therefore offer comment on his individual suitability for a particular category of DA. Nevertheless, they all expressed surprise, given the accident pilot's relative inexperience of unlimited aerobatics, that he had been given the '*Unlimited*' category of aerobatics for his first DA.

Human factors

The investigation consulted a human factors expert to explore why the pilot had not followed the planned display routine, and why he held the aircraft in a flat spin for five turns instead of his more usual two or three turns. His report included the following:

'The fact that he chose to pursue aerobatics and display flying suggests that he was probably relatively extraverted. This can be associated with impulsivity.

The aerobatics restriction on his Flying Instructor's licence was removed in 2008 and he received his display authorisation less than a year before the accident. That authorisation was endorsed as 'Unlimited'. The effect of this endorsement can only be guessed at. However, it was unlikely to be seen as counselling caution or the need for supervision, particularly if applied to an already confident individual. As such, it might exacerbate the effects of impulsivity.

Some cumulative fatigue and life stress may have played a part. The wind on the day was difficult; perhaps that played a part. An independent assessment of his performance and advice from a more experienced performer either on 19 June or during the preceding week might have helped the pilot overcome his difficulties or decide that he was not yet ready for the display. Such advice would be especially valuable if he was, indeed, an extravert and impulsive person as suggested. The granting

of a Display Authorisation appropriately and necessarily involves an assessment of skill in flying aerobatics. A failure of skill is, however, less likely to be the root cause of a display flying accident than a failure of judgement. Judgement is harder to assess. It may be worthwhile considering a Display Authorisation process that requires an element of mentoring and supervision until a reasonable amount of experience has been accrued. This requirement, of itself, might induce some caution in newly authorised pilots.'

Analysis

The examination of the aircraft wreckage did not reveal any problems with the flight control system and this was consistent with the photographic evidence, which revealed that the rudder and elevator were being moved as expected during the spin and during the recovery. There were no pre-impact separations or other defects that might explain a failure of the aircraft to recover from a spin, and the engine appeared to have been producing power prior to impact.

The pilot departed from the routine shown on his display card after two flypasts. CAP 403 states:

'The impromptu, ad hoc, unrehearsed or unplanned should never be attempted.'

The pilot's DA approved a minimum aerobatic display height of 300 ft. Flight observations in a similar aircraft showed consistently that 1,000 ft was required to recover the aircraft to level flight from a flat spin. Therefore, to achieve this, the pilot would have needed to initiate the recovery from the spin at a height of 1,300 ft. Photographic evidence indicated that the recovery was initiated at 690 +/-150 ft agl. From this height flight observations indicated a safe recovery would not have been possible.

The human factors expert considered that the pilot's judgement may have been affected by fatigue and life stresses. He also considered that any tendency the pilot may have had towards impulsive behaviour was unlikely to have been checked by him being awarded the highest category of aerobatic DA at his first assessment.

The pilot suffered a fatal head injury when the tubular structure retaining his shoulder harness failed and his head struck the instrument panel. However, the impact loads were significantly in excess of the certification requirements for the pilot restraint system. The pilot was wearing a headset but no helmet. It is possible that had he been wearing a helmet, the severity of his head injury would have been reduced, but it was not possible to determine whether this would have been to a degree sufficient to alter the fatal outcome. Furthermore, the main impact was to the pilot's forehead, and in an area for which most flying helmets do not provide impact protection.

Safety Recommendations

The DA process was followed correctly, but the existing guidance to DAEs given in CAP 403 did not preclude a relatively inexperienced pilot being awarded an Unlimited category authorisation on first assessment for an aerobatic DA. There may be circumstances in which this would be appropriate, but the forgoing discussion suggests that it should not be the norm. Therefore, the following Safety Recommendation is made:

Safety Recommendation 2010-001

It is recommended that the Civil Aviation Authority amend CAP 403 to advise that only in exceptional circumstances should a pilot be authorised to conduct aerobatic displays in the Unlimited category upon first assessment for an aerobatic display authorisation.

The accident pilot had not had an experienced colleague critique his flying display, or any of his practices, during the 2010 season. The human factors expert considered that a process that requires an element of mentoring and supervision until a reasonable amount of experience has been accrued may help a pilot improve his judgement. Therefore the following Safety Recommendation is made:

Safety Recommendation 2010-002

It is recommended that the Civil Aviation Authority consider introducing a mentoring process for pilots who have received their first Display Authorisation.

ACCIDENT

Aircraft Type and Registration:	Grumman AA-5A Cheetah, G-OPWK
No & Type of Engines:	1 Lycoming O-320-E2G piston engine
Year of Manufacture:	1978
Date & Time (UTC):	10 November 2010 at 1433 hrs
Location:	3 miles NW of Cumbernauld Airport, Scotland
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Right wing leading edge damaged, right landing gear bent, nosewheel detached, minor damage to wall
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	36 years
Commander's Flying Experience:	993 hours (of which 945 were on type) Last 90 days - 20 hours Last 28 days - 10 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and other reports

Synopsis

Following pre-flight inspection, during which water was found and drained from the fuel tanks, and a number of aborted starts due to battery problems, satisfactory engine runs were performed. Shortly after takeoff, at about 600 ft agl, the engine lost power. During the subsequent forced landing the aircraft hit a concealed dry stone wall but both occupants escaped injury. The conditions at the time were close to those during which serious carburettor icing at any power could have occurred.

History of the flight

The instructional flight was the first flight of the day; the instructor was the pilot in command. A quantity of water was found and drained from the fuel tanks during the pre-flight inspection and a number of engine starts failed due to battery related problems. Later pre-flight checks, including approximately eight minutes of engine running and monitoring, were satisfactory.

The aircraft departed from Runway 26 of Cumbernauld Airport at about 1433 hrs and soon afterwards, at approximately 600 ft agl, the engine lost power. The pilot selected a field for a forced landing. The instructor and student carried out emergency checks and the student made a MAYDAY call. The fuel tank selection

was changed and the fuel pump was checked as being ON but, with the short time available, carburettor heat was not selected.

On landing, the aircraft clipped a dry stone wall hidden by long grass, damaging both the wall and the aircraft. The aircraft came to a stop in the wet and boggy field after approximately 50 m and both occupants, who were wearing lap and diagonal harnesses, vacated the aircraft uninjured.

The pilot reported that the temperature and dewpoint were 2°C and -2°C respectively, and that carburettor icing was highly likely. These conditions are close to those in which serious carburettor icing at any power may occur.

ACCIDENT

Aircraft Type and Registration:	Hunting Percival P56 T Provost Mk 51, G-BLIW
No & Type of Engines:	1 Alvis Leonides 126 radial piston engine
Year of Manufacture:	1954
Date & Time (UTC):	16 September 2010 at 1138 hrs
Location:	Shoreham Airfield, West Sussex
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to both wings, main landing gear, tailwheel, lower front cowls, air box, oil cooler and propeller
Commander's Licence:	Private Pilot's Licence
Commander's Age:	66 years
Commander's Flying Experience:	1,197 hours (of which 113 were on type) Last 90 days - 8 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Shortly after departure the engine started vibrating and the pilot could not control the propeller pitch angle. He initiated a forced landing back towards the airfield but overshot the end of the runway and touched down heavily in a field, causing the landing gear to collapse.

History of the flight

The Hunting Percival P56 T Provost Mk 51, also known as a 'Piston Provost', is a single-engined two-seat ex-military training aircraft with a fixed landing gear. It is powered by a 550 hp Alvis Leonides 126 radial engine which, through a reduction gearbox, drives a three-bladed constant-speed propeller.

G-BLIW had been rebuilt by its owner and was being prepared for its first test flight. The pilot/owner had not flown a Piston Provost in five years, but he was current on the T-6 Harvard. After carrying out his pre-flight checks he departed from Runway 25 (grass). The wind was 7 kt from 300° and there was scattered cloud at 2,500 feet and broken cloud at 4,800 feet. He made a gentle climbing turn to the left at 100 kt, climbing at 1,000 ft/min. Upon reaching 2,300 feet he reduced the power to zero boost and reduced the rpm to 2,600. He then moved the propeller lever to make a slight adjustment to the rpm but this had no effect. He pulled the propeller lever further back and this resulted in a sudden drop in rpm accompanied by

vibration. Reducing the power caused the vibration to reduce, but when he tried to increase the power the vibration increased again with little increase in engine rpm or thrust.

The pilot made a PAN urgency call to the Shoreham controller and initiated a descent to the south of the airfield in order to position himself for a landing on Runway 25. He turned on to final at 90 kt, closed the throttle, set the propeller lever to fine pitch, and set full flap. However, the aircraft was too high, its speed was decaying slowly, and the pilot realised that he was going to overshoot the end of the runway. Upon passing the far end of Runway 25 he rolled to the left to avoid a raised bank and aimed to land in a field within the airfield boundary. He held the aircraft off to reduce the airspeed further, and the right wing dropped, causing the right gear to hit the ground heavily, followed shortly by the left gear. Both main gear legs collapsed and the aircraft slowed rapidly and yawed round to the left until it was facing due east. The aircraft came to rest about 250 m south-west of the Runway 07 threshold. The pilot was able to vacate the aircraft unassisted.

Pilot's assessment of the cause

The pilot reported that, after landing, the propeller was found to be in the full coarse position while the propeller lever was set to full fine. The cause of the loss of propeller pitch control was not determined. He said that contributory factors to his overshooting the runway were the absence of a headwind and the reduced drag from the propeller being in coarse pitch rather than in fine pitch.

ACCIDENT

Aircraft Type and Registration:	Mooney M20B, G-JDIX
No & Type of Engines:	One Lycoming O-360-A1D piston engine
Year of Manufacture:	1961
Date & Time (UTC):	9 May 2010 at 1705 hrs
Location:	Old Buckenham Airfield, Norfolk
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:	66 years
Commander's Flying Experience:	Not established
Information Source:	AAIB Field Investigation

Synopsis

The aircraft was seen to depart from controlled flight whilst flying at slow speed and low height in the vicinity of Old Buckenham Airfield, which was believed to be the point of intended landing. The circumstances which gave rise to the loss of control could not be determined, but sufficient evidence existed to cause doubt about the pilot's fitness to safely act as pilot of an aircraft on the day of the accident.

Background information

The pilot purchased G-JDIX in August 2009 and flew it to Hohenems Airport in Austria, which was close to his home and where the aircraft was to be kept. At that time, the pilot owned and flew a Morane Saulnier 880 Rallye aircraft, which was destroyed in a forced landing accident a short while later, in November 2009.

In February 2010 he flew G-JDIX to Biberach Airport in Southern Germany. It is believed this was to have been a permanent move and that the pilot intended to transfer the aircraft to the German register, but this did not happen. He subsequently made arrangements with a maintenance facility at Old Buckenham Airfield in Norfolk (from where he had purchased the aircraft) for them to carry out maintenance on the aircraft. It was arranged that he would fly it from Biberach to Old Buckenham on 9 May 2010.

History of the flight

Prior to departure, the pilot fuelled the aircraft with 106 litres of fuel, and loaded a single bag into the aircraft. Takeoff from Biberach was at 1226 hrs. The airport operator reported that the pilot rejected the first

takeoff attempt, reportedly for failing to gain adequate airspeed, but took off successfully at the second attempt (the reason for the rejected takeoff was not confirmed). According to information listed on the filed flight plan, the flight was expected to last 3 hours 30 minutes, with a fuel endurance of 4 hours 20 minutes. At about 1620 hrs, the pilot called on the Old Buckenham Air/Ground frequency to request the airfield details, which were passed to him: Runway 07 was in use and the surface wind was from 040°(M) at 8 kt. The weather was fine, with broken cloud cover at about 2,500 ft and visibility in excess of 10 km.

About 10 minutes after his initial call, the pilot called 'DOWNWIND' and then 'FINALS'. When the aircraft had not landed some minutes later, staff checked with Tibenham airfield (4.5 nm to the south-east) and learnt that the aircraft had landed there unexpectedly. Recorded data from the aircraft's GPS navigation unit, which was recovered from the accident site, showed that the aircraft had not in fact made an approach to Old Buckenham, but had landed at Tibenham after first orbiting briefly to the south of the airfield.

Gliding operations were in progress from Runway 03 at Tibenham; there was a launch control vehicle on the airfield and the local Air/Ground frequency was in use. The pilot of G-JDIX made no radio calls on the frequency, and landed on the out-of-use Runway 33, which was across the prevailing wind and across which ran glider launch cables. The aircraft appeared to make a very low approach, and seemed to onlookers to be rather fast, possibly without wing flaps lowered. The aircraft bounced several times on landing and used 1,100 m of the runway's 1,250 m length.

After parking at the clubhouse, the pilot spoke to several club members. They described him as being in a highly agitated, even distressed, state. He was sweating profusely, with sweat-soaked clothing. He was also very voluble, and talked of a number of things, including personal family issues which were obviously a source of concern to him. He was given a hot drink but did not eat anything. His English was not good, but he was able to explain that he had landed at Tibenham because of concerns over the aircraft's brakes and the short runway at Old Buckenham, which is 800 m in length, with a Landing Distance Available of 640 m. The pilot did not seek any engineering assistance, although a club member did carry out a brief external check of the wheels and brakes and found nothing obviously amiss. The pilot did not enquire about refuelling. People who met with the pilot were concerned and thought he should not fly again in his condition. They encouraged him to delay the last stage of his flight, but the pilot was clearly keen to continue.

The gliding operations were explained to the pilot, who was instructed to taxi for Runway 03 and to contact launch control before takeoff. Contrary to these instructions, he taxied straight out to the start of Runway 33 and commenced a takeoff run without appearing to carry out any engine checks beforehand and without making any radio calls on the local frequency. The aircraft climbed to an estimated 1,000 ft agl and departed on approximately the runway track until out of sight.

At about the time the aircraft took off the pilot called again on the Old Buckenham frequency and asked for the airfield details. After these were passed to the pilot, he made comments about his brakes and about returning to Tibenham. Personnel at Old Buckenham were not certain of the exact meaning of his comments, but took them to mean that he was intending to return to land at Tibenham. When nothing further was heard, Tibenham was called again to see if the aircraft had landed again there, but it had not.

Witnesses saw the aircraft flying in the vicinity of Old Buckenham Airfield at what was described as very low height and speed. Given its proximity to the airfield (only about 500 to 700 m from the Runway 07 threshold), its presence was not remarkable, but the aircraft was not flying on a recognised approach path and even turned away from the airfield shortly before the accident occurred. Witnesses described what appeared to be a low-speed departure from controlled flight, in which the aircraft dropped a wing and descended rapidly, disappearing from view behind trees. There were no reports of smoke or flames, or anything falling from the aircraft. One witness, who was in an open field close to the aircraft's flight path, could clearly see the pilot as the aircraft passed over, and reported seeing the aircraft's anti-collision beacon operating. He described the engine being at near idle power, but thought that the engine noise had increased markedly for a brief moment just before the loss of control.

Witnesses alerted the emergency services and went to the scene of the accident, which was in a field of young crops, a few hundred metres from a road. A fire had broken out and was accompanied by one or more small explosions. Although some paper documents were on the ground outside of the cabin, the cabin door itself was closed and the pilot was seen to be lying, apparently deceased, across the front seats. The fire quickly consumed much of the cabin area. Later examination revealed that the pilot's seat belt was unfastened.

Wreckage

The wreckage site was located in a field approximately one mile west of the threshold of Runway 07 at Old Buckenham Airfield. The aircraft was largely intact and all the wreckage was located within 10 m of the main wreckage. A fire had consumed most of the cockpit and upper fuselage.

There was significant damage to the left wingtip and left wing leading edge. The right wing was less damaged than the left. There was a 10 cm deep by 1 m long vertical mark in the ground next to the lower rear fuselage. This mark was consistent with having been made by the right side of the rear fuselage moving sideways with low energy and with little or no forward velocity. It was concluded that the aircraft had struck the ground in a nose-down, left-wing-low attitude, at a low speed, and with significant rotation. These conditions were consistent with a spin to the left.

The propeller was located 2 m from the main wreckage. One of the propeller blades was buried in the ground; the tip of this blade had sheared off and there were chordwise score marks on the remaining portion of this blade. The other blade was intact, bent backwards and relatively free of witness marks. Next to the propeller were some smooth cuts in the soil, these were black in colour (similar in colour to the propeller blades) and were consistent with propeller ground strikes. It was concluded that the propeller was probably rotating when the aircraft struck the ground, and it had stopped in approximately half a revolution.

Approximately 10 litres of fuel were recovered from the right wing fuel tank.

Aircraft information

The Mooney M20B has conventional three-axis flying controls and is equipped with a retractable landing gear and trailing edge flaps. G-JDIX was aircraft serial number 1866.

The aircraft and engine logbooks were found in the wreckage; however they were significantly fire-damaged. From the remains of the logbooks and maintenance engineering information it was established that the

aircraft had a 50-hour inspection in August 2009, at which time the airframe had completed 1,729 flying hours and the engine 10 hours since complete overhaul. The aircraft's Certificate of Airworthiness had expired in February 2010.

Post-accident performance calculations were made using known flight data from the GPS log and performance data supplied by the Mooney Airplane Company. The pilot's planned 3 hours 30 minutes duration appeared to have been based on still-air direct track calculations, with an allowance for takeoff and approach. The aircraft's track was very close to the direct track. The actual flight time between Biberach and Old Buckenham would have been around 4 hours.

The Mooney M20 Owner's Manual presented fuel planning data for two main cruise configurations: performance and normal. Using normal figures and with due allowance for en route climbs, descents and manoeuvring, calculations showed that the aircraft would have taken off from Tibenham with slightly less than 5 US gallons of fuel on board, sufficient for approximately 30 minutes flying time without reserves. (The total fuel capacity was 48 US gallons of useable fuel.)

Wreckage examination

The wreckage was recovered to the AAIB for further examination. The rudder, elevator and aileron systems were checked for continuity as well as for full and free movement; no anomalies were found.

The engine was stripped and inspected. Heat damage to the engine prevented a detailed assessment of the carburettor and the magnetos. The engine otherwise appeared to be in good condition and no engine defect that might have caused or contributed to the accident was found.

The fuel sample from the right tank was laboratory tested. The fuel had been in the vicinity of the post-crash fire, which made accurate conclusions very difficult, but the results indicated that the fuel was probably fit for purpose.

Recorded information

When found, the aircraft's transponder was selected ON, with altitude reporting selected. However, an analysis of area radar showed no returns for G-JDIX in the accident area, whereas other transponding aircraft were visible on radar down to about 400 ft in the Old Buckenham circuit. The damaged state of the transponder fascia (which was thrown from the main wreckage) and the lack of radar data suggested that the observed selections were functions of the ground impact.

A portable GPS navigation unit was recovered from the accident site and recorded data was successfully downloaded. Data had been stored in the unit in a mix of manually saved data files and automatically saved data logs.

Route data up to early November 2009 had been manually saved, a process which led to some information (notably date and time) being automatically deleted. The majority of the manually saved routes in this period were between Hohenems Airport and two airfields in southern Germany, but included one flight from Hohenems Aiport direct to Old Buckenham, returning via Heligoland, off the north German coast. Based upon the dates on which the data was saved, almost all the recorded flights were made prior to the pilot taking ownership of G-JDIX.

There were 61 active logs in the unit's memory, dating from 7 November 2009 and including the accident flight. The pilot used the GPS for surface travel as well, and only four logs pertained to flights (not including the

accident flight). Three of these were made between 7 and 10 November 2009 in the pilot's Rallye aircraft, the last of which ended when the pilot force-landed the aircraft following engine failure. The fourth was the flight in G-JDIX from Hohenems to Biberach on 27 February 2010.

Accident flight

The GPS track showed an approximately straight line flight from Biberach, at altitudes varying between about 2,000 ft and 4,500 ft over mainland Europe, down to about 500 ft over the North Sea. At about the time the pilot was in contact with Old Buckenham, the aircraft was flying in the vicinity of Tibenham, and completed an orbit before making an approach to Runway 33 (Figure 1).

The aircraft took off again at 1659 hrs, after which a further seven GPS points were recorded. Whilst the GPS positions recorded during the take off at Tibenham correlate well with the runway, the final GPS position at 1704:41 hrs appears to be less accurate in its position, possibly due to satellite tracking issues at or near the accident site.

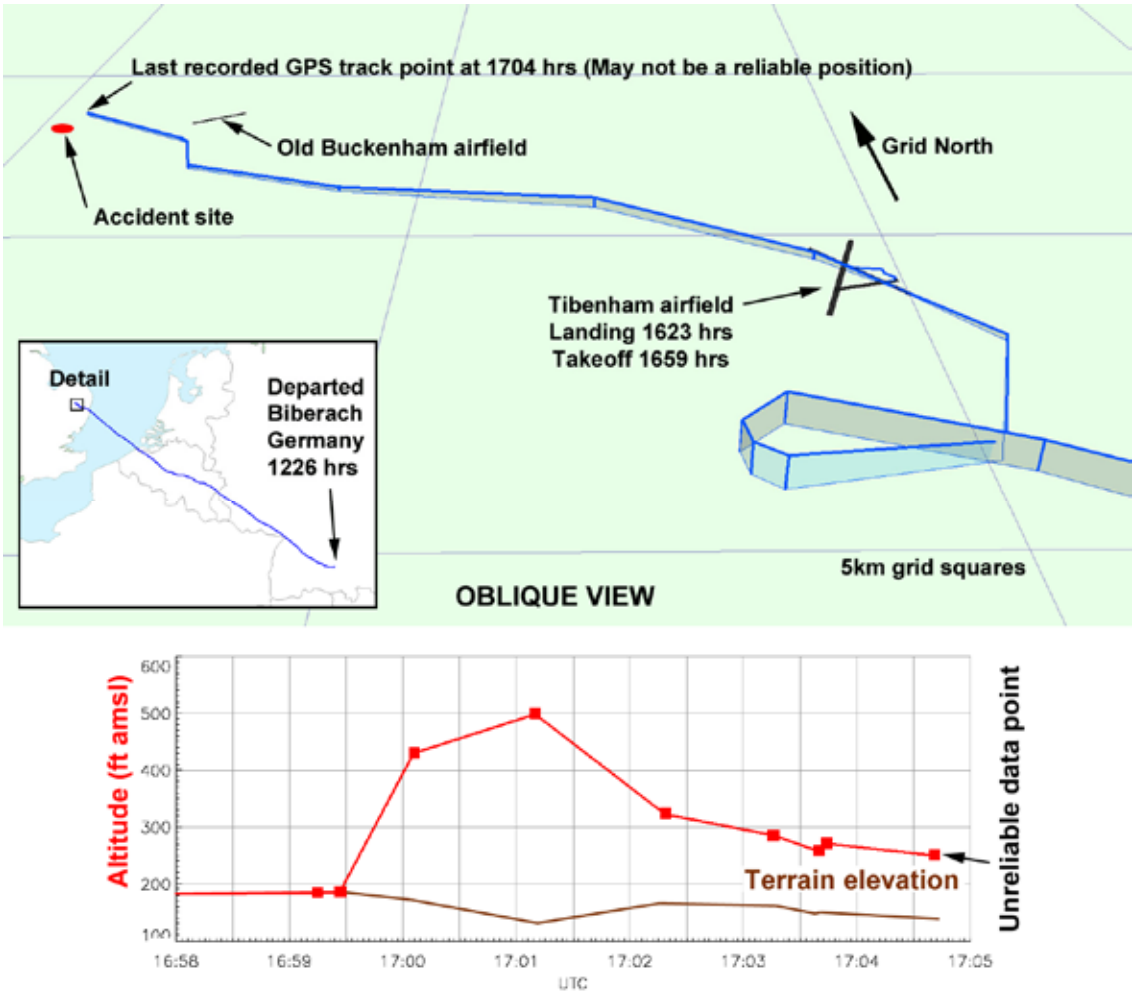


Figure 1

Overview of the last recorded GPS track and an oblique view showing the arrival at Tibenham, ground manoeuvring and onward flight. Graph depicts aircraft altitude for the accident flight

The maximum recorded altitude was 500 ft (370 ft agl) and the maximum groundspeed (averaged between points) was 82 kt. The light wind was generally from abeam, so average groundspeed values would approximate to those for airspeed. For about the last two minutes of flight, the data points show a relatively constant height of about 120 ft agl, with the groundspeed falling to about 60 kt over the final 80 seconds.

Pilot information

The 66 year old pilot was a national of the Czech Republic, living in Austria. He started flying training at Hohenhems in late 2006 and gained a Private Pilot's Licence, issued by the Austrian Civil Aviation Authority, on 5 June 2007. He held a Class 2 medical certificate, issued in October 2009. The Austrian authorities confirmed that the pilot's licence and medical certificate were valid at the time of the accident.

Information about the pilot's flying hours and training records was sought from the Austrian authorities but was not available from official sources. However, some information about the pilot's flying abilities and general disposition was gained from personnel at Old Buckenham, including a pilot who flew with him in G-JDIX prior to its purchase.

The pilot's general handling was described as being of a quite low standard. Compared to the Rallye that the pilot was used to, the Mooney approached the runway at a higher speed and with less drag (even with flaps extended), requiring greater attention to speed control to avoid landing too fast. The pilot reportedly used an incorrect technique which consistently resulted in fast approaches and long landings that were also remarked upon by onlookers. It was suggested to the pilot that he should seek the guidance of a qualified instructor whilst he became familiar with G-JDIX, but he was reportedly dismissive of the suggestion.

Personnel at Old Buckenham also had cause to question the pilot's airmanship and approach to safety matters. Their concerns were first raised when it was learnt that the pilot flew from Germany to Old Buckenham with incomplete charts and without any over-water safety aids such as lifejackets. The pilot generally appeared nervous and agitated, with a number of personal family issues which he seemed prepared to discuss freely. These issues, which existed in August 2009 had, according to the accounts from those who met him at Tibenham, escalated by May 2010 and were clearly an ongoing concern for the pilot.

Information from the airfield operator at Biberach indicated similar patterns of behaviour. The pilot was described as appearing confused on occasions, and his arrival from Hohenems in February 2010 involved an approach to the incorrect runway and an attempted wheels-up landing which was only averted when the pilot was warned of the situation.

Regulations pertaining to international flights

As the accident flight originated in a European Union country, there was no restriction on the place of landing in the UK. However, the UK AIP[1] required that the pilot notify HM Revenue & Customs and the UK Border Agency of the flight plan details, for Customs & Excise and Immigration purposes. No such notification was made. A flight plan was required for the international flight, and although the pilot did prepare a flight plan, he did not file it prior to departure. This was done by airport staff at Biberach after the aircraft had taken off.

Footnote

[1] Aeronautical Information Publication Section GEN 1.2 '*Entry, transit and departure of aircraft'*. The UK AIP is published by authority of the UK Civil Aviation Authority.

Medical and pathological information

A post-mortem examination was carried out by a local histopathologist at the direction of HM Coroner. The cause of death was given as multiple injuries; these were all confined to the chest and would have been rapidly fatal. The pattern of injuries described in the post-mortem report was not distinctive enough to reliably comment on whether the pilot's harness was in use at the time of the accident. Toxicological examinations revealed no evidence of alcohol in the pilot's blood. A toxicological screen for drugs was not performed.

Safety action

Concerns about the pilot's competency were raised by the AAIB with the Austrian authorities. The AAIB was informed that a safety audit was to be conducted at the school where the pilot trained.

Analysis

From the ground marks, damage to the wings and the compact spread of the wreckage it was concluded with a reasonable level of confidence that the aircraft had struck the ground in a nose-down, left-wing low attitude, at a low speed, and with significant rotation, these conditions being consistent with a spin to the left.

The damage caused by the post-crash fire made it difficult to establish if there was a defect or problem that had affected the operation of the aircraft. However, since no technical defects were found, and with good evidence that the propeller was rotating under power when the aircraft struck the ground, it was concluded that there was probably no technical defect that had either caused or contributed to the accident. Nothing was found to account for the pilot's reports of poor brake effectiveness, and it was thought this may have been due to landing too fast as a result of a poor approach technique, rather than a technical issue.

Based on the available evidence, it is unlikely that the pilot had gained much experience on G-JDIX and he had not flown it since the flight to Biberach, more than two months before the accident. The pilot's flying abilities and standard of airmanship appeared questionable, considering the events of the accident day and reports from beforehand.

The pilot's mental and physical fitness to fly were also in doubt. As no toxicological screen for drugs was carried out at post-mortem, the investigation was unable to rule out the possibility that the pilot may have been under the influence of drugs.

From eyewitness accounts, it is probable that the pilot became distracted from the task of landing his aircraft at nearby Old Buckenham (if indeed it was his intention to do so), which could easily have been reached had the aircraft turned towards it, rather than away. Instead, the pilot allowed the aircraft to become dangerously slow at very low height. The source of distraction was not identified: the low fuel state perhaps presents the most likely reason, but this could not be confirmed. Given the pilot's questionable state of fitness to safely act as the pilot of an aircraft on the day in question, no further meaningful analysis was possible.

ACCIDENT

Aircraft Type and Registration:	Pietenpol Air Camper, G-OFFA
No & Type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	2005
Date & Time (UTC):	4 September 2010 at 1428 hrs
Location:	White Waltham Airfield, Berkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Right landing gear, venturi and propeller
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	70 years
Commander's Flying Experience:	608 hours (of which 65 were on type) Last 90 days - 11 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft landed at White Waltham and turned left off Runway 11. It had taxied about 50 m when the right main gear leg collapsed. The ball end on one of the structural members of the gear was found to have failed. The Light Aircraft Association and the UK Pietenpol Club are assessing possible modifications to the landing gear.

ACCIDENT

Aircraft Type and Registration:	Piper PA-22-150 Caribbean, G-ARHN
No & Type of Engines:	1 Lycoming O-320-B2B piston engine
Year of Manufacture:	1960
Date & Time (UTC):	9 September 2010 at 1310 hrs
Location:	Woodlands, Hampshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Serious) Passengers - 1 (Serious)
Nature of Damage:	Aircraft extensively damaged, third party damage to buildings and garden
Commander's Licence:	Private Pilot's Licence
Commander's Age:	74 years
Commander's Flying Experience:	340 hours (of which 20 were on type) Last 90 days - 18 hours Last 28 days - 4 hours
Information Source:	AAIB Field Investigation

Synopsis

A forced landing was conducted following an engine failure. The pilot was unable to achieve his selected field and the aircraft struck the roof of a house before crashing into the garden. Both the aircraft occupants received serious injuries; however, there were no injuries to persons on the ground. No cause for the engine failure could be established.

History of the flight

The aircraft had departed from its base at Popham, Hampshire at 1050 hrs for a return trip to Bembridge Airfield on the Isle of Wight. Before departure from Popham, the pilot had conducted a pre-flight inspection, this included physically checking the contents of the fuel tanks, which he recalls as being just under full. The fuel level was as expected, as the aircraft tech-log showed 15 mins of flying since it had been refuelled to full four days previously.

The outward flight passed without incident and the pilot recorded a flight time of 33 minutes. After a stop of about an hour at Bembridge, the aircraft departed at 1250 hrs; the pilot had conducted a transit check, but had not physically rechecked the fuel quantities. For the outward flight, the pilot had selected the left fuel tank; for the return he therefore selected the right tank.

The accident flight initially routed west from Bembridge

to The Needles and, after orbiting once over Hurst Castle at the north side of the Solent, the aircraft flew north with the pilot intending to turn towards Popham once clear of the Solent Control Area (CTA).

The pilot recalls flying at an altitude of 1,800 ft amsl, this was in order to remain below the base of the Solent CTA at 2,000 ft. The flight was proceeding normally and it was about 15 minutes after departure when the pilot heard a bang followed by a spluttering noise. The pilot saw the engine rpm drop immediately to about 1,800 rpm. He selected carburettor heat to HOT and then changed the fuel selector to LEFT. Neither of these selections appeared to have any effect and the pilot recalls the engine rpm declining further.

At 1308 hrs the pilot transmitted a PAN call to Bournemouth Approach informing them that the engine was running very slowly and he was "LOOKING FOR SOMEWHERE TO PUT DOWN." Bournemouth Approach asked if the aircraft could reach the airfield; however, the pilot replied he was unable to maintain altitude. The pilot selected a field he believed he could conduct a forced landing into. The pilot recalled that in order to ensure he selected a field within the likely glide range of the aircraft, he had selected a field 45° below the horizon. He then flew a curving approach to the field; however, the aircraft had insufficient energy to reach the field, struck the roof of a house and then crashed into a garden, demolishing a greenhouse. The pilot does not recall making any flap selections during the approach.

At 1310 hrs another aircraft, which had seen the accident from several miles away, reported to Bournemouth Approach that G-ARHN was "NOW DOWN".

The passenger recalled that the flight seemed normal until the pilot started "moving various knobs" and said the engine had lost power. The passenger's last recollection of the flight was of the aircraft approaching the roof of the house, he then had no further memory until he came round following the accident.

Following the crash, a witness with flying experience was amongst several bystanders who went to help before the emergency services arrived. The witness asked the pilot to confirm the fuel and electrics were off. The pilot turned off the electrical master switch, located under his seat, and believed he had turned the fuel selector to OFF. At some stage the magnetos were switched to OFF and the keys removed from the ignition; however, it is unclear when this occurred.

Pilot experience

The pilot had gained his PPL in 1997. The pilot last conducted practice forced landings during his biennial flight with an instructor in November 2009. The pilot stated that he would normally practise forced landings during his biennial flight, but was unlikely to have done so during other flights without an instructor.

Injuries to persons

The pilot received multiple injuries, including serious head injuries and fractures to the right arm, and received extensive medical treatment.

The passenger received serious head injuries.

Witnesses

Various witnesses on the ground had seen parts of the forced landing approach. Their reports were all consistent that there had been no engine noise during the accident.

One witness described the aircraft as passing over them in a curving flight path. (Figure 1)

Figure 1

G-ARHN circled, witness ground track arrowed, note wires crossing field in foreground, pylon boxed.

Weather

At the time of the accident Bournemouth Airport reported the surface wind as from 270° at 6 kt, the temperature 19°C and dewpoint 13°C.

Accident site

The aircraft had initially struck the roof of a chalet bungalow, dislodging a number of ridge tiles, before impacting a flat roof extension on the far side. This second impact resulted in the nose wheel punching a hole in the roof, causing debris to fall into a bedroom below. From here the aircraft continued on a downwards trajectory before striking a greenhouse in the back garden some 15 m from the house, where it came to rest in a left wing low attitude and approximately level in pitch, with the left main and nose landing gear legs collapsed.

It was observed that the flaps were in their fully down position, which corresponded with the raised position of the operating lever located on the floor between the front seats. This area had sustained comparatively little disruption in the impact; accordingly it was concluded that the lever, which was of the automotive handbrake type, was likely to have been selected to the as-found position prior to the impact.

One of the two propeller blades bore scuff marks made by fragments of glass from the greenhouse. The fact that there were no similar marks on the other blade, together with minimal overall damage, suggested that the propeller had been stationary at the time of the accident.

The aircraft was equipped with an 18 US gallon (approximately 68 litres) fuel tank in each wing; the fuel system allowed the engine to be fed from either the left or right tank, but not both simultaneously. Inside the cockpit it was noted that the fuel selector, located on the left sidewall, was selected to RIGHT. However, given his injuries and medical treatment, the pilot did not have an entirely accurate recall; thus the as-found position of the fuel selector is not considered a reliable indication of the pre-impact selection. Nevertheless, it was clear that the pilot had managed to turn off the aircraft electrics via the master switch, which was located underneath the front left seat.

Elsewhere in the cockpit it was observed that the throttle, mixture and carburettor heat control knobs were all at their fully forward positions. The distortion on the area of the panel in which they were located, in conjunction with the injuries the pilot had sustained to his forearm, suggested that the pilot may have had his hand on the throttle during the impact.

Following an on-site examination, the aircraft was recovered to the AAIB's facility at Farnborough. The recovery entailed removing both wings in preparation for lifting the aircraft from its location in the garden. During this process, 45 litres of Avgas were recovered from the left fuel tank, with no evidence of water or any other form of contamination being observed. The right tank was empty, although after the fuselage was raised, it was apparent that the fuel strainer on the forward face of the engine firewall had been broken open as a result of the nose underside striking the ground. As a consequence, any fuel in the right tank would have drained away. It was additionally apparent that the quick release drain plug on the engine sump had been pushed up into its open position, thus allowing the engine oil to drain into the ground.

Detailed examination of the aircraft

General

The investigation focussed on the engine, together with the fuel and ignition systems. The fuel selector was removed and its right tank selection was confirmed.

All the remaining airframe fuel system pipe work was checked for evidence of blockages or debris; none was found.

Each fuel tank was equipped with a filler cap with the word 'vented' embossed on its upper surface. Whilst both components appeared superficially identical, it was noted that the internal fitting in the right cap did not contain the vent holes that were present in the left. The general appearance of the caps suggested that they were original to the aircraft, with the seals around the underside of each cap being in a worn condition such that they probably provided tank venting irrespective of the provision of vent holes. In the absence of any reported occurrence of fuel feed problems from the right tank over the years of service, the absence of vents in the filler cap was not considered to be a factor in the accident.

The airframe examination also included disassembling the ignition switch, which confirmed that there had been no internal failure that could have caused an inadvertent grounding of the magnetos.

Engine

The engine was last overhauled in April 2009 following a shock-load inspection and had since accumulated approximately 120 hours at the time of the accident.

Damage to the engine appeared to be limited to the oil drain plug, noted earlier, and the carburettor, which had sustained damage to the throttle body. This had resulted in the carburettor having been almost torn off its mounting on the engine underside, leaving it suspended by its two rear bolts. It was established that the throttle and mixture controls were correctly attached.

Before removing the engine from the airframe it was observed that the 'P' leads, which connected the magnetos to the ignition switch (and which were grounded when the ignition key was selected to OFF) were in poor condition over the sections running between the magnetos and the firewall. Each lead had an outer braided sheath to provide Radio Frequency (RF) shielding. It was noted that the sheaths were severely frayed close to their attachments to the rear of the magnetos and, in the case of the left P lead, had completely separated at the point where it emerged from the firewall, thus exposing a short length of the inner lead. (Note: during discussions with members of the G-AHRN flying group, it emerged that there was a history of poor radio reception. It is possible that this was associated with the condition of the P leads.) It was noted that the holes in the firewall had jagged edges and this had caused the damage to the sheathing. In addition, in the case of the right lead, there was a severe kink close to a ferrule that formed part of the attachment to the magneto. A close examination revealed that the inner lead was also kinked, to the extent that the insulation had broken. However, no strands of wire from the internal conductor were visible, and there was no obvious evidence of arcing, either on the braided sheath or the ferrule. Thus, whilst this was clearly an undesirable feature, it was considered that, although the possibility of intermittent arcing could not be excluded, it was not likely to have caused the engine to fail, particularly as the left P lead insulation was found to be intact.

The engine was taken to an overhaul company, where, following an inspection, refilling with oil, and fitting a replacement carburettor, it was run in a test cell. The engine started and ran normally, although below specified maximum power output. This was attributed to the replacement carburettor, which was a different model from that normally fitted to this engine type (no example of the correct model being available).

After the test, the magnetos were removed and subjected to a bench test, where it was found that they performed satisfactorily. They were then disassembled, when, despite the external labels indicating that they had not been overhauled since 1995, it was found that the internal components were in good condition. Documentation subsequently came to light indicating that the magnetos were overhauled by a specialist company at the time of the engine overhaul.

Finally, since the carburettor could not be run with the engine, it was disassembled. It was noted that the accelerator pump was primed with fuel and that the float chamber was approximately one third full. This activity took place approximately one week after the accident. Although there would have been limited scope for evaporation via the broken fuel strainer, it is considered more probable that, if the carburettor was tilted significantly away from the vertical after the accident, fuel could have drained through the holes in the venturi that supplied the idle fuel flow. No debris was found within the carburettor and it was noted that the main jet and the fuel inlet screen were clear.

Despite the damage to the carburettor, it was possible to mount it on a rig in order to test the functionality of the float assembly and float valve. This confirmed that the latter opened and closed at the required fuel inlet pressures, thus indicating that there was little likelihood of fuel flooding or starvation.

New Zealand CAA forced landing advice

In January 2007 the New Zealand CAA published[1] in its *Vector* safety magazine a guide to conducting a forced landing. It included a section on field selection which states that, in order of importance a pilot should consider the field's Size, Shape, Slope, Surface, Surroundings Stock and Sun.

For Size the guide states:

> *'Size*
>
> *Look for the longest possible landing site that faces into wind…'*

And for Surroundings the guide suggests:

> *'Select a landing site that has a clear approach path. An approach should not be planned over tall trees, power lines and buildings that will prevent you from achieving an unimpeded profile. A clear approach path will also mean that undershooting your landing site is less likely to result in a collision with a solid obstacle. Some consideration should also be given to the possibility of an overrun….'*

Analysis

The pilot's choice of field was guided by his perception of the likely glide range of the aircraft. He had selected a field that was, in his recollection, 45° below his line of sight and should have been achievable. It is difficult to be certain which field the pilot was intending to land in; the field most in line with the aircraft's accident orientation was relatively short, with a 177 m distance from fence to fence. A slight change in flight-path, to the left, would have offered almost 300 m and it may have been this field that the pilot was aiming for. Both these fields required the aircraft to cross over a residential street before reaching the landing site. Ultimately the aircraft had insufficient energy available and struck the roof of a house before coming to a stop in the garden.

Footnote

[1] http://www.caa.govt.nz/Publications/Vector/Vector_2007_Issue-1_Jan-Feb.pdf

The pilot had, however, maintained flying speed and thus control of the aircraft, avoiding stalling and/or spinning which, with the resultant high vertical descent rates, often result in the most serious or fatal injuries.

The pilot only recalls practising forced landings at his biennial flight with an instructor. The flight path angle of an aircraft with a stopped engine is likely to be steeper than that achieved during practice forced landings and it seems that the pilot did not account for this in his field selection.

An exhaustive examination of the engine and fuel system revealed all components to be in good condition, with the exception of the damage to the magneto P leads. The insulation of the right lead was broken; however, it was considered unlikely to have resulted in an engine stoppage. At worst there may have been some misfiring of the right magneto, although no evidence, in the form of arcing damage, was found. The engine ran satisfactorily on test, indicating there had been no internal mechanical failure. There was thus no explanation for the reported engine failure. The temperature and dewpoint were respectively 19ºC and 13ºC, which, according to the CAA's carburettor icing probability chart, gives a 'moderate' risk of icing at cruise power. However, the apparent suddenness of the stoppage tends to militate against this as a potential cause.

ACCIDENT

Aircraft Type and Registration:	Piper PA-32-300 Cherokee Six, G-BBSM
No & Type of Engines:	1 Lycoming IO-540-K1A5 piston engine
Year of Manufacture:	1973
Date & Time (UTC):	1 September 2010 at 1727 hrs
Location:	3 miles off Orfordness, Suffolk
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Aircraft lost at sea
Commander's Licence:	Private Pilot's Licence
Commander's Age:	49 years
Commander's Flying Experience:	571 hours (of which 533 were on type) Last 90 days - 54 hours Last 28 days - 12 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft was ditched successfully in the sea after a burning smell and smoke became apparent in the cabin and the engine began to run roughly. The two occupants were able to vacate the aircraft and board their life raft before the aircraft sank.

History of the flight

The aircraft was flying from Donaueschingen-Villingen, Germany to Hardwick, England at a cruising level of FL060 in VMC. At the commencement of the sea crossing, the pilot briefed the passenger on the safety procedures to follow in the event of a ditching. Approximately 17 nm before reaching the English coast, they both smelt a burning smell and opened the cabin air vents and the direct vision window to clear the fumes from the cabin. The smoke and burning smell persisted. The engine was by now running roughly and the EGT was high, prompting the pilot to reduce engine power. He declared a MAYDAY to London Information and prepared to ditch the aircraft, as the sea conditions were favourable and he considered that a glide to the coast was unlikely to be successful.

The pilot reminded the passenger of the ditching procedures, including the importance of not inflating the life raft prematurely and they wedged the cabin door slightly open. Because of concerns about a possible fire in the engine compartment, he shut the engine down by closing the throttle and selecting the mixture and fuel selector to OFF. As the aircraft descended, he became

aware that he might be able to reach land, but decided the best option was to continue with the ditching as planned, as the sea conditions were good and there were several boats in the area. He turned the aircraft into the wind and concentrated on the touchdown.

The aircraft touched down in a wings-level attitude. The pilot reported the impact was violent and the deceleration was rapid; "it felt like the undercarriage had tripped us forward", he commented. The aircraft settled nose-down and water ingress into the cabin was faster than he expected. The occupants' egress was slightly impeded by cables and headset leads, but once onto the wing they successfully deployed and inflated the life raft. The raft's drogue became temporarily entangled but was freed before the aircraft sank.

Discussion

The aircraft was not recovered and therefore it was not possible to determine the cause of the burning smell and other reported symptoms.

The pilot, who had flown this route on several previous occasions, always ran through the emergency landing/ditching procedures in his head before and during each flight. However despite this, he candidly made the following observations: in the stress of the event he did not find it easy to complete the memorised items and whilst concentrating on the arrival, he omitted to deploy the flaps and to select the master and ignition switches to OFF. He found the mnemonic 'Aviate, Navigate, Communicate' very helpful and considered that adhering to his original decision to ditch was the right thing to do, as the outcome may not have been so successful had he tried to stretch the glide to reach land, or attempted to restart the engine. The risk of fire was a significant factor in the pilot's decision making.

The pilot commented that there is little to prepare a pilot for the reality of such situations and that regular flying, continual education, reviewing of accident reports and attendance of safety seminars all help a pilot to be better prepared.

The CAA Safety Sense Leaflet 21, '*Ditching*', contains useful advice and guidance on the subject and is recommended reading for anyone contemplating an overwater flight.

ACCIDENT

Aircraft Type and Registration:	Robin R2112 Alpha, G-EWHT
No & Type of Engines:	1 Lycoming O-235-L2A piston engine
Year of Manufacture:	2004
Date & Time (UTC):	16 November 2010 at 1919 hrs
Location:	Gloucestershire Airport, Gloucestershire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Wings, ventral fin, firewall and two runway edge lights damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	Not provided
Commander's Flying Experience:	430 hours (of which 250 were on type) Last 90 days - 5 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot was making a crabbed approach to Runway 09 in crosswind conditions. As the pilot rounded out and aligned the aircraft with the runway heading, the aircraft dropped suddenly and contacted the ground heavily just short of the runway, before bouncing back into the air. It possibly bounced a second time and then touched down firmly on the runway. The pilot considered that windshear might have been a contributory factor. The surface wind at the time was 140º at 5 kt. Inspection revealed a tyre mark 3 ft short of the runway, damage to two runway edge lights and structural damage to the aircraft.

ACCIDENT

Aircraft Type and Registration:	Robinson R22 Beta, G-HRBS
No & Type of Engines:	1 Lycoming O-360-J2A piston engine
Year of Manufacture:	2004
Date & Time (UTC):	28 September 2010 at 1256 hrs
Location:	Goodwood Aerodrome, West Sussex
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Tail skin creased with associated damage to firewall
Commander's Licence:	Private Pilot's Licence
Commander's Age:	57 years
Commander's Flying Experience:	270 hours (of which 52 were on type) Last 90 days - 9 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The pilot judged that he had over-controlled the aircraft when experiencing dynamic rollover during takeoff. The aircraft became airborne and began rotating, before impacting the ground and sustaining serious damage to its tail. The pilot was unaware of the damage and continued the flight, landing without further incident.

History of the flight

The pilot had completed a refresher flight with an instructor and was about to embark on a solo flight to practise circuits. The aircraft was parked on a grass area with the engine running as the instructor got out. The pilot stated that he then completed the before-takeoff checks and started to lift, but that the aircraft began to tilt sharply to the right. He reported that the right skid was digging into the soft ground and that the situation was exasperated by his being the sole occupant and seated in the right seat. Believing the aircraft was going to roll over, he reduced power and aggressively applied a left cyclic control input. The aircraft became airborne, lifting to a height of about a foot and began to rotate to the left. The rear of the right skid then dug into the ground, bringing the rotation to an abrupt halt and causing the aircraft to land heavily.

The instructor returned to the aircraft and confirmed with the pilot that he was still happy to undertake a flight on his own. The pilot confirmed that he was, and subsequently successfully practised several takeoffs and landings before flying three circuits of the airfield. He

experienced no handling problems and on completing the flight shut down the aircraft and completed the normal post-flight paperwork before going home.

Subsequently a three inch long crease was found in the right side of the tail section of the aircraft, at its junction with the main fuselage.

Assessment of the cause

The pilot was aware of dynamic rollover and had been "somewhat shaken" by the degree to which the aircraft had rolled when attempting to takeoff. He judged that he had made an "over-aggressive correction" in the opposite direction as a result, which led temporarily to his losing control of the aircraft. The damage was caused by the torsion loads experienced when the aircraft skid contacted the ground.

The decision to continue with the flight was based on lack of evidence of any damage having been caused and the pilot wishing to regain his confidence in his handling abilities.

ACCIDENT

Aircraft Type and Registration:	EV-97 TeamEurostar UK Eurostar, G-CFRT
No & Type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	2008
Date & Time (UTC):	13 October 2010 at 1630 hrs
Location:	Clench Common Airfield, Marlborough, Wiltshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Nosewheel, propeller, cowling, radiator
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	50 years
Commander's Flying Experience:	158 hours (of which 12 were on type) Last 90 days - 13 hours Last 28 days - 6 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot conducted an approach to Runway 08 at Clench Common. The weather conditions were good, with an 8 kt wind from the east. Following touchdown, which the pilot described as slightly fast, the aircraft bounced and became airborne again. The pilot attempted to hold off to allow the aircraft to settle back onto its main landing gear, however the aircraft pitched nose down prior to contacting the ground, causing the nose landing gear to collapse. The aircraft came to rest on the runway and the pilot and his passenger, who were uninjured, were able to vacate the aircraft via the normal exit.

The pilot considered that the accident was the result of not applying full power to initiate a go-around after the bounce.

ACCIDENT

Aircraft Type and Registration:	Flight Design CTSW, G-CEDM
No & Type of Engines:	1 Rotax 912ULS piston engine
Year of Manufacture:	2006
Date & Time (UTC):	23 October 2010 at 1305 hrs
Location:	North Coates Airfield, Lincolnshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Serious) Passengers - 1 (Minor)
Nature of Damage:	Aircraft destroyed
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	45 years
Commander's Flying Experience:	274 hours (of which 240 were on type) Last 90 days - 35 hours Last 28 days - 8 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Due to the prevailing crosswind, which had increased since his departure one hour earlier, the pilot decided to land the aircraft on a much shorter grass area, adjacent to the threshold of Runway 23, which had a reduced crosswind component. During the latter stages of the approach, the pilot abandoned the landing, but at about 80 ft, whilst banking right away from an area of trees, the aircraft rolled rapidly to the right. The right wingtip struck the ground and the aircraft cartwheeled. Both pilot and passenger sustained whiplash injuries to the neck. The pilot also suffered a broken left ankle. The aircraft was destroyed.

History of the flight

The pilot was returning to North Coates Airfield, following a local flight of about one hour duration. North Coates has a single unlicensed grass runway, on a heading of 07/23. Near to the threshold of Runway 23 is a much shorter grass area, bounded to the north by an area of trees. The pilot reported that he took off from Runway 23, with a westerly wind of about 20 kt but, upon returning to the airfield, he noted from the wind-sock that the wind was now from a northerly direction across the runway. He estimated the wind speed to be between 25 and 30 kt.

Initially he positioned the aircraft for a landing on Runway 23, but due to the high crosswinds and turbulent conditions, he abandoned the approach. Having had

previous experience of landing on the north-south grass area, he advised the air/ground radio operator that he would land there in a northerly direction, into wind. The approach appeared normal, but shortly before touching down the pilot abandoned the landing and applied full power. As the aircraft climbed to about 80 ft, level with the tops of the trees ahead, the pilot started to make a progressive right turn. The aircraft rolled rapidly to about 90° right wing down. The pilot applied full left rudder and full left aft stick, but the aircraft failed to respond. The right wing tip struck the ground and the aircraft cartwheeled, before coming to a stop. The pilot and passenger were both wearing four-point harnesses and were able to vacate the aircraft unaided. Both pilot and passenger sustained whiplash injuries to the neck and the pilot also suffered a broken left ankle. The aircraft was damaged beyond economic repair.

The pilot considered that the cause of the accident was due to the aircraft entering turbulent air near to the top of the tree line during the go-around. The Pilot's Operating Handbook (POH) states that the maximum crosswind components for takeoff and landing are 16 kt to 13 kt for flap settings of -6° to 15° and 13 kt to 11 kt for flap settings of 15° to 40°. The POH also provided the following guidance regarding wind limitations:

> *'In gusty wind or wind speeds greater than 21 kt (24 mph) flight operations should be stopped.'*

ACCIDENT

Aircraft Type and Registration:	Flight Design CTSW, G-CENE
No & Type of Engines:	1 Rotax 912 ULS piston engine
Year of Manufacture:	2007
Date & Time (UTC):	3 October 2010 at 1050 hrs
Location:	Arclid airstrip, Cheshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - 1 (Minor)
Nature of Damage:	Damage to engine cowling and propeller, nose landing gear, right wing, windscreen and passenger window, rudder hinge
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	39 years
Commander's Flying Experience:	124 hours (of which 99 were on type) Last 90 days - 28 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot was flying from Wycombe Air Park to Barton Aerodrome and had checked the Manchester Airport TAF before departing from Wycombe Air Park. This TAF forecast a 40% to 50% probability of 3,000 m visibility in heavy rain, with a broken cloud layer at 900 ft agl for the planned arrival time at Barton Aerodrome, which is 8 nm from Manchester Airport. The pilot reported being confronted by low cloud on his intended route to Barton Aerodrome and he decided to make a precautionary landing at Arclid airstrip. He descended to 500 ft agl whilst positioning the aircraft on a right-hand downwind leg for Runway 20. The aircraft flew into heavy rain during the turn onto final approach and the pilot reported that the airspeed shown on the ASI fell to zero. The final approach was high and fast, and the aircraft touched down approximately halfway along the 400 m grass runway. Following a bounce, the aircraft landed and during heavy braking, it departed from the runway approximately 15 m from its end. The nose landing gear leg collapsed and the aircraft overturned. The pilot and his passenger were able to vacate the aircraft without further incident.

ACCIDENT

Aircraft Type and Registration:	Hybred 44XLR, G-MWRM
No & Type of Engines:	1 Rotax 503 piston engine
Year of Manufacture:	1991
Date & Time (UTC):	1 September 2010 at 0600 hrs
Location:	Sackville Farm airstrip, Riseley, Bedfordshire
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:	38 years
Commander's Flying Experience:	85 hours (of which 6 were on type) Last 90 days - 6 hours Last 28 days - 6 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot had been flying circuits for approximately 30 minutes with no abnormal indications. Then, following rotation and climb out to 200 ft agl, the engine stopped abruptly with the rpm dropping to zero. The pilot landed in a field, but touched down fast at around 50 mph. The nosewheel dug into the ground and the aircraft rolled over, causing extensive damage to the airframe but no injuries.

ACCIDENT

Aircraft Type and Registration:	P and M Quik GT450, G-CDTO
No & Type of Engines:	1 Rotax 912ULS piston engine
Year of Manufacture:	2005
Date & Time (UTC):	26 June 2010 at 1555 hrs
Location:	Perth Aerodrome, Scotland
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to nose landing gear and underside of fuselage
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	67 years
Commander's Flying Experience:	224 hours (of which 209 were on type) Last 90 days - 8 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot reported that, following a glide approach to Runway 09 at Perth, the microlight landed normally. However, on touchdown the front forks of the nose landing gear collapsed, allowing the nosewheel to fold rearwards. The aircraft continued to slide along the runway for approximately 20 metres before coming to rest; the pilot then announced to Perth Radio that G-CDTO was unable to clear the runway, turned off the electrical master switch and climbed out of the aircraft. The reported wind was 090º/12 kt.

Both the pilot, and an instructor/co-owner who observed the landing, considered the touchdown normal. The owners have undertaken to send the front forks to the aircraft manufacturer, to examine the fracture for evidence of pre-existing damage.

ACCIDENT

Aircraft Type and Registration:	P and M Quik R, G-CFTE
No & Type of Engines:	1 Rotax 912ULS piston engine
Year of Manufacture:	2008
Date & Time (UTC):	6 June 2010 at 1440 hrs
Location:	Oakley Airfield, Buckinghamshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to base tube, front fork and right main wheel
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	45 years
Commander's Flying Experience:	660 hours (of which 46 were on type) Last 90 days - 63 hours Last 28 days - 40 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot had undertaken a local flight with a passenger and was returning to land at his departure airfield. A straight in approach was flown from a distance of about 3 nm but as he approached the threshold the pilot judged he was too high, so he closed the throttle. The aircraft then sank, contacting the runway and bouncing. The pilot stated that he decided to go around and applied full power, at which point the aircraft stalled. The right wing dropped, inducing a turn to the right and, despite the efforts of the pilot to recover the aircraft attitude, it struck the ground again. The pilot closed the throttle and the aircraft rolled to a stop in an area of crops alongside the runway. Neither occupant was injured but the aircraft suffered damage to the base tube, front fork and right rear wheel.

The pilot stated that he reacted with appropriate speed in applying power after the aircraft bounced, but had not appreciated the high wing attitude and low airspeed, and did not attempt to adjust these sufficiently early to prevent the stall.

ACCIDENT

Aircraft Type and Registration:	Pegasus Quantum 15-912, G-CDAA
No & Type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	2004
Date & Time (UTC):	3 June 2010 at 0930 hrs
Location:	Damyns Hall Aerodrome, Essex
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Wing, struts, sail, pylon, hang bracket
Commander's Licence:	Student
Commander's Age:	38 years
Commander's Flying Experience:	12 hours (of which 2 were on type) Last 90 days - 3 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The student pilot was just completing a solo flight during which the wind had strengthened, and was gusting up to 20 kt from the east for his approach and landing onto Runway 03. He had taken off earlier from the same runway when the wind was lighter. The instructor had briefed the student to consider using Runway 14 for landing if the conditions changed sufficiently, and to 'go around' if unhappy with the approach or landing. The aircraft touched down and, at speed, departed the grass runway to the left shortly afterwards, and then rolled over causing substantial damage to the wing structure, sail and parts of the airframe. The student pilot, who was wearing a three-point lap strap and shoulder harness, was uninjured.

ACCIDENT

Aircraft Type and Registration:	Pegasus XL-Q, G-MVVN
No & Type of Engines:	1 Rotax 462 HP piston engine
Year of Manufacture:	1989
Date & Time (UTC):	3 September 2010 at 1814 hrs
Location:	Watnall airstrip, Nottinghamshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Pod and propeller shattered, tubes bent and broken, sail torn
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	62 years
Commander's Flying Experience:	105 hours (of which 40 were on type) Last 90 days - 1 hour Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

During the final stages of a glide approach in benign weather conditions, the aircraft encountered a sudden and rapid descent. The pilot applied power in an attempt to arrest the rate of descent, but the aircraft's mainwheels contacted the hedge on the airfield boundary. The aircraft impacted the ground heavily at the beginning of the grass strip and came to a rapid halt.

The pilot was wearing a lap harness and a protective helmet and suffered minor injuries. He assessed the cause as a "sudden unexpected sink" encountered during the latter stages of the approach.

ACCIDENT

Aircraft Type and Registration:	Rans S6-ES Coyote II, G-BYRS
No & Type of Engines:	1 Rotax 582-48 piston engine
Year of Manufacture:	2000
Date & Time (UTC):	15 October 2010 at 1132 hrs
Location:	Sandy Airfield, Bedfordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Nose landing gear collapsed
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	71 years
Commander's Flying Experience:	152 hours (of which 117 were on type) Last 90 days - 6 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

During a check flight, the engine suffered a gearbox failure which caused a loss of drive to the propeller. The aircraft overturned in the subsequent forced landing in a field. Both occupants were uninjured.

History of the flight

The aircraft was undertaking a check flight from Sandy Airfield, Bedfordshire. The departure and climb to the overhead was without incident. Shortly after the pilot opened the throttle to commence a timed climb, the engine rpm rapidly increased and it appeared to him there was no drive to the propeller. He closed the throttle and commenced a left turn to return to the airfield. Once established in a glide he tried opening the throttle again, but the result was the same. A forced landing was made in a field close to the airfield during which the nose landing gear collapsed, causing the aircraft to overturn.

Technical information

The pilot/owner reported that a strip inspection of the gearbox revealed that the secondary gear angular ring and the two retaining half rings had broken into several pieces (Figure 1). It is most likely that the failure of this retaining mechanism allowed the gear to move axially causing the overload dog-clutch to disengage, thereby removing drive to the propeller. The engine had completed 446 hours since new, but had been recently inspected. The gearbox had completed approximately 90 hours since an inspection and overhaul.

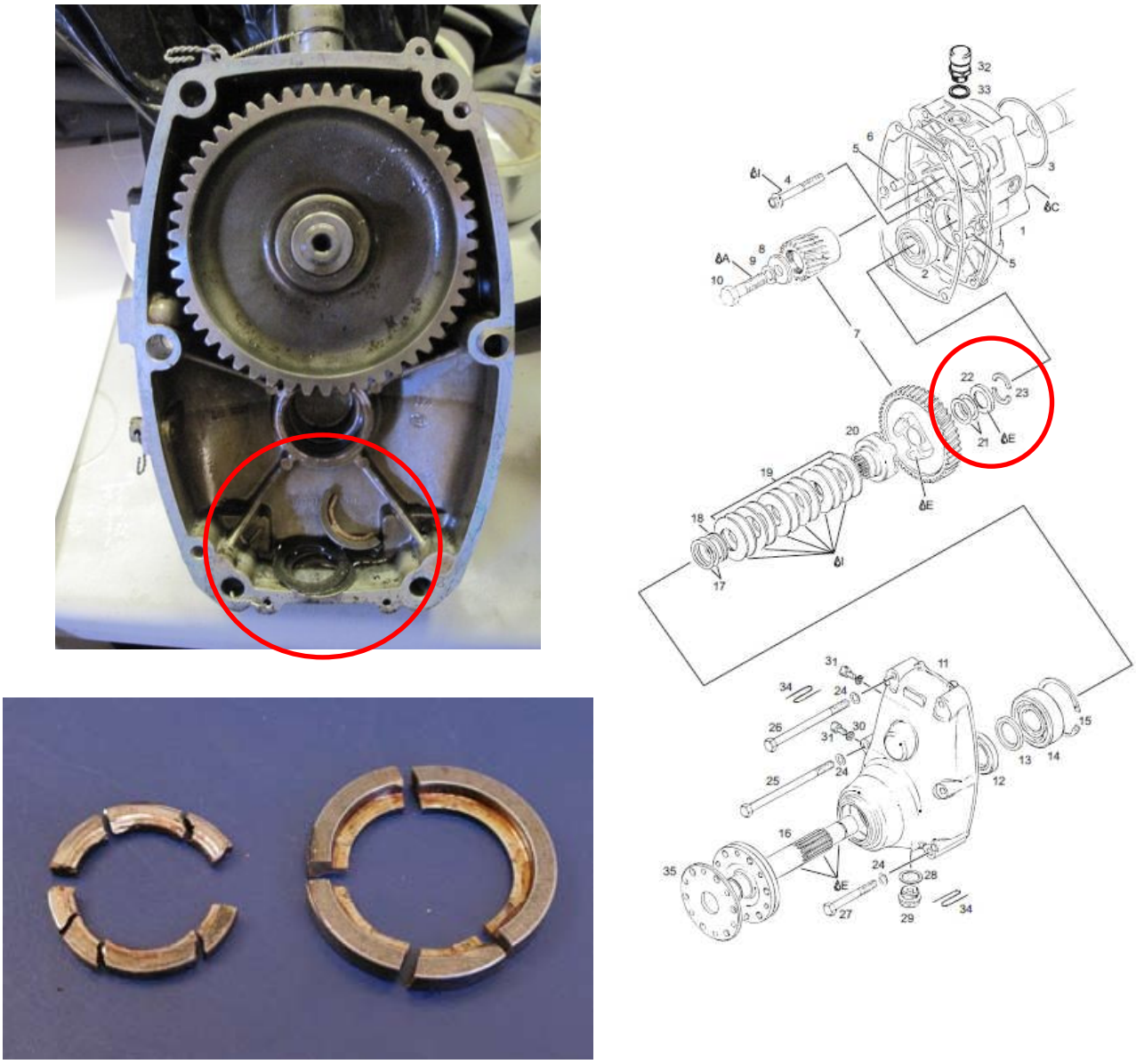


Figure 1

Failed gearbox components

Operational discussion

The pilot commented candidly that with the benefit of hindsight he would have most likely been able to land on the airfield had he turned right instead of left after the failure occurred.

Technical discussion

The condition of the half rings is assessed as part of the 100-hour gearbox inspection. Enquiries with various organisations familiar with the inspection and overhaul of this type of gearbox indicated that failures of the half rings are occasionally seen and in these previous cases the broken parts had usually remained in position. The failed parts have been returned to the manufacturer

for further analysis. Should any further significant and relevant information be obtained by AAIB, an addendum to this report will be published.

A similar gearbox failure, in which the propeller became detached, was reported in AAIB bulletin 2/2008, G-MZDA; the investigation was not able to determine the root cause of the half ring failure.

The 'B-type' gearbox fitted to this aircraft is designed for lightweight propellers and as such the manufacturer in the Installation Manual limits the maximum allowable propeller mass moment of inertia to 3,000 kg cm^2. The engine manufacturer's Service Information Letter, 11 UL 91 E, describes how to determine the actual mass moment of inertia of a given propeller, along with the maximum admissible figures for each type of gearbox, and contains the warning:

> *'Using propellers of a mass moment of inertia above the maximum admissible values indicated by ROTAX means reduced life time or damage of the gearbox.'*

The propeller fitted to this aircraft was of a type and size approved by the LAA but its exact mass moment of inertia is not known. Similar propellers from the same manufacturer are known to exceed the maximum admissible values specified by ROTAX for the B-type gearbox. It is therefore possible that the propeller may have contributed to the failure. Given this possibility both the LAA and the BMAA intend to offer advice on the implications of propeller selection to owners of aircraft fitted with B-type gearboxes, so they can take appropriate action.

ACCIDENT

Aircraft Type and Registration:	Rotorsport UK MTOSport, G-CGGW
No & Type of Engines:	1 Rotax 912 ULS piston engine
Year of Manufacture:	2009
Date & Time (UTC):	1 November 2010 at 1230 hrs
Location:	Chiltern Park Aerodrome, Oxfordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Rotor and rudder
Commander's Licence:	Private Pilot's Licence
Commander's Age:	51 years
Commander's Flying Experience:	205 hours (of which 205 were on type) Last 90 days - 18 hours Last 28 days - 10 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The pilot was unable to accelerate the fully loaded gyroplane to climb speed after becoming airborne at too low an airspeed. The aircraft landed heavily in a field beyond a row of trees at the end of the runway.

History of the flight

The pilot had already completed two solo circuits when he was joined by a friend who he intended to take on a local flight. He satisfactorily completed the pre-takeoff checks and pre-rotated the rotor to 200 rpm before taking off on Runway 04. After becoming airborne, he levelled the aircraft at about 10 ft above the runway to allow it to accelerate to climb speed (55 mph) before climbing away. On this occasion he was not able to accelerate above 45 mph by the time he reached the end of the runway. He climbed to clear a row of trees beyond the end of the runway, but this resulted in the aircraft having insufficient airspeed to maintain level flight and it landed heavily in a field beyond the trees. Both occupants, who were wearing full harnesses and protective helmets, were uninjured.

Discussion

The pilot candidly commented that he had little experience of operating the aircraft at close to its maximum weight and he thought that this, combined with the calm conditions, contributed to him getting the aircraft airborne at too low an airspeed. Once airborne, he was unable to accelerate the heavy aircraft out of this high drag condition. He also reported that it had become

normal practice at the airfield for him and pilots of other similar aircraft to start their takeoff roll from just beyond a hump on the runway, rather than using the full length available.

The CAA Safety Sense Leaflets No 7 '*Aeroplane Performance*' and No 12 '*Strip Sense*' contain useful information on subjects relevant to this report.

ACCIDENT

Aircraft Type and Registration:	Savannah VG Jabiru (2), G-CCSV
No & Type of Engines:	1 Jabiru Aircraft PTY 2200 piston engine
Year of Manufacture:	2004
Date & Time (UTC):	9 September 2010 at 1005 hrs
Location:	Inglenook Farm, Maydensole, Dover
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to wings, landing gear and propeller; third party damage to boundary fence
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	77 years
Commander's Flying Experience:	288 hours (of which 174 were on type) Last 90 days - 9 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot reported that he applied excessive rudder to correct a swing as the aircraft approached lift off speed. The right wingtip touched a hedge and the aircraft then ground looped into the boundary fence.

FORMAL AIRCRAFT ACCIDENT REPORTS ISSUED BY THE AIR ACCIDENTS INVESTIGATION BRANCH

2009

3/2009 Boeing 737-3Q8, G-THOF
on approach to Runway 26
Bournemouth Airport, Hampshire
on 23 September 2007.
Published May 2009.

4/2009 Airbus A319-111, G-EZAC
near Nantes, France
on 15 September 2006.
Published August 2009.

5/2009 BAe 146-200, EI-CZO
at London City Airport
on 20 February 2007.
Published September 2009.

6/2009 Hawker Hurricane Mk XII (IIB), G-HURR
1nm north-west of Shoreham Airport,
West Sussex
on 15 September 2007.
Published October 2009.

2010

1/2010 Boeing 777-236ER, G-YMMM
at London Heathrow Airport
on 28 January 2008.
Published February 2010.

2/2010 Beech 200C Super King Air, VQ-TIU
at 1 nm south-east of North Caicos
Airport, Turks and Caicos Islands,
British West Indies
on 6 February 2007.
Published May 2010.

3/2010 Cessna Citation 500, VP-BGE
2 nm NNE of Biggin Hill Airport
on 30 March 2008.
Published May 2010.

4/2010 Boeing 777-236, G-VIIR
at Robert L Bradshaw Int Airport
St Kitts, West Indies
on 26 September 2009.
Published September 2010.

5/2010 Grob G115E (Tutor), G-BYXR
and Standard Cirrus Glider, G-CKHT
Drayton, Oxfordshire
on 14 June 2009.
Published September 2010.

6/2010 Grob G115E Tutor, G-BYUT
and Grob G115E Tutor, G-BYVN
near Porthcawl, South Wales
on 11 February 2009.
Published November 2010.

7/2010 Aerospatiale (Eurocopter) AS 332L
Super Puma, G-PUMI
at Aberdeen Airport, Scotland
on 13 October 2006.
Published November 2010.

8/2010 Cessna 402C, G-EYES and
Rand KR-2, G-BOLZ
near Coventry Airport
on 17 August 2008.
Published December 2010.

AAIB Reports are available on the Internet
http://www.aaib.gov.uk