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(ALL TIMES IN THIS BULLETIN ARE UTC)

ACCIDENT

Aircraft Type and Registration:	Boeing 777-236 ER, G-YMMM
No & Type of Engines:	2 Rolls-Royce RB211 Trent 895-17 turbofan engines
Year of Manufacture:	2001
Date & Time (UTC):	17 January 2008 at 1242 hrs
Location:	Runway 27L, London Heathrow Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 16 Passengers - 136
Injuries:	Crew - 4 (Minor) Passengers - 1 (Serious) 8 (Minor)
Nature of Damage:	Aircraft damaged beyond economic repair
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	43 years
Commander's Flying Experience:	12,700 hours (of which 8,500 hours were on type) Last 90 days - 85 hours Last 28 days - 52 hours
Information Source:	Inspectors Investigation

The investigation

The Air Accidents Investigation Branch (AAIB) was informed of the accident at 1251 hrs on 17 January 2008 and the investigation commenced immediately. The Chief Inspector of Air Accidents has ordered an Inspector's Investigation to be conducted into the circumstances of this accident under the provision of The Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 1996.

In accordance with established international arrangements, the National Transportation Safety Board (NTSB) of the USA, representing the State of Design and Manufacture of the aircraft, has appointed an Accredited Representative to participate fully in the investigation. The NTSB Accredited Representative is supported by a team which includes additional investigators from the NTSB, the Federal Aviation Administration and Boeing; Rolls-Royce, the engine manufacturer, is also participating fully in the investigation. British Airways, the operator, is cooperating with the investigation and providing operational expertise as required and the CAA and the EASA are being kept informed of developments.

Because of the interest within the aviation industry, and amongst the travelling public, it is considered appropriate to disseminate the results of the initial investigation as soon as possible. This Bulletin is in addition to the

Initial Report, published on 18 January 2008, and a subsequent update published on 23 January 2008. As the investigation has developed, additional data has been derived from non-volatile memory within specific systems of the aircraft. This has allowed previously reported data to be refined.

One Safety Recommendation has been made.

History of the flight

The aircraft was on a scheduled flight from Beijing, China, to London (Heathrow) and departed Beijing at 0209 hrs; the flight was uneventful until the later stages of the approach into Heathrow. During the descent, from Flight level (FL) 400 the aircraft entered the hold at Lamborne at FL110; it remained in the hold for approximately five minutes, during which time it descended to FL90. The aircraft was radar vectored for the ILS approach to Runway 27L at Heathrow and subsequently stabilised on the ILS with the autopilot and autothrottles engaged. At 1,000 ft the aircraft was fully configured for the landing, with the landing gear down and flap 30 selected. The total fuel on board was indicating 10,500 kg, which was distributed almost equally between the left and right main fuel tanks, with a minor imbalance of about 300 kg. The fuel cross-feed valves indicated that they were closed and they had not been operated during the flight. The first officer took control for the landing at a height of approximately 780 ft, in accordance with the briefed procedure, and shortly afterwards the autothrottles commanded an increase in thrust from both engines. The engines initially responded but, at a height of about 720 ft, the thrust of the right engine reduced. Some seven seconds later, the thrust reduced on the left engine to a similar level. The engines did not shut down and both engines continued to produce thrust at an engine speed above flight idle, but less than the commanded thrust. The engines failed to respond to further demands for increased thrust from the autothrottles, and subsequent movement of the thrust levers fully forward by the flight crew. The airspeed reduced as the autopilot attempted to maintain the ILS glide slope and by 200 ft the airspeed had reduced to about 108 kt. The autopilot disconnected at approximately 175 ft, the aircraft descended rapidly and its landing gear made contact with the ground some 1,000 ft short of the paved runway surface just inside the airfield boundary fence. During the impact and short ground roll the nose gear collapsed, the right main landing gear separated from the aircraft and the left main landing gear was pushed up through the wing. The aircraft came to rest on the paved surface in the undershoot area of Runway 27L. A significant amount of fuel leaked from the aircraft after it came to rest, but there was no fire. The cabin crew supervised the emergency evacuation and all occupants left the aircraft via the slides, all of which operated correctly; eight of the passengers received minor injuries and one suffered a broken leg.

Aircraft information

The aircraft was serviceable on departure from Beijing and there were no relevant reported defects. It departed with 79,000 kg of Jet A-1 fuel on board, and the planned arrival fuel at London (Heathrow) was 6,900 kg.

Weather

The recorded weather at Beijing, prior to departure, indicated no significant weather and a surface temperature of -7ºC.

The aircraft's flight plan required it to climb initially to 10,400 m (FL341) before descending back to 9,600 m (FL315) at POLHO (on the border between China and Mongolia) because of 'Extreme Cold'. However, to accommodate a request from ATC the crew accepted a climb to a cruise altitude of 10,600 m (FL348), and closely monitored the fuel temperature. The ambient temperature at FL348 was approximately -65ºC and the associated total air temperature[1] (TAT) was -37ºC. Shortly after crossing the Ural mountains, the aircraft climbed to FL380. There was a region of particularly cold air, with ambient temperatures as low as -76ºC, in the area between the Urals and Eastern Scandinavia. The Met Office described the temperature conditions during the flight as 'unusually low compared to the average, but not exceptional'. The lowest TAT recorded during the flight was -45ºC, and the minimum recorded fuel temperature was -34ºC. The fuel temperature in flight must not reduce to a temperature colder than at least 3ºC above the fuel freezing point of the fuel being used. The specified freezing point for Jet A-1 fuel is -47ºC; analysis of fuel samples taken after the accident showed the fuel onboard the aircraft had an actual freezing point of -57ºC.

On arrival at Heathrow, the surface wind was from 210º at 10 kt, the visibility was greater than 10 km, the cloud was scattered at 800 ft and broken at 1,000 ft, the surface temperature was +10ºC and the dew point was +8ºC. The flight crew reported that they were visual with the runway at about 1,000 ft agl.

Recorded data

The aircraft was fitted with a Digital Flight Data Recorder (DFDR), a Cockpit Voice Recorder (CVR) and a Quick Access Recorder (QAR). The CVR and DFDR were successfully downloaded at the AAIB laboratories at Farnborough and both records covered the critical final stages of the flight. The QAR was downloaded with the assistance of British Airways and the equipment manufacturer. Data from the non-volatile memory of various systems were also available.

The recorded data indicates that there were no anomalies in the major aircraft systems. The autopilot and the autothrottle systems behaved correctly and the engine control systems were providing the correct commands prior to, during, and after, the reduction in thrust.

Engineering examination

The aircraft was recovered from the accident site to a secure location for detailed examination. There were no indications of any pre-existing problems with any of the aircraft systems.

During the impact the right main landing gear separated from the aircraft rupturing the rear right wall of the centre fuel tank. The two front wheels of the right main landing gear broke away and struck the rear right fuselage penetrating the cabin at seat height adjacent to rows 29/30. Additionally, the right main landing gear damaged the wing-to-body fairing and penetrated the rear cargo hold, causing damage to, and leakage from, the passenger oxygen cylinders.

The engines, their control systems and the fuel system were the focus of a detailed examination.

Engines

Examination of the engines indicated no evidence of a mechanical defect or ingestion of birds or ice.

Data, downloaded from the Electronic Engine Controllers (EECs) and the QAR, revealed no anomalies with the control system operation. At the point when the right engine began to lose thrust the data indicated that the

Footnote

[1] TAT is measured by a specially designed temperature probe, on the surface of the aircraft, that brings the air to rest causing an adiabatic increase in temperature. TAT is higher than static (or ambient) air temperature and is the value to which the fuel temperature will drift.

right engine EEC responded correctly to a reduction in fuel flow to the right engine, followed by a similar response from the left EEC when fuel flow to the left engine diminished. Data also revealed that the fuel metering valves on both engines correctly moved to the fully open position to schedule an increase in fuel flow. Both fuel metering units were tested and examined, and revealed no pre-existing defects.

Both engine low pressure fuel filters were clean. The fuel oil heat exchangers (FOHE) in both engines were free of blockage. The right FOHE was clear of any debris, however the left engine FOHE had some small items of debris on its fuel inlet bulkhead. The high pressure filters were clean. The variable stator vane controllers and the fuel burners were examined and found to be satisfactory.

Detailed examination of both the left and right engine high pressure fuel pumps revealed signs of abnormal cavitation on the pressure-side bearings and the outlet ports. This could be indicative of either a restriction in the fuel supply to the pumps or excessive aeration of the fuel. The manufacturer assessed both pumps as still being capable of delivering full fuel flow.

Fuel system

Several fuel samples were taken from the fuel tanks, pipe lines and filter housings prior to the examination of the fuel system and these are currently being examined at specialist laboratories. Initial results confirm that the fuel conforms to Jet A-1 specifications and that there were no signs of contamination or unusual levels of water content. A sump sample taken from the left and right main fuel tanks shortly after the accident revealed no significant quantities of water. Samples from the centre tank had been contaminated by fire fighting foam and hydraulic fluid: this contamination was a consequence of the rupture of the right rear wall of the centre tank.

A detailed examination of the fuel tanks revealed no pre-existing defects except for a loose union in the left main tank at its inner wall; the union formed part of the centre tank to left main tank fuel scavenge line. Some small items of debris were discovered in the following locations:

1. Right main tank – a red plastic sealant scraper approximately 10 cm x 3 cm under the suction inlet screen.
2. Left main tank, water scavenge inlet - a piece of black plastic tape, approximately 5 cm square; a piece of brown paper of the same size and shape, and a piece of yellow plastic.
3. Right centre tank override pump – a small piece of fabric or paper found in the guillotine valve of the pump housing.
4. Left centre tank water scavenge jet pump – small circular disc, 6 mm in diameter, in the motive flow chamber.

The relevance of this debris is still being considered. Examination of the fuel surge tanks showed no signs of blockage of the vent scoops and flame arrestors. Neither pressure relief valve had operated; the relief valves were tested and found to be operate normally.

The fuel boost pumps, and their associated low pressure switches, were tested and examined and found to be satisfactory. A pressure and suction test of the engine fuel feed manifold, from the fuel boost pumps to the engine, did not reveal any significant defects. Similarly, a visual examination of the fuel feed lines, using a boroscope, did not reveal any defects or restrictions. A test of the fuel quantity processor unit (FQPU) was satisfactory and its non-volatile memory did not reveal any defects stored prior to the accident. A test of the fuel temperature probe, located in the left main fuel tank, was satisfactory.

Maintenance

The aircraft's fuel tanks were last checked for water[2] in the fuel on the 15 January 2008 at Heathrow; this was prior to its refuelling for the outboard sector to Beijing.

Access by maintenance personnel, to the aircraft's fuel tanks, had last taken place during maintenance activity in 2005. The last scheduled maintenance activity on the aircraft was on the 13 December 2007.

Spar valves

On examination, both of the engine spar valves were found to be OPEN, allowing the fuel leak evident at the accident site.

The spar valves are designed to shut off the fuel supply to the engines following the operation of the fuel control switches or after operation of the fire handles in the cockpit. Their function is to cut off the fuel flow to the engine in the event of an engine fire or an accident. Each valve has two separate electrical wire paths which can be used to supply power to shut the valve; the first is via a run/cut-off relay, controlled by the fuel control switches, the other is directly from the fire handle.

The wiring on G-YMMM was as originally designed and manufactured, and such that when the fire handle was operated, it isolated the power supply to the run/cut-off relay. When tested, the run/cut-off relays for the left and right engines were still in the valve OPEN position, despite the fuel control switches being set to cut-off. The fire handles had also been pulled and the engine fire bottles had been fired. Therefore the fire handles had been operated prior to the fuel control switches.

The left spar valve circuit breaker (CB) had been tripped. This was due to damaged wiring to the valve as a result of the left main landing gear being forced upward through the conduit at the initial impact. The tripping of the CB meant there was no means of electrically closing the left spar valve. Similar damage was also evident to the right spar valve wiring, however, in this instance the CB had remained set.

Examination and tests of the wiring identified that, in the case of the right engine, the valve CLOSE wire from the run/cut-off relay was still continuous. This could have allowed the valve to operate had the fuel control switch been operated before the fire handle.

Boeing had issued a Service Bulletin (SB 777-28-0025) which advised the splicing together of the wires for the fuel control switches and the fire handles to avoid the need to sequence their operation. An FAA airworthiness directive requires this SB to be completed by July 2010. This had not yet been incorporated on G-YMMM; however, had it been incorporated, the right spar valve should have closed when the fuel control switch was operated.

The evacuation checklist for the Boeing 777, issued by Boeing, shows operation of the fuel control switches to cut-off prior to operation of the fire handles. This sequence allows for both CLOSE paths to the spar valve to be exploited and increases the likelihood that the spar valves close before electrical power to the spar valves is isolated. However, if the fire handle is operated first, then only a single path is available.

Footnote

[2] A check for water in the fuel tank is carried out by draining fluid from the sump drains located at the lowest point of each fuel tank in its 'on-ground' attitude.

The operator's evacuation checklist, for which Boeing had raised no technical objection, required the commander to operate the fuel control switches whilst the first officer operated the fire handles, this was in order to reduce the time required to action the checklist. These actions were carried out independently, with no measure in place to ensure the correct sequencing. The evacuation drill was placarded on the face of the control column boss, directly in front of each pilot.

An evacuation checklist with the division of independent tasks between the crew leaves a possibility that the fire handles could be operated before the fuel control switches which, with fire handle to spar valve fire damage, could leave the engine fuel spar shut-off valves in an OPEN position. This occurred in this accident, and resulted in the loss of fuel from the aircraft. This was not causal to the accident but could have had serious consequences in the event of a fire during the evacuation. It is therefore recommended that:

Safety Recommendation 2008-009

Boeing should notify all Boeing 777 operators of the necessity to operate the fuel control switch to cut-off prior to operation of the fire handle, for both the fire drill and the evacuation drill, and ensure that all versions of its checklists, including electronic and placarded versions of the drill, are consistent with this procedure.

Boeing has accepted this recommendation. On 15 February 2008 Boeing issued a Multi Operator Message, which advised operators to ensure that "evacuation and engine fire checklists specifiy that the fuel control switches are placed in the cut-off position prior to the operation of the fire handles". This advice only relates to those aircraft that have not had Boeing SB 777-28-0025 incorporated. Boeing also recommends that operators review their engine fire and evacuation checklists (Quick Reference Handbook, Electronic and Placard) to make sure that they are consistent with this advice.

Continuing investigation

Investigations are now underway in an attempt to replicate the damage seen to the engine high pressure fuel pumps, and to match this to the data recorded on the accident flight. In addition, comprehensive examination and analysis is to be conducted on the entire aircraft and engine fuel system; including the modelling of fuel flows taking account of the environmental and aerodynamic effects.

Published February 2008

INCIDENT

Aircraft Type and Registration:	Beech King Air 350, F-GVLB
No & Type of Engines:	2 Pratt & Whitney PT6A-60A turboprop engines
Year of Manufacture:	2000
Date & Time (UTC):	9 December 2007 at 1752 hrs
Location:	En route Galway to Paris
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 2 Passengers - 8
Injuries:	Crew - None Passengers - None
Nature of Damage:	Right side circuit breaker panel
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	42 years
Commander's Flying Experience:	3,600 hours (of which 170 were on type) Last 90 days - 170 hours Last 28 days - 39 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

During cruising flight at Flight Level (FL) 330, the crew reported an electrical burning smell and smoke in the cockpit, and diverted to Cardiff Airport. The cause was subsequently found to have been caused by electrical shorting due to moisture ingress into the right circuit breaker panel, located directly below the direct vision (DV) panel in co-pilot's side window. Before the flight, the aircraft had been parked outside for two days at Galway, during which time it had rained.

History of the flight

The aircraft was operating a commercial air transport flight between Galway, Ireland and Paris Le Bourget Airport, France. Whilst at FL330, the crew became aware of the acrid smell of burning electrical insulation. A 'MAYDAY' was transmitted to ATC and an emergency descent to FL120 was performed. Although no visible smoke was visible in the cockpit, the commander initiated the Smoke Removal drill. Shortly thereafter, the acrid smell returned, accompanied by smoke, prompting the crew to divert to Cardiff Airport, where an uneventful emergency landing was performed. The smoke dissipated prior to landing. The airport emergency services attended but on inspecting the aircraft could find no evidence of fire.

Subsequent investigation revealed that the burning smell had been caused by electrical shorting due to moisture ingress into the right circuit breaker panel, which is located directly below the DV panel in the co-pilot's side window.

The aircraft had been parked outside for two days at Galway, during which time it had rained, and water had seeped past the DV panel seal and run down on to the circuit breakers.

ACCIDENT

Aircraft Type and Registration:	Bombardier BD-700 Global Express, VP-CRC
No & Type of Engines:	2 Rolls-Royce BR71DA turbofan engines
Year of Manufacture:	2007
Date & Time (UTC):	22 January 2008 at 1448 hrs
Location:	Exeter Airport
Type of Flight:	Private
Persons on Board:	Crew - 3 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	40 years
Commander's Flying Experience:	6,558 hours (of which 2,974 were on type) Last 90 days - 145 hours Last 28 days - 38 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and additional AAIB enquiries

Synopsis

As VP-CRC was taxiing prior to departure, its jet wash blew over and substantially damaged an unoccupied light aircraft.

History of the flight

VP-CRC arrived at Exeter for a transit stop before departing for Los Angeles. It was marshalled onto disused Runway 31 and parked facing east, approximately 150 ft clear of the nearest light aircraft. The normal grass light aircraft park at Exeter is to the west of the disused runway but this was unavailable due to its surface condition and about nine light aircraft were parked on or near the disused runway. Prior to starting the engines for its next flight, the commander of VP-CRC assessed the distance to the light aircraft and consulted the Flight Crew Manual for the Global Express jet wash effects. He advised the handling agent that although the light aircraft may take some buffeting, they should be in no danger as they were tied down. After starting one engine VP-CRC was instructed by ATC to shut down due to concerns over the amount of buffeting an unoccupied Cessna 152 was sustaining. Airport personnel and staff from the flying club moved two light aircraft from their tiedown locations to a position on the disused runway approximately 170 ft away from VP-CRC.

VP-CRC was again cleared to start and after starting both engines, the aircraft commenced a right hand turn to align itself with the disused runway. A higher thrust setting than idle was required to sustain the turn. The repositioned Cessna 152 was not tied down but being held by two members of the flying club staff. As VP-CRC completed its turn, the jet wash lifted the tail of the Cessna 152 forcing the two staff members to release their hold. It came to rest inverted, sustaining considerable damage.

Global Express Jet Exhaust Chart:

The Global Express Flight Crew Operating Manual provides guidance regarding the jet exhaust flow behind the aircraft. The manual suggests that with idle thrust set, at the reported distance between VP-CRC and the Cessna 152 of 150-170 ft, there would be a 20 ft wide plume of exhaust moving at 30 kt. No guidance is provided for thrust settings above idle.

Flight Data

The FDR for VP-CRC was downloaded and data from the taxi out at Exeter recovered. The data shows that during the turn, the thrust lever is above idle for approximately 11 seconds. The maximum thrust lever angle is 15.5º (approximately 1/3rd open) with maximum engine thrust peaking at 57% N_1. The maximum speed VP-CRC attains is 3 kt.

AAIB Comment

VP-CRC was destined for the west coast of the USA and therefore was operating at a high gross weight. Additional thrust above idle would be required to start taxiing and to complete any tight turns. Following this incident Exeter Airport reconsidered the risk assessment for the Runway 31 parking area. As a result they have stated that self-manoeuvre parking will be limited to small jet aircraft up to approximately Cessna 550 size. Larger jet aircraft will only use the area if they can be towed on and off it.

INCIDENT

Aircraft Type and Registration:	Embraer EMB-145EU, G-EMBT
No & Type of Engines:	2 Rolls-Royce AE 3007/A1/1 turbofan engines
Year of Manufacture:	2001
Date & Time (UTC):	29 December 2006 at 2001 hrs
Location:	Bristol Airport
Type of Flight:	Public Transport (Passenger)
Persons on Board:	Crew - 4 Passengers - 15
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	40 years
Commander's Flying Experience:	8,000 hours (of which 3,300 were on type) Last 90 days - 150 hours Last 28 days - 50 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

During the landing roll, in a strong crosswind, the aircraft's rudder hardover protection system (RHPS) tripped, which resulted in the loss of both rudder hydraulic systems and reversion to the rudder's mechanical mode. Despite the loss of hydraulic power to the rudder, the commander was able to maintain directional control using a combination of asymmetric braking and rudder. There was no fault found in the aircraft and no evidence of a rudder 'runaway'; high rudder pedal or brake pedal force application by the commander, or incorrectly adjusted pedal force microswitches, may have triggered the RHPS.

This report includes one Safety Recommendation to Embraer SA.

History of the flight

The aircraft was on approach to Bristol Airport after a flight from Edinburgh. During the first coupled ILS approach the commander became visual with Runway 27 at approximately 500 ft agl and took manual control. The last reported wind was a direct crosswind of between 23 and 27 kt; the aircraft's crosswind landing limit was 30 kt. During the final stages of the approach the commander estimated from his drift angle of approximately 15º that the crosswind was now beyond the limit, so he initiated a go-around.

During the second approach the commander became visual with the runway between 700 ft and 500 ft agl. After decision altitude ATC reported a crosswind of 31 kt. The commander decided to initiate another go-around but the next wind report was '30 kt across' so he continued the approach. The aircraft touched down on the runway centreline near the touchdown markers. He then applied heavy manual braking. At some point during the ground roll he started to lose directional control and had to apply a large rudder pedal input to correct it. At about the same time he felt that he had lost hydraulic assistance to the rudder. This was followed by a Master Caution warning and a 'RUDDER SYS 1-2 INOP' EICAS message. The commander reported that he was able to maintain directional control using asymmetric braking and he could not tell if the rudder pedals were having an effect. Once the aircraft had decelerated below 40 KIAS he was able to use the tiller to steer the aircraft and make a normal exit from the runway.

Post-flight engineering rectification consisted of cycling both rudder systems on and off. This resulted in the reactivation of both hydraulic systems and a return to normal hydraulic-assisted rudder operation.

Weather and runway surface conditions

The reported weather conditions at 1950 hrs (11 minutes before the incident) were: broken cloud at 400 ft, wind from 180º at 26 kt with gusts to 43 kt, light rain, visibility of 4,000 m and a temperature of 11ºC. The last runway surface condition report at 1923 hrs was 'Damp-Wet-Damp' indicating that the centre section of the runway was soaked but to a depth of less than 3 mm. A section of the runway, 300 m long, had recently been resurfaced and had not yet been grooved.

The subject of the runway resurfacing programme, and of two runway excursion incidents, involving an ATR and another EMB-145 on 29 December 2006, is covered by a separate AAIB investigation and the results will be published in a future AAIB Formal Report.

Rudder control system description

The rudder on the EMB-145 is split into two sections in tandem, forward and aft. The forward rudder is driven by the control system while the aft rudder is mechanically linked to the forward rudder and is thus deflected as a function of forward rudder deflection. The forward rudder is driven by two rudder actuators connected to a Power Control Unit (PCU). The PCU is commanded by the rudder pedals via control cables that run from the pedals in the flight deck to the PCU in the rear fuselage (see Figure 1). The rudder PCU is a dual hydraulic unit which is powered by two hydraulic systems at the same time. Each PCU hydraulic circuit controls the hydraulic power to one rudder actuator. Therefore, the rudder system is divided into Rudder System 1 and 2. Either system can be automatically or manually shut off. When both hydraulic systems are shut off the rudder can be operated directly through the mechanical controls. In mechanical mode the control forces are greater because the aerodynamic loads on the rudder are directly transmitted to the rudder pedals. If either Rudder System becomes inoperative a caution message is presented on EICAS. If both become inoperative the message 'RUDDER SYS 1-2 INOP' is displayed.

During normal operation both systems are powered at speeds below 135 KIAS. Above 135 KIAS, Rudder System 1 is automatically shut off. If Rudder System 2 hydraulic power supply fails above 135 KIAS, then Rudder System 1 automatically takes over.

The maximum rudder deflection on the ground is ±15º and in the air is ±10º. The corresponding rudder pedal deflection on the ground is ±9º and in the air is ±6º.

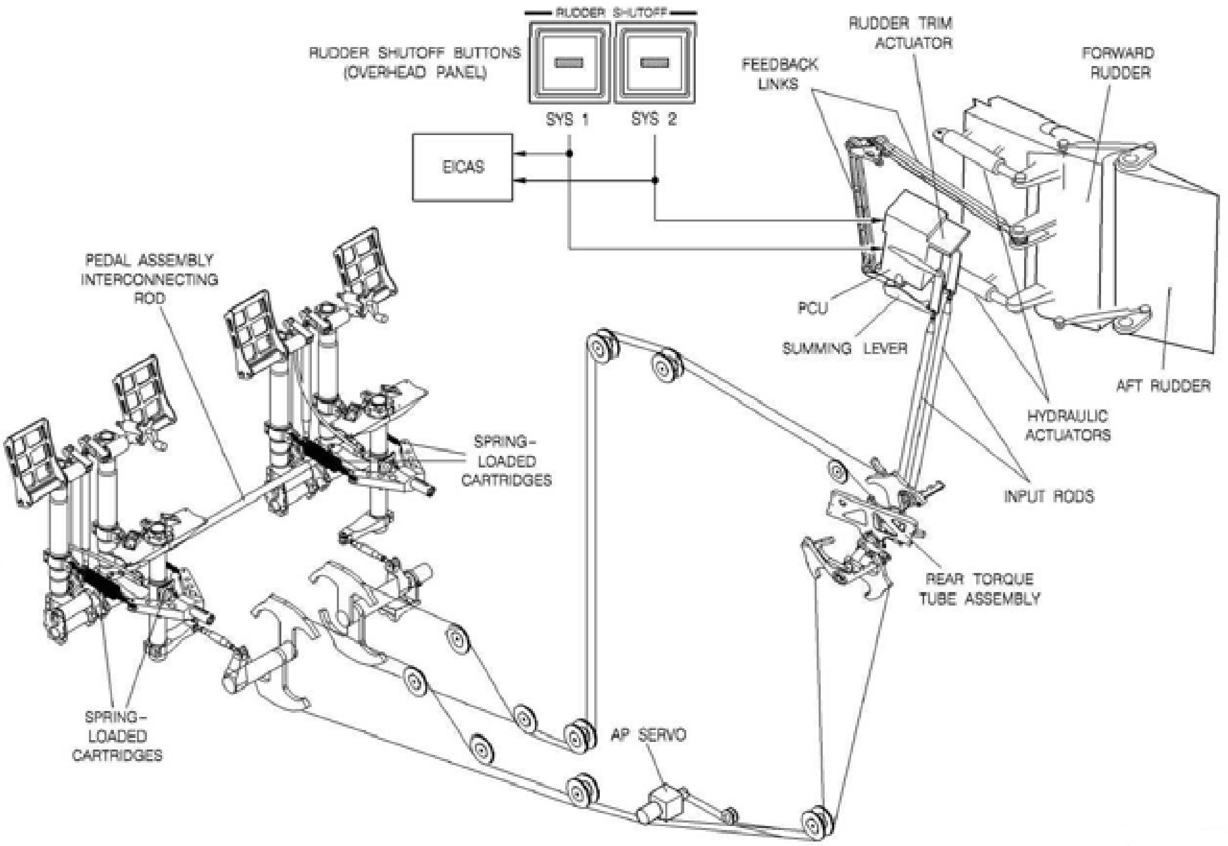

Figure 1

Embraer 145 Rudder System Schematic

Rudder hardover protection system (RHPS)

The rudder hardover protection system is designed to remove hydraulic power to the rudder PCU in the event of a rudder runaway (ie uncommanded rudder deflection). RHPS will automatically shut off both Rudder System 1 and 2 if the following three conditions are met simultaneously:

1. Rudder pedal force greater than 130 lbf (59 kgf)
2. Rudder deflected greater than 5º (±1º) in the direction opposite to the applied pedal force
3. Both engines operating (based on engine N_2 greater than 56%)

Condition 3 ensures that RHPS is disabled in the event of an engine failure. RHPS will indirectly trigger the 'RUDDER SYS 1-2 INOP' message on the EICAS once the pressure switches sense the loss of pressure.

The 130 lbf pedal force is measured by a spring-loaded cartridge. There are four cartridges – one attached to each rudder pedal. The cartridge contains a spring and microswitch. When a pedal force in excess of 130 lbf is applied, the spring compresses sufficiently to release the microswitch, which sends a signal to the RHPS.

A rudder deflection in excess of ±5º is detected indirectly by a pair of microswitches mounted on the pilot's pedal assembly stop. One microswitch is triggered when the rudder deflects more than 5º to the left and the other microswitch is triggered when the rudder deflects more than 5º to the right. These microswitches send their respective signals to the RHPS.

Brake system description

The EMB-145 has two main landing gears, with two wheels on each gear. Each wheel has a disk brake and an associated brake control valve which controls the hydraulic pressure to the brake. Normal braking is controlled by toe brakes on the rudder pedals. The anti-skid system controls the amount of hydraulic pressure applied by the pilots to the brakes. The anti-skid is designed to provide the maximum allowable braking effort for the runway surface in use, while preventing skidding. This is accomplished by measuring each wheel speed. If one wheel speed drops significantly below the aircraft's average wheel speed, a skid is probably occurring, so brake pressure is relieved to the appropriate wheel brake until its speed recovers.

The anti-skid system does not apply pressure on the brakes, but only relieves the pilot-commanded pressure to avoid a skid. Therefore, in order to steer the aircraft using asymmetric braking, during a heavily braked landing, the pilot needs to reduce brake pressure on the side opposite to the direction of turn, instead of applying pressure to the desired side. The pedal force required to command maximum braking is 61.9 lbf, and is achieved when the brake pedal reaches its maximum deflection of 15º.

Flight Data Recorder

The FDR was removed from the aircraft and downloaded by the operator. A copy of this data was sent to the AAIB for analysis. The download contained just over 25 hours of operation, recording parameters at a rate of 128 words per second (wps).

The FDR identified the aircraft on both approaches to Bristol Airport, the second approach showing the aircraft heading slightly to the left of Runway 27. No drift angle or aircraft position was recorded but this heading suggests that the aircraft was positioned with respect to the crosswind conditions. The heading increased as the aircraft neared the runway, coincident with right rudder pedal input and a left roll input on the control column. The aircraft touched down at 19:59:47 (Figure 2) with an airspeed of 124 kt, heading of 266º, the rudder pedals deflected 4.6º to the right and control wheel 37º to the left (maximum achievable is 40º).

The FDR shows that, once on the ground, the ground spoilers deployed, braking was applied and further rudder pedal deflections were applied, predominantly to the right. Longitudinal deceleration reached its greatest value around five seconds after touchdown. Throughout the following five seconds, this deceleration decayed from -0.37 g to -0.16 g, indicating that the level of aircraft retardation was reducing. The engine N_2 speed remained between 62% and 67% on both engines, consistent with IDLE power selection (the aircraft was not equipped with thrust reversers).

At 20:00:01, a master caution was triggered with the aircraft at a groundspeed of 79 kt. Based on the pilot's report, this master caution was probably triggered by the RHPS. According to the manufacturer, the 'RUDDER SYS 1-2 INOP' message requires a 3 second confirmation time. The message should appear at the same time as the master caution. The master caution is recorded by the FDR every second so, in this case, the event which triggered it would be between three and four seconds before 20:00:01.

Figure 2 confirms that, during this 4 second period, the minimum rudder pedal deflection was 4º, corresponding to 6.7º of right rudder deflection.

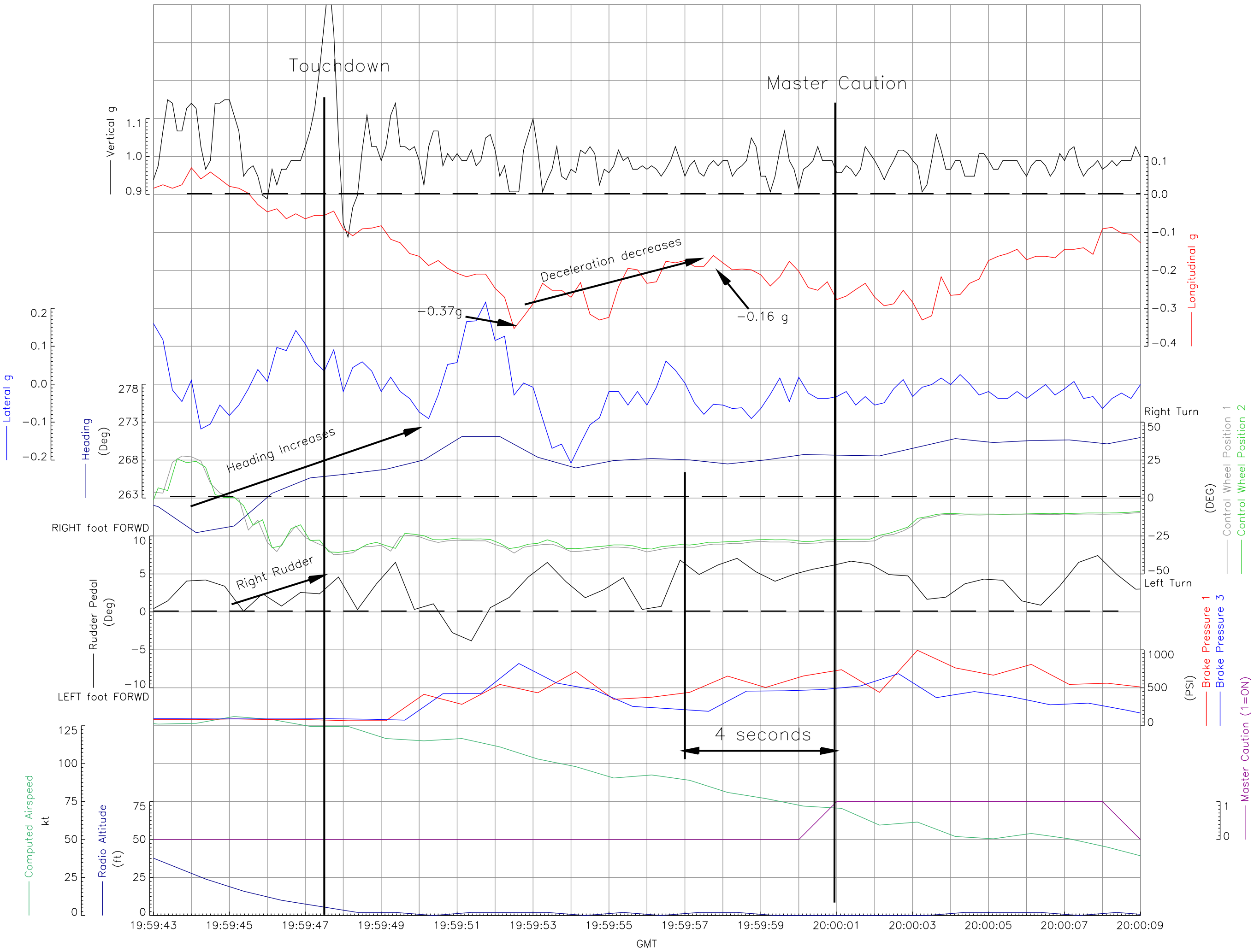

Figure 2

G-EMBT FDR Parameters

Previous incidents of dual rudder system shutoff

The aircraft manufacturer reported that they were aware of previous occurrences of the 'RUDDER SYS 1-2 INOP' message during landing. They believe that these were most likely caused by the pilot applying 'excessive' force on the rudder pedals (that is, force greater than that required for maximum braking) while attempting to brake – particularly in strong crosswinds – although these events were difficult to confirm with the limited parameter set of the Flight Data Recorder (FDR). They have also had reports of dual system shutoff in the air, usually during approach in strong turbulence, where they believe the pilot most likely applied rapid opposite pedal control inputs.

The operator of G-EMBT experienced a similar incident on another EMB-145 (G-EMBI) on 9 January 2007 while it was landing at Birmingham airport. According to the operator the aircraft experienced a 'RUDDER SYS 1-2 INOP' EICAS message during landing and directional control was maintained using differential braking. Engineers were unable to find a fault with the aircraft, but it was noted that there was a strong crosswind at the time of the landing. The FDR data from this event showed similar characteristics to that from G-EMBT.

Analysis

The 'RUDDER SYS 1-2 INOP' message was triggered below 135 KIAS and was accompanied by the pilot's sensation of a loss of rudder assistance. These factors indicate a genuine shutoff of both rudder hydraulic systems rather than a sensor or indication problem. Both systems were easily reset by engineers on the ground, which indicates that it was a transitory event triggered by specific conditions rather than a permanent failure of both systems. Therefore, RHPS was the likely cause of the dual rudder system shutoff.

Of the three conditions required to trigger RHPS, two conditions were apparent most of the time. First, the N_2 on both engines was above 56% during the entire ground roll. Second, the rudder pedal deflection was 3º or greater for a large portion of the ground roll which corresponds to 5º, or greater, of rudder deflection. The third condition, pedal force, is not known because it was not recorded by the FDR.

The Master Caution associated with the RHPS trip occurred at 20:00:01 hrs. According to the aircraft manufacturer there is a 3 to 4 second delay time between RHPS trip and Master Caution trigger. Therefore, the probable time of RHPS activation was between 19:59:57 and 19:59:58. During this period the pedal was deflected by more than 3º to the right, which means that the rudder was deflected by more than 5º to the right. So, during this period the left pedal spring cartridge microswitch probably tripped in order to trigger RHPS. This would normally only occur as a result of a 130 lbf force being applied to the left pedal. It is possible that the pilot was applying a heavy force to both pedals as a result of his attempts to brake and slow the aircraft. A component of brake pedal force application is detected by the rudder pedal force microswitch; for example, a 163 lbf force applied to the brake pedal will be sensed as 130 lbf by the pedal force microswitch. During this same period (19:59:57 to 20:00:01) the aircraft's deceleration rate reduced to a minimum of -0.16 g, after a maximum deceleration of -0.37 g. However, the 'Brake pressure 1' FDR parameter had not reduced significantly so this loss of deceleration was probably caused by reduced friction on the wet and ungrooved centre section of the runway. This loss of deceleration might make a pilot increase the force applied to the brake pedals. Unfortunately the brake pedal pressure parameters on the FDR do not indicate brake pedal force or show whether asymmetric braking was being used, because the brake pressures were probably reduced by the anti-skid system.

It is possible that one of the pedal spring-loaded cartridges was incorrectly adjusted and thus triggered at a force lower than 130 lbf of pedal force. The only accurate method for testing the spring cartridge is to remove it from the aircraft and bench test it in accordance with the component maintenance manual instructions (CMM 27-25-01). The aircraft operator plans to carry out this test during G-EMBT's next base maintenance check.

The low sample rate of the recorded pedal position and brake pressures, combined with the lack of recorded rudder position, rudder pedal force and brake pedal force, make it impossible to determine exactly what caused the RHPS to trigger. However, dual system shutoff had not recurred on G-EMBT (as of 14 September 2007) and therefore it is most probable that this event was caused by heavy pedal forces in the unusually strong crosswind and slippery runway surface conditions.

A landing in a strong crosswind, with slippery runway conditions, is a time when maximum rudder authority and control is desired in order to maintain directional control. It is highly undesirable to have a system in which the rudder's hydraulic assistance may drop out as a result of a pilot's energetic attempts to control and slow the aircraft. Therefore, the following AAIB Safety Recommendation is made:

Safety Recommendation 2007-112

It is recommended that Embraer SA should review and modify the design of the RHPS (rudder hardover protection system) in the EMB-145, to prevent unnecessary RHPS triggering.

Safety actions

Subsequent to this incident, and the AAIB draft report, the National Civil Aviation Agency (ANAC) in Brazil and the manufacturer, Embraer, have been actively reviewing this incident, with a view to issuing an Operational Bulletin to operators and potential design improvements.

Embraer has stated that they will be issuing a revised Component Maintenance Manual (CMM) procedure for testing the spring-loaded cartridges, to ensure that activation of the microswitches occurs within a specified range of loading.

ACCIDENT

Aircraft Type and Registration:	Lockheed L188C Electra, G-FIJV
No & Type of Engines:	4 Allison 501-D13 turbprop engines
Year of Manufacture:	1961
Date & Time (UTC):	12 October 2006 at 0540 hrs
Location:	Nottingham East Midlands Airport
Type of Flight:	Commercial Air Transport (Cargo)
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Loss of the No 3 engine cowlings and impact damage to the fuselage and No 4 propeller
Commander's Licence:	Air Transport Pilot's Licence
Commander's Age:	38 years
Commander's Flying Experience:	3,477 hours (of which 933 were on type) Last 90 days - 87 hours Last 28 days - 28 hours
Information Source:	AAIB Field Investigation

Synopsis

During taxi prior to flight, the engine cowlings from the No 3 engine detached, causing minor damage to the fuselage and the No 4 propeller. The flight proceeded uneventfully and their loss was only discovered after the aircraft's arrival at its destination; the doors were discovered on a taxiway at the departure airfield. The investigation concluded that the No 3 engine air turbine starter motor casing probably failed after engine start, releasing a rotating clutch assembly into the nacelle, which caused deformation to one of the cowling doors. This in turn allowed propeller wash to enter the nacelle and overstress the door latches attachment structure. Only approximately half of the casing fragments were recovered but none showed any evidence of pre-existing cracking or other defects. The operator, to whom the L188 aircraft type is unique in the UK, has instituted regular inspections of the starter motors to check for defects/cracks.

History of the flight

After an uneventful flight from Nottingham East Midlands Airport (EMA) to Cork, having departed East Midlands at 0540 hrs, one of the ground crew at Cork observed that two engine cowlings were missing from the No 3 engine. After calling their operations department, the flight crew were informed that both cowlings had been found on taxiway Alpha at EMA. The flight crew stated that there had been no abnormal indications during the engine start sequence, and that the aircraft's handling and engine indications had been normal throughout the flight.

Examination of the aircraft revealed that the No 3 engine air starter motor had failed, components of which were recovered from the engine nacelle; no other damage to the engine or its associated equipment had occurred but impact damage was identified on the No 4 propeller and the fuselage.

Engine starter motor description

Each engine is fitted with an air-turbine starter motor, mounted on the aft side of the propeller reduction gearbox. The starter is attached to the propeller gearbox by a band clamp, which fits over a flange on the unit's case and allows for its rapid replacement. The motor consists of an air-driven turbine which, through an internal reduction gearbox, a clutch unit and output drive shaft, drives the propeller gearbox. The clutch unit prevents the starter motor being 'driven' by the engine when the engine speed exceeds that of the starter output drive. When the engine is running, the clutch unit continues to rotate within the air starter as it is directly connected via the output drive shaft to the propeller gearbox.

Each air starter motor is powered by bleed air from the aircraft's bleed air manifold, which is pressurised by an operating engine or, during ground starting, by an external pneumatic supply. The supply of pressurised air to each engine is controlled by an electro-pneumatic starting valve. When the engine start sequence is initiated, the start valve opens, allowing the bleed air to turn the starter turbine. At 2,200 (engine) rpm, the fuel and ignition systems are activated and the engine accelerates to idle speed. The engine starter remains engaged to assist engine acceleration during this period. As the engine accelerates further, a cut-out switch within the starter is activated at between 8,000 and 8,400 (engine) rpm, which closes the start valve. If this does not occur, a 'starter overspeed' light will illuminate in the cockpit when engine speed exceeds 8,500 rpm. Operational procedures require that, in the event of a starter overspeed warning, the engine must be shut down immediately.

Investigation

The No 3 engine, including the nacelle, had been removed by the operator after the incident and was examined by the AAIB, together with the remains of the starter and the damaged cowlings, at the operator's maintenance facility at Cork. It had been reported that the remains of the cowling latches were still attached to the nacelle. A review of the aircraft's technical log book showed that no maintenance had been carried out on the engine prior to the flight and subsequent tests confirmed that the aircraft's starter overspeed warning system was serviceable. The remains of the starter unit, together with the pneumatic start valve, were the subject of a detailed examination.

The engine cowlings are hinged on their upper edge and held in the closed position on the left and right sides of the nacelle by two latches on their lower edges. Damage to the hinges confirmed that both doors had been torn backwards and upwards before being released from the aircraft. Both latches on each cowling, together with some adjacent structure, had been pulled from the cowling doors. The right door had lost its upper aft corner, the failure surface of which was consistent with it having been struck by the rotating No 4 propeller. The leading edge of the left door had been bent outwards in line with the position of the forward latch, and there was evidence of impact damage to the inner surface of the lower leading edge corner, which had distorted the forward lip of the cowling. Detailed examination revealed that the mounting structure for all the cowling latches had failed due to an overload condition, and that the latch hooks were undistorted and remained operable.

The pneumatic start valve was tested and no faults were identified with its operation. The air starter unit gearbox case had broken up, but sections of the case remained secured to the air turbine containment case by the mounting bolts. The forward section of the case remained attached to the propeller reduction gearbox by the quick disconnect clamp and examination of the case fracture surfaces showed all fractures to have resulted from overloading. It was estimated that approximately 55% of the air starter reduction gearbox casing was recovered.

All of the starter unit's internal components were found within the nacelle. The turbine containment case was intact and detailed examination showed there was evidence of rubbing contact between the air turbine blade tips and the inner surface of the case. The reduction gearing components were intact and undamaged, and all these components were covered with a film of light-coloured oil. The clutch and governor assembly showed clear evidence of rotational damage but, when tested, the clutch functioned satisfactorily. The bearings within the assembly were intact and rotated without restriction.

A review of the aircraft's maintenance records showed that the starter motor had been installed for 3,139 hours prior to this incident; there were no entries in the aircraft technical log relating to this unit since its installation. It was not possible to determine either the total age or operational life of the unit. The Approved Maintenance Schedule for the Lockheed L188C Electra requires that the air starter unit is subject to weekly oil servicing and magnetic chip detector inspections. However, it is considered to be an 'on-condition' item and therefore not subject to scheduled removal, or any other inspections, whilst installed.

Analysis

The flight crew reported that the start of the No 3 engine was normal, with no indication of a starter 'overspeed', and tests confirmed that the pneumatic start valve operated normally. The fact that the cowling latches remained attached to the nacelle after the cowlings had departed the aircraft, and their general condition, confirmed that they had been correctly engaged prior to the incident. The condition of the hinges revealed that both cowlings were lifted upwards and aft, indicating that the latch attachments failed before the hinge attachment structure. The impact damage and deformation to the forward edge of the left engine cowling showed that the cowling had been struck on its inner face with some force, probably by the rotating clutch assembly. Any deformation in this area would have subjected the cowling to increased forces from the propeller wash, increasing the loading on the hinges and latches. It would also have allowed the propeller wash to enter the interior of the nacelle, most likely causing an increase in the ambient pressure, thereby increasing the load on the cowlings. Any increase in engine power, either during taxiing or at the start of the takeoff roll, was likely to have significantly increased the loads experienced by the cowling attachments and probably precipitated the failure of the latches attachment structure.

The satisfactory operation of the clutch unit, together with the apparently normal start of the No 3 engine, indicted that the starter was unlikely to have been 'oversped'. The film of oil found on the gearbox components confirmed that oil had been present in the gearbox, and its appearance indicated that it had not been overheated.

The lack of damage to the reduction gearbox components indicated that the reduction gearing was not rotating with any significant speed when the failure occurred. However, as the starter clutch unit does continue to rotate at considerable speed while the engine is operating, a failure of the gearbox case would allow the clutch unit to be released into the nacelle whilst it had considerable kinetic energy, as indicated by the evidence of rotational damage on the unit.

When attached to the propeller gearbox by the quick disconnect clamp, the majority of the loads acting on the starter unit are carried by the casing and mounting flange. The condition of the air turbine motor and its casing indicated that there may have been some imbalance or misalignment of the turbine rotor prior to the incident, leading to the rubbing of the turbine blade tips on the turbine containment case. It is possible, therefore, that given the likely high levels of vibration experienced by the starter in operation, a crack could have developed in the reduction gearbox casing. If this was so, then it may have occurred in the upper, but missing, portion of the casing, where tensile stresses are likely to be at their highest. A crack in this region would be above the level of oil within the casing and may not have been readily identifiable through a visible oil leakage or excessive oil consumption. In this situation, a crack might progress undetected until it became large enough to precipitate the remaining material to fail in overload and release the internal components of the starter.

Although examination of the recovered fragments of gearbox casing, amounting to approximately half of the unit, failed to identify any sites of crack initiation or progression, the possibility that a significant crack in the starter unit had grown to a critical length prior to the incident, in the casing sections not recovered, could not be dismissed.

Conclusion

Failure of the air starter motor gearbox case on the No 3 engine occurred as the aircraft taxied prior to the flight to Cork, releasing the turbine wheel, reduction gearbox and clutch unit from the motor. The leading edge of the left engine cowling was deformed outwards as a result of an impact on its inner face, probably from the air starter clutch unit, causing it to protrude into the propeller wash. This appeared to have pressurised the interior of the engine nacelle sufficiently to have overloaded the cowlings latch structure, allowing both cowlings to be released. The right cowling was then struck by the No 4 propeller.

As approximately half of the casing fragments were not recovered, the origin of the failure could not be determined with any certainty. However, the most probable cause of the failure of the air starter gearbox casing was the propagation of a crack, which remained undetected until the casing failed due to an overload condition.

Safety action

As a result of this incident, the operator has introduced a repetitive inspection of the air starter units installed on their Lockheed Electra aircraft. In view of the fact that this aircraft type is unique to this operator in the UK, no further safety action is considered to be appropriate at this time.

ACCIDENT

Aircraft Type and Registration:	Bellanca 7GCBC Citabria, G-BRJW
No & Type of Engines:	1 Lycoming O-320-A2D piston engine
Year of Manufacture:	1980
Date & Time (UTC):	27 October 2007 at 1330 hrs
Location:	Old Buckenham Airfield, Norfolk
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Minor) Passengers - 1 (Minor)
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	46 years
Commander's Flying Experience:	137 hours (of which 21 were on type) Last 90 days - 8 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft ground looped on landing in a crosswind of approximately 6 kt. The pilot considered that he had been slow to react when the into-wind wing rose and the aircraft began to yaw.

History of the flight

The aircraft, a tailwheel type with the pilot and one passenger onboard, took off into the circuit at Old Buckenham in conditions of haze and a surface wind of 210º/8-10 kt. During the first approach to asphalt Runway 25 the aircraft encountered turbulence on final approach and bounced on touchdown. The pilot executed a go-around and carried out a further approach. He stated that this second approach and flare appeared satisfactory and resulted in a touchdown on all three wheels. Shortly afterwards, however, the left wing lifted and the aircraft yawed left, travelling across the grass beside the runway towards the airfield clubhouse and adjacent parked aircraft.

The pilot attempted to go around again, applying full power and forward elevator control to raise the tail but the aircraft would not accelerate on the soft ground. Nevertheless, because it was still heading towards the club house, he applied nose up elevator control in an attempt to get airborne. This resulted in a "nose-high" attitude and the left wing dropped until it impacted the ground, causing the aircraft to cartwheel. It came to rest upright approximately 30 m from the club hangar and a parked fuel tanker. There was no fire but the aircraft suffered damage to the fuselage, both wingtips and the entire structure forward of the instrument panel, which had become almost completely detached. Both occupants were able to vacate the aircraft unaided, having suffered what the pilot described as minor injuries. He noted that the cockpit structure had not been distorted.

Discussion

The crosswind component of approximately 6 kt was below the maximum for which a successful landing had been demonstrated in this aircraft. The Chief Flying Instructor (CFI) of the flying club which operated the aircraft commented that the pilot had received instruction in its operation and recent refresher training on crosswind techniques during which he achieved a “good standard”. The CFI added that the weather conditions on the day of the accident were “well within” the pilot’s capabilities.

The pilot considered that he had been slow to react to the effects of the crosswind on touchdown and that he should have applied into wind aileron and opposite rudder.

There was no indication of any pre-existing mechanical fault that would have contributed to the accident.

ACCIDENT

Aircraft Type and Registration:	Cessna 152, G-BNRK
No & Type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1984
Date & Time (UTC):	15 September 2007 at 1345 hrs
Location:	Runway 18 at Redhill Aerodrome
Type of Flight:	Training (solo cross-country exercise)
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Bent propeller and extensive damage to fuselage, wings and tail
Commander's Licence:	Student pilot
Commander's Age:	53 years
Commander's Flying Experience:	59 hours (all of which were on type) Last 90 days - 9 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The pilot returned to the airfield due to a suspected altimeter error. The aircraft bounced at touchdown and the second touchdown resulted in the aircraft nosing over and coming to rest inverted. There was no fire and the pilot was not injured.

History of the flight

The student pilot had prepared fully for a solo cross-country flight from Redhill to Manston. After completing his pre-takeoff checks the pilot took off from Runway 18 (which has a grass surface) at 1344 hrs. The weather was good, with light southerly winds.

Once airborne the pilot checked the altimeter, which appeared to read zero. He radioed the Redhill tower to confirm the QNH setting and checked that his altimeter was set correctly. Continuing east, towards the Visual Reporting Point (VRP) at Godstone railway station, he became concerned that there might be an error with the altimeter and elected to return to Redhill. He radioed the tower and received instructions that gave him priority for landing, to join left base for Runway 18, as well as the QFE setting.

The pilot carried out pre-landing checks and radio calls before being given clearance to land. After a reasonably normal approach, which ATC considered 'higher than normal', the pilot lowered full flap at 200 ft, the aircraft rounded out and touched down with a slight bounce and then became airborne again. The aircraft continued along the runway and nosed over after a second touchdown, causing extensive damage. The pilot recalls being concerned with the aircraft's speed and the length of the remaining runway; he considered that he may inadvertently have touched the brakes prior to the second touchdown. There was no fire and the pilot was not injured.

The pilot later considered carefully the lessons that might be learned from his accident. First, he commented that his initial decision to return immediately to Redhill was probably taken too quickly and that he would have done better to have remained airborne longer to "give me more time to settle down". Second, he considered that, after the aircraft bounced on first touchdown, he should have initiated a 'go-around' and not remained focussed on getting the aircraft onto the ground.

ACCIDENT

Aircraft Type and Registration:	Cessna 152, G-BXWC
No & Type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1983
Date & Time (UTC):	24 May 2007 at 1600 hrs
Location:	Stapleford Airfield, Essex
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Nose landing gear collapsed, propeller damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	32 years
Commander's Flying Experience:	87 hours (of which 67 were on type) Last 90 days - 7 hours Last 28 days - 7 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Whilst landing, during a circuit flying detail, the aircraft bounced. On touching down for the third time, the nose landing gear collapsed. The pilot thought that the nosewheel may have struck a mound of earth on the runway, precipitating the first bounce.

History of the flight

The pilot had been flying circuits in a flight school aircraft. At the conclusion of his fifth circuit, he landed on the grass section of Runway 04R and later stated that "after approximately 20 ft, the aircraft nosewheel felt like it hit something solid". In his opinion this was "perhaps a mound of earth on the grass part of the runway". This caused the aircraft to become airborne and reach a height of about 10 ft. He did not attempt to go around from this position because he was concerned about the safety implications of touching down again at approach speed, in the event that the nosewheel had been severely damaged, and considered it safer to attempt to complete the landing. He stated that he "gently held off and attempted to land", but the aircraft bounced again and he found it difficult to control. On touching down for the third time the nose landing gear collapsed, the propeller contacted the ground, and the aircraft came to a halt. The pilot closed the throttle and mixture, switched off the electrical services and vacated the aircraft.

The flight school have stated that there was no mound of earth on the runway, but believe the pilot may have been referring to a bump or undulation in the surface of the grassed section of the runway.

ACCIDENT

Aircraft Type and Registration:	Cessna 152, G-OPJC
No & Type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1979
Date & Time (UTC):	6 October 2007 at 1620 hrs
Location:	St Mary's Marsh, 4 mile NE of Gravesend, Kent
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to nose gear and forward fuselage
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	48 years
Commander's Flying Experience:	4,279 hours (of which over 1,000 were on type) Last 90 days - 130 hours Last 28 days - 64 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and AAIB enquiries

Synopsis

The pilot made a forced landing after smoke had started to fill the cockpit. The smoke was attributed to an internal failure of the 'flaps up' switch located behind the console in front of the right seat, although the precise cause of the switch failure could not be identified.

History of the flight

The aircraft was flying normally at 2,000 ft with an instructor and a student pilot on board, and had been airborne for fifteen minutes. Without warning the instructor felt a sharp stinging sensation on his right ankle, and also noticed a burning smell, and smoke then started to fill the cockpit. The instructor promptly declared a 'MAYDAY' and switched both the fuel and the magnetos off, and selected a field for a forced landing. He recalled that the smoke cleared during the descent, and he continued with the forced landing into a field that he felt was suitable, on St Mary's Marsh. Having successfully touched down, during the ground roll the aircraft went into a drainage ditch at the end of the field. This resulted in damage to the nose gear leg and the forward fuselage. From the air the field had appeared suitable and the instructor had thought that the ditch, which had been visible, was a path. The instructor and student exited normally and were uninjured. The Coast Guard attended the scene as a result of the 'MAYDAY' call.

After landing the instructor noticed that the flaps were not deployed, despite having selected full flap during the approach. He also noticed burn marks on his shoe and sock.

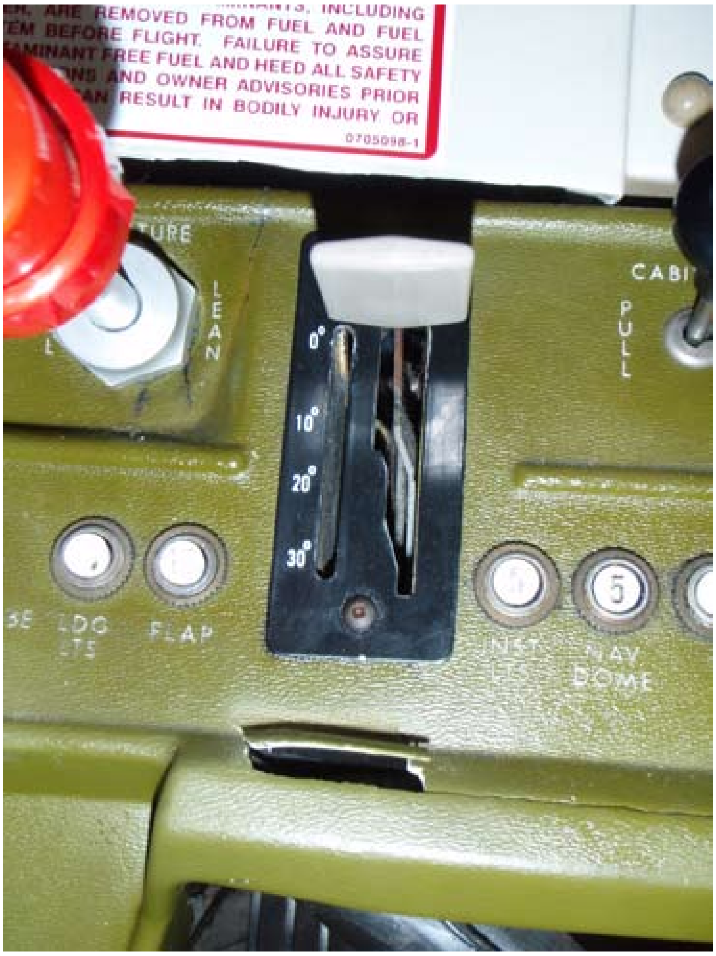

Figure 1

Aircraft information

The Cessna 152 has an electrically operated flap system. On the instrument panel is a selector switch and located next to the switch is a flap position indicator, see Figure 1. To operate the flaps the selector is moved to the desired detent position; this activates either the 'flaps up' or 'flaps down' switch as appropriate, which then powers the flap motor in the wing. There is a mechanical feedback system from the cable that links the left and right flaps and this moves the flap position indicator on the instrument panel.

The electric circuit for the flap actuation is protected by a 15 Ampere circuit breaker. Such circuit breakers are designed to open should the current exceed the rated value, and the time it takes to trip is dependent on the magnitude of the overcurrent in excess of the rated value.

Inspection of flap control system

The flap actuation lever and indication assembly were inspected on the aircraft, and the indicator was found to be bent upwards such that it did not protrude from its slot on the console, (Figure 1), and could potentially have offered some mechanical resistance. The flap actuation lever and indicator assembly was removed along with the associated wiring and circuit breaker. There was evidence of mechanical scoring by the position indicator on the mounting plate, see Figure 2, although it was not possible to determine when this took place. The wiring was checked and found to be correct, however there was significant heat damage to the 'flaps up' switch, see Figure 3. The circuit breaker had not tripped.

Three-dimensional X-ray images were taken of both the circuit breaker and flaps switch assembly and no pre-accident mechanical defect could be found.

The circuit breaker was then tested at various currents in a laboratory and it was concluded that it would not trip at 14 Amperes, but would trip at greater than 15 Amperes.

The 'flaps up' switch was disassembled and examined. The damage appeared to have been caused by arcing inside the switch, although it was not clear from the

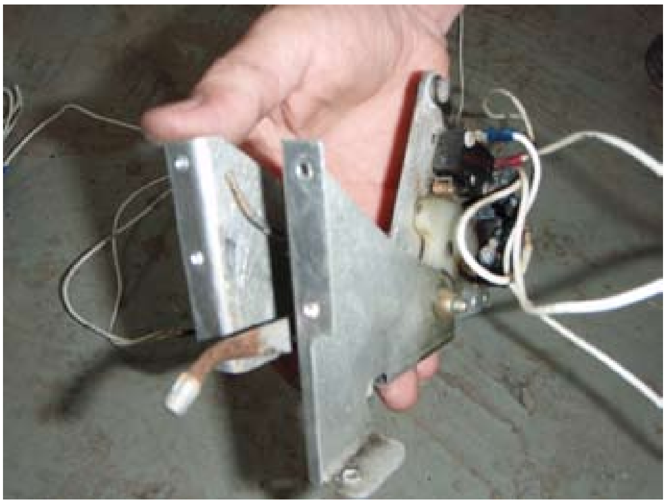

Figure 2

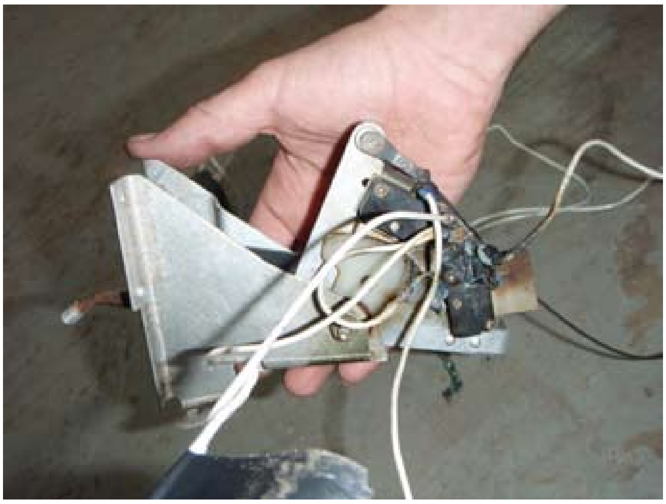

Figure 3

damaged components why the arcing had occurred. It was not possible to determine when the switch was made, although it may well have been at the time of the aircraft, around 30 years ago.

Comments

Circuit breakers, as their name suggests, are designed to protect all the components of a circuit, and the current rating is driven by the peak current in the circuit, in this case the current for the flap motor. From the tests on the circuit breaker it appears that it did not carry more than its rated load otherwise it would have tripped 'open circuit'.

It is considered unlikely that the bent position indicator contributed to this accident, since the flaps selector was not used during the fifteen minutes after takeoff and before the smoke appeared in the cockpit. The pilot stated that the flaps were checked prior to takeoff and that they operated satisfactorily. The most likely cause would appear to be arcing within the 'flaps up' switch.

ACCIDENT

Aircraft Type and Registration:	Luscombe 8E Silvaire Deluxe, G-BUKT
No & Type of Engines:	1 Continental Motors Corp C85-12F piston engine
Year of Manufacture:	1946
Date & Time (UTC):	1 November 2007 at 1611 hrs
Location:	Near Dolgellau, Gwynedd
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Aircraft extensively damaged
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	43 years
Commander's Flying Experience:	225 hours (of which 221 were on type) Last 90 days - 26 hours Last 28 days - 7 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Following a loss of engine power, thought to have resulted from carburettor icing, the pilot attempted a forced landing, during which the aircraft stalled and dropped into a tree.

History of the flight

The pilot departed Sleap Aerodrome in Shropshire, with the intention of flying along the Welsh coast between Barmouth and Aberystwyth, before returning to Sleap. He noted nothing unusual during the pre-flight inspections, which included engine oil and fuel sample checks, and the engine power checks were completed satisfactorily prior to departure.

He reported there was scattered cloud between 3,000 and 4,500 ft amsl. Eyewitnesses recalled the cloudbase being relatively low at the time of the accident.

Whilst en-route to the coast, the pilot made a few deviations to remain clear of low cloud. He drifted to the south of his planned track and, accordingly, took up a northwesterly heading, in the direction of Dolgellau. As the aircraft passed over a ridge, at approximately 2,600 ft amsl, it encountered a strong updraft. Shortly after this the engine note changed and, whilst it continued to run, it no longer produced significant power and did not respond to throttle movements or the application of carburettor heat.

Losing height rapidly, the pilot chose not to use up valuable time in transmitting a MAYDAY call, concentrating instead on flying the aircraft and finding a suitable field for a forced landing. He lined up with the chosen field, but was too high, overshot but then found himself to be very low, with woodland ahead to the left and a rough, steep, hillside to the right. With the airspeed decaying, he attempted to turn the aircraft to the right, whereupon it stalled and dropped into a tree.

The aircraft was extensively damaged and was leaking fuel, but the cabin area remained intact. The pilot, who was wearing a lap and diagonal harness, sustained only minor injuries. Eyewitnesses assisted him in exiting the aircraft.

The pilot believed that the loss of engine power was probably the result of carburettor icing. Carburettor icing is more likely to occur in the more humid conditions that exist in the vicinity of the cloudbase.

ACCIDENT

Aircraft Type and Registration:	Piper PA-24-250 Comanche, N7348P
No & Type of Engines:	1 Lycoming 0-540 piston engine
Year of Manufacture:	1961
Date & Time (UTC):	30 December 2007 at 0907 hrs
Location:	Retford (Gamston) Airport, Nottinghamshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage limited to propeller, belly skin aft of cabin area, and underbelly antennae
Commander's Licence:	Private Pilot's Licence
Commander's Age:	73 years
Commander's Flying Experience:	1,152 hours (of which 310 were on type) Last 90 days - 14 hours Last 28 days - Less than one hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft landed with the landing gear retracted.

The accident

The pilot departed from Netherthorpe bound for nearby Gamston to collect two colleagues for a flight to Le Touquet. He joined 'downwind right-hand' for Runway 21 at Gamston and completed the downwind checks, including lowering the landing gear. He was then requested to stand off for 5 to 10 minutes to allow a runway inspection to be completed. He therefore left the circuit to the west, raising the landing-gear. On being informed the runway was clear, the pilot re-joined on the right base leg before making a normal approach.

On touchdown it became clear to the pilot that he had not lowered the landing gear. The aircraft was subsequently lifted by crane and the landing gear could then be lowered normally.

The pilot considered that he had not lowered the landing gear.

ACCIDENT

Aircraft Type and Registration:	Piper PA-30 Twin Comanche, N7EY
No & Type of Engines:	2 Lycoming IO-320-B1A piston engines
Year of Manufacture:	1964
Date & Time (UTC):	23 November 2007 at 1345 hrs
Location:	Farley Farm Airstrip, Braishfield, Hampshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Left undercarriage detached, left wing and propeller damaged, engine shock loaded
Commander's Licence:	Private Pilot's Licence
Commander's Age:	50 years
Commander's Flying Experience:	524 hours (of which 65 were on type) Last 90 days - 31 hours Last 28 days - 0.5 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Approximately 40 metres into the takeoff roll, the aircraft veered to the right, departed the grass runway and entered a field, causing the left main landing gear to detach and the left wing and propeller to be damaged.

The pilot believed that the brakes may not have been fully released prior to commencing the takeoff roll.

History of the flight

The aircraft had been positioned at Farley Farm airstrip for a maintenance check and for various modifications to be carried out. This work had been completed and the purpose of the flight was to return the aircraft to its base at White Waltham. The weather conditions at the time were good visibility and a light north-easterly wind. The condition of the grass runway was reportedly damp.

The pilot noted nothing abnormal during his pre-flight checks. He chose Runway 24 for takeoff as the wind was light and Runway 06 had an upslope. He checked the rudder and brakes during taxi and both performed satisfactorily. Whilst performing the pre-takeoff checks, the aircraft moved forward slightly so he reapplied the brakes. Given that there was a slight tailwind for the takeoff, the pilot brought the engines up to full power before releasing the brakes. Everything seemed normal, until about 40 metres into the takeoff roll, when the aircraft suddenly veered to the right, departed the runway and entered a field. It travelled over rough ground, causing the left main landing gear to detach, resulting in damage to the left wing and propeller. The pilot was uninjured and shut down the aircraft prior to exiting in the normal manner.

On examining the tyre tracks in the grass, he concluded that the mainwheels had locked up during the takeoff roll, possibly due to the brakes not having been fully released. In hindsight, he felt that it would have been prudent to check that the brakes were fully off, by allowing the aircraft to roll forward a short distance before commencing the takeoff roll.

INCIDENT

Aircraft Type and Registration:	Piper PA-32-300, N2989M
No & Type of Engines:	1 Lycoming IO-540 SER piston engine
Year of Manufacture:	1977
Date & Time (UTC):	6 October 2007 at 1140 hrs
Location:	Newmarket Racecourse, Cambridgeshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 3
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to both lower wing skins and right wing leading edge, wing spars distorted
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	28 years
Commander's Flying Experience:	1,490 hours (of which 32 were on type) Last 90 days - 70 hours Last 28 days - 50 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and follow-up AAIB investigation

Synopsis

Immediately after touchdown at Newmarket, at the end of a flight from Middleham, the pilot retracted the flaps to prevent 'float' in an attempt to improve the aircraft's braking performance. It passed over an undulation in the grass runway surface and became airborne again. The pilot was unable to arrest the subsequent descent and the aircraft made what was described by the pilot as a 'firm' landing. No specific inspection of the aircraft, other than its normal pre-flight inspection, was carried out at Newmarket and the aircraft returned to Middleham without incident. Two days later, during a routine maintenance inspection, serious structural damage was found affecting both lower wing skins and the right wing leading edge. This damage was considered to have weakened the wing structure sufficiently such that there was a risk of a structural failure during the aircraft's return flight to Middleham.

History of the flight

The aircraft had flown from Middleham to the airstrip at Newmarket Racecourse. After making a normal approach and touchdown the pilot had immediately retracted the flaps in an attempt to ensure positive ground contact and reduce any tendency of the aircraft to 'float'. However, shortly after touching down, the aircraft passed over an undulation in the runway which caused it to become airborne again. The pilot attempted to minimise the sink rate with the application of power but the aircraft made what the pilot described as a 'firm' touchdown. The pilot, based on his experience, did not consider the landing to be excessively firm and did not judge that any additional inspection of the aircraft was required prior to flying the aircraft back to Middleham.

On 8 October, whilst the aircraft was undergoing a 50 hr inspection, buckling was found on the lower wing skins, outboard of the landing gear, and the right wing leading edge. Removal of the wing skins showed that a significant download had been applied to the outer wings which had resulted in compressive buckling and cracking of the lower spar webs outboard of the main landing gear. Both wings were subsequently removed for repair.

Fuel

The PA-32-300 is fitted with four fuel tanks within the wings, two inboard, each holding 25 US gallons, and two outboard tanks, each holding 17 US gallons. The normal procedure for fuel management, detailed in the PA-32 Pilot Operating Handbook (POH), calls for the fuel in the inboard tanks to be consumed prior to using the fuel in the outboard tanks, presumably to provide bending moment relief for the wings. In the event of a hard landing with fuel in the outboard tanks, their mass (in excess of 100 kg when full) would exert a significant downward bending moment to the wings outboard of the main landing gear. The pilot reported that the aircraft had left Middleham carrying approximately 70 US gallons of fuel, evenly distributed. Given a flight time to Newmarket of approximately 1.5 hours, and a fuel burn of approximately 14 US gallons per hour (PA-32 POH data), the fuel in the outer wing tanks would have remained largely unused prior to the landing.

Landing technique

The short field landing technique used by the pilot, of retracting the flaps immediately after touchdown, was intended to reduce the lift from the wings, and allow wheel braking to be started earlier in the landing run. A secondary effect of this technique, however, is that the aerodynamic drag produced by the aircraft is significantly reduced and this results in a decrease in the rate of deceleration prior to the application of the brakes. If, as in this event, the aircraft bounced or became airborne during this phase of the landing, it is probable that there would be insufficient lift available to reduce the aircraft's subsequent rate of descent. Whilst the pilot did not consider the landing to be sufficiently 'firm' to warrant additional inspection of the airframe, the areas of damage, particularly that on the wing leading edge, was sufficiently large to have been easily observed during the pre-flight inspection carried out prior to the return flight to Middleham. The subsequent operation of the aircraft in its damaged condition meant that the wing's ability to carry design flight loads would have been severely compromised.

ACCIDENT

Aircraft Type and Registration:	Pulsar, G-BULM
No & Type of Engines:	1 Rotax 582 piston engine
Year of Manufacture:	1994
Date & Time (UTC):	17 April 2007 at 1543 hrs
Location:	Dairy House Farm Airstrip, Aston Juxta Mondrum, near Nantwich, Cheshire
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:	National Private Pilot's Licence
Commander's Age:	56 years
Commander's Flying Experience:	1,266 hours (of which 194 were on type) Last 90 days - 29 hours Last 28 days - 21 hours
Information Source:	AAIB Field Investigation

Synopsis

The pilot attempted to return the aircraft to the runway after it suffered a loss of power shortly after takeoff. The aircraft had insufficient performance to complete this manoeuvre and stalled before the pilot was able to make a controlled landing. The investigation did not determine the cause of the loss of power.

History of the flight

The pilot departed Lymm Dam, the airfield at which he kept the aircraft, for the short flight to Dairy House Farm airstrip (Figure 1) at Aston Juxta Mondrum, near Nantwich. A witness who flew regularly from the airstrip saw the aircraft circling overhead and drove the short distance from his home to welcome the visiting pilot. When he arrived, the aircraft had landed and was parked at the northwest end of the airstrip. He greeted the pilot, whom he remembered having met briefly at another airfield. During a conversation about flying and aircraft maintenance the pilot mentioned that previously he had had "problems with the electrics in his plane", but did not say if these problems persisted.

Before departure the pilot discussed his intended takeoff technique with the witness, who advised that if the aircraft had not become airborne before passing the intersection of the two runways the pilot should abort the takeoff. The pilot appeared to be "in good spirits". After a stay of approximately half an hour he boarded

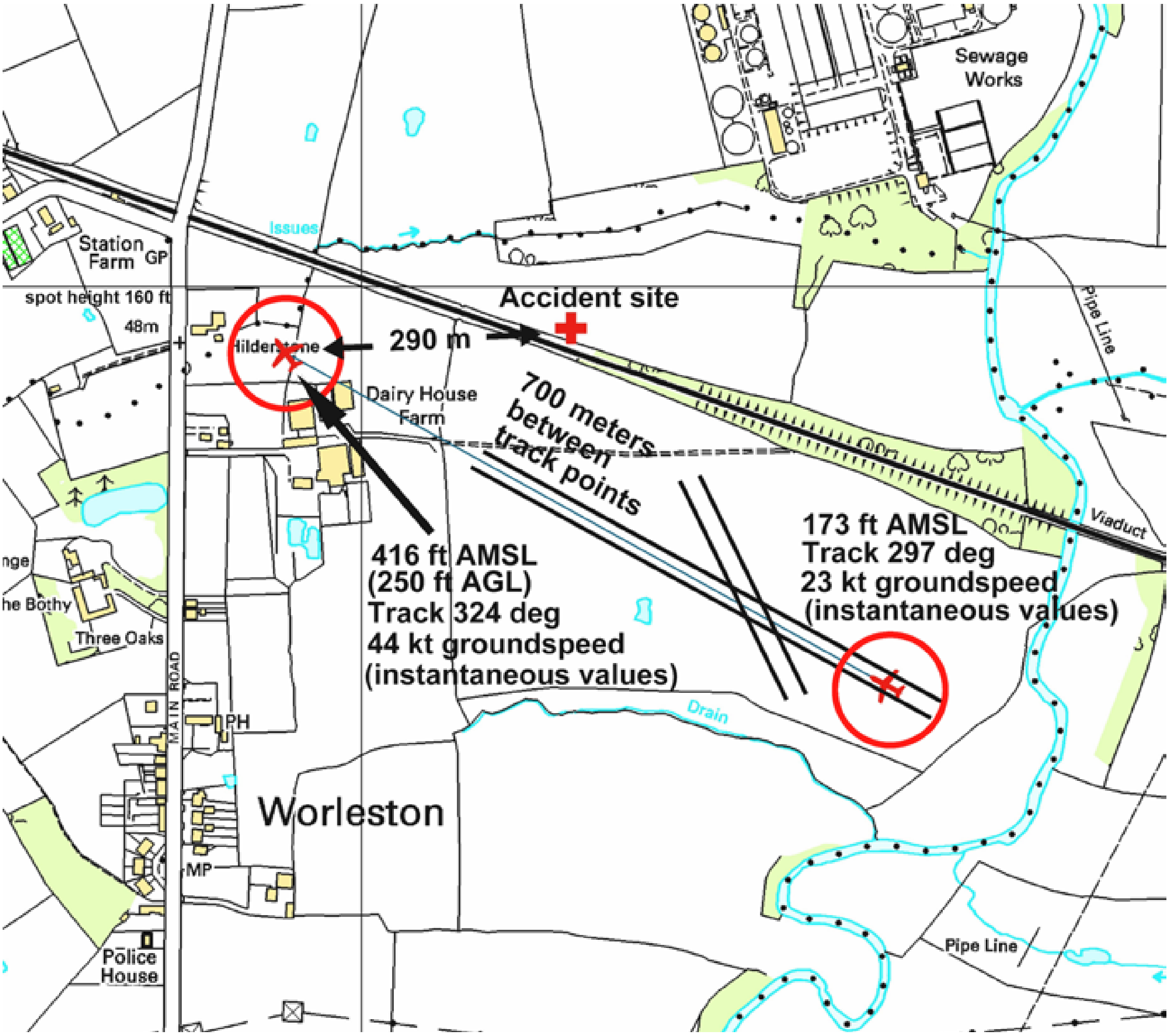

Figure 1

Accident at Dairy House Farm Airstrip

his aircraft and taxied to the south eastern end of the airstrip, in preparation for takeoff. He paused at the end of the main runway for approximately 2 minutes before lining up. The witness was unable to tell whether the pilot conducted engine power checks. The aircraft then lined up, commenced its takeoff and was airborne before the runway intersection.

Shortly before the takeoff the original witness, who stood beside the northwest end of the runway, was joined by three others who had been working at the farm. In their statements, each witness stated that the initial climb over the runway appeared normal but that, at a height of approximately 100 to 150 ft, the engine "coughed". The engine sound returned to normal briefly but, as the aircraft passed over the end of the runway, the engine coughed again. The aircraft then made what one witness described as a coordinated turn to the right until it was flying almost parallel to the runway in the opposite direction to takeoff, losing height as it did so. All of the witnesses reported that the propeller had stopped turning. At a height of approximately 60 ft the aircraft entered a tight turn to the right and impacted the ground in a field north of the airstrip, separated from it by a double railway line.

In order to access the crash site it was necessary for the witnesses to use a locked railway crossing. One witness, a worker at the farm who was familiar with crossing procedures, stayed at the gate to control access to the crossing. The other witnesses attempted to assist the pilot but determined that he had been fatally injured.

Aircraft description

The Pulsar is a two-seat, low-wing amateur-built aircraft with a fixed tricycle undercarriage, sliding canopy and side-by-side seating. The aircraft is equipped with conventional manual flying controls with the flaps, aileron and elevator operated by control rods and the rudder by control cables. G-BULM was powered by a Rotax 582 UL liquid-cooled, twin-cylinder two-stroke engine driving a two-blade fixed-pitch propeller through a reduction gearbox. A composite fuel tank, with a capacity of 16 Gal US, was mounted in the fuselage between the pilot and the stainless steel engine bulkhead. The manufacturer recommends that 2% of oil is mixed with the fuel to give a fuel/oil ratio of 50:1. G-BULM was not equipped with a stall warning system.

This engine is equipped with two BING carburettors and a diaphragm fuel pump which is operated by pressure pulses in the crankcase. The engine is also fitted with a 12v capacitor-discharge dual ignition system consisting of two magneto switches, flywheel magneto generator, two Electronic Units (EU) - containing the ignition coils and control circuits - and two external triggers. The flywheel incorporates 12 permanent magnets and the stator is equipped with 12 coils. Eight of the coils are connected in series and provide power to the aircraft electrical system, the remaining four coils are used for the dual ignition with two coils connected 'in series' to each ignition system.

Crash site examination

The aircraft crashed on a heading of 260°M in a small level field adjacent to the railway line. Both wings and the forward section of the fuselage were destroyed and the wreckage trail extended for 20 m from the initial impact point on a heading of 155°M. Damage to the aircraft, and ground marks, indicated that the right wing struck the ground first, when the aircraft was in a near vertical pitch attitude. The right wing spar failed close to the fuselage and the aircraft continued moving laterally before the propeller struck the ground and the engine broke away from the fuselage. The aircraft then 'cart-wheeled' and the tail section came to rest upside down on the broken left wing.

Both carburettors, which had come out of their rubber sockets, were still connected to the throttle cables and fuel feed pipe. The fuel bowl on one carburettor was half full and the fuel bowl on the second carburettor was empty. The gascolator was damaged and contained no fuel or evidence of debris. The fuel tank had disintegrated and there was a strong smell of fuel in the ground. The fuel cock was in the ON position. The propeller hub had bent backwards, allowing one of the blades to come out of the hub. The other blade had broken off close to the blade root. There was no damage to the leading edge of either propeller blade.

The control rod between the control column and the elevator was still connected and operated satisfactorily. The rudder pedals, which had broken away from the structure, were still connected to the control cables.

The flap and the aileron control rods and torque tubes all exhibited post-impact damage.

The aircraft master switch was found in the ON position, the Magneto 1 switch had bent to the left and was in the OFF position and the Magneto 2 switch was in the ON position. The pilot was sitting in the left hand seat secured by a four-point harness.

In the tail cone, and scattered around the cockpit, were a flight bag and a number of auxiliary items such as tools, oil, air compressor, battery, cleaning equipment and a stirrup pump.

Aircraft history

The last Certificate of Validity for the Permit to Fly, which was valid until 19/5/07, was issued by the Popular Flying Association (PFA) on 20/5/06. The last flight test was undertaken on 27/4/06, by the owner of the aircraft who recorded the stall buffet speed as 35 kt and the minimum airspeed achieved as 30kt. The owner also made a comment that the left wing dropped at the stall. A flight test undertaken a year previously by another pilot also recorded the same buffet and minimum airspeeds, though he made no comment on the wing dropping in the stall.

Friends of the pilot revealed that he had been experiencing engine problems, possibly involving the stator coil in the engine. Some believed that it involved the electrical charging circuit and others that he had been experiencing a large magneto drop. There were also reports that he had an intermittent ignition problem that would "appear during the pre-takeoff power checks". However, two other pilots who accompanied the owner, flying their own aircraft, on a 'fly out' two days prior to the accident, stated that whilst they were aware that he had been experiencing engine problems, he made no mention of any technical problems with his aircraft during the day of their outing.

A maintenance engineer, who had previously worked on the engine and gearbox from the aircraft, informed the AAIB that in the weeks before the accident the owner had visited him at his workshop and asked him to check the stator coil as he was experiencing problems with the electrical charging system. The engineer checked the charging coil resistance and found it to be satisfactory. It was also reported that the owner had obtained three stator coils over the previous four months.

The AAIB could find no evidence in the engine and aircraft log books, and other documents owned by the pilot, that he had been experiencing engine difficulties prior to the accident flight. The log book made no mention of the engine having been removed in the weeks prior to the flight, nor was there evidence that a duplicate inspection, required following the installation of an engine, had been carried out. The most recent work was the fitting of new upholstery and the painting of the instrument panel and interior of the aircraft 27 hours prior to the accident flight. The last documented work on the electrical system was carried out 46 hours prior to the accident flight when the stator coil, rectifier and battery were replaced and the earth cable cleaned.

Apart from a pencilled comment in the aircraft log book, there was no evidence of any formal documentation for the modification to fit the baggage compartment. The PFA were also unaware that this modification had been installed on the aircraft.

Detailed examination of the wreckage

Engine

The engine, complete with the controls and electrical leads still attached to the back of the instrument panel, was taken to a maintenance organisation where it was stripped and tested under AAIB supervision.

There was clean oil in the reduction gearbox and the magnetic plug was clean. It was established that the correct spark plugs had been fitted and, whilst they were slightly worn, the colour of the electrodes was considered to be typical of an engine that had been operating normally. Marks were found on one side of the electric start housing casing which had been caused by contact with the starter motor ring. These marks most probably occurred during the crash and indicate that the engine was not rotating. There was no evidence of a mechanical failure, seizure or of the engine having overheated.

The external trigger on the exhaust side of the engine and its associated EU at the front of the engine had been damaged in the crash. Both magneto switches and the continuity of the wiring between the magneto switches and the engine were tested and found to be satisfactory. The EUs, undamaged trigger and the spark plugs were also tested and found to be satisfactory.

There was no obvious damage to the stator, though it was noted that a repair had been carried out to one of the connections to the charging coil. A resistance check of the stator coil revealed that the resistance of both coils was approximately 27 Ω higher than the published limits.

The carburettor rubber sockets showed evidence of starting to perish, however given the colour of the deposits on the cylinder head and spark plug, it is assessed that the damage was not sufficient to affect the operation of the engine. The jets on both carburettors were clear. It was noted that the bottom of both float needle valves had worn dimples into the valve operating arms approximately 0.2 and 0.1 mm deep. The diaphragm on the fuel pump was found to be intact.

Controls

The damage to all the flying controls was consistent with the aircraft crashing. There was no evidence of a control restriction having occurred prior to the accident.

Baggage compartment

Aero Design, the designers of the Pulsar type, had produced a drawing for a baggage compartment for the Pulsar which is fitted behind the seats and above the flying controls. The compartment fitted to G-BULM did not conform to the Aero Design modification. The compartment sat 2 inches higher and extended 4.5 inches further down the tail cone than the specifications in the drawings. The drawings also stated that the maximum load in the baggage compartment was 20 lbs. Following the accident, equipment found in the tail cone and cockpit was weighed and it was calculated that between 48 to 58 lbs of equipment had been stowed in the baggage compartment.

The AAIB calculated that the effect of the deviation from the approved modification was that the moment arm for the equipment stored in the baggage compartment would have been 2.25 inches aft of the figure of 64 inches quoted in the aircraft operating manual. By using an incorrect moment arm the pilot would not be able to calculate an accurate CG position. There was also a risk, in exceeding the baggage compartment weight limit, that the compartment could collapse and interfere with the controls.

Fuel

With the fuel tank destroyed in the crash, it was not possible to establish either the quantity or quality of the fuel in the aircraft.

Three jerry cans, which are believed to have belonged to the owner, were found outside his hangar. The fuel in the cans, one full and two with residual amounts of fuel, were tested by QinetiQ and found to be of an acceptable standard with an oil/fuel ratio of between 2.2 and 2.6%.

Aircraft weight and balance information

It was assessed that the refurbishment of the cabin would have had a negligible effect on the aircraft weight and moment. The weight and balance of the aircraft, on the day of the accident, was calculated by the AAIB and found to be within acceptable limits.

Flight characteristics

According to several published flight tests and the statements of other pilots familiar with the type, the Pulsar is considered to have pleasant handling characteristics even at low airspeed. Though the type usually exhibits a left wing drop at the stall in the absence of additional pilot control inputs, one flight test noted a right wing drop. The behaviour of individual examples will differ.

Literature produced by the design organisation stated that the glide ratio was 12 to 1. If a loss of power occurred at 230 ft above ground level the aircraft could glide a maximum of 840 m with its wings level in still air conditions. The best angle of glide speed was approximately 55 mph (48 kt). A headwind of 7 kt would reduce the maximum straight line gliding distance by approximately 15%, to 717 m. The landing ground roll was estimated by this organisation to be approximately 800 ft (243 m), but the conditions in which this could be achieved were not stated.

Personnel information

The pilot's logbooks indicated that he started to learn to fly flex-wing microlight aeroplanes in 1991 and gained a Private Pilot's Licence, issued by the United Kingdom CAA, on 19 June 1992. His logbook shows that he first flew a fixed wing aeroplane, a Rans S6, on 24 January 2000. He flew only this aircraft type until 25 March 2005, when he first flew the accident aircraft.

Between March and June 2005 he conducted several flights under instruction in G-BULM and in a Cessna 150 for the issue of a National Private Pilot's Licence (NPPL), valid for single engine piston land planes. His NPPL was issued on 27 September 2005. From that date until the accident he only flew G-BULM. His licence was valid at the time of the accident.

Meteorological information

No official meteorological information was available for the accident location. The farm workers who witnessed the accident reported that the windsock indicated a wind blowing along the runway against the direction of takeoff. The witness who flew regularly from the airstrip estimated a surface wind speed of 5-8 mph (4-7 kt) and considered conditions to be, "mild, sunny" and "ideal" for flying.

Aerodrome information

The airstrip at Dairy House Farm had two intersecting grass runways. The runway used by G-BULM was the longer of the two, aligned west-north-west with a total length of 564 m and a slight upslope. The shorter runway crossed this runway approximately 190 m from the start of the available takeoff run. When inspected the day after the accident the runway surface appeared to have been mown recently, to be well drained and free of debris.

A row of low farm buildings crossed the takeoff flight path approximately 640 m from the start of the takeoff run. Beyond this there were several tall trees and further domestic and farm buildings. The nearest substantial area of open ground within an arc of 90º each side of the extended runway centreline was a rectangular field beyond the railway lines, 260 m northwest of the upwind end of the runway. Its maximum length was approximately 280 m. To the west of this field was another area of open ground, 245 m beyond the end of the runway, with a maximum length of approximately 260 m. The field containing the wreckage had a maximum length of approximately 390 m in a direction broadly parallel to the departure runway.

Recorded information

Introduction

The aircraft was not equipped with a flight data recorder (FDR) or cockpit voice recorder (CVR) and neither was required by legislation. However, a Global Positioning System (GPS)[1] was recovered from the aircraft. The GPS was successfully downloaded at the AAIB and a track log was found to have been recorded during the accident flight. A track log consists of a sequence of data points. For this model of GPS, each data point contained the time, aircraft position, its instantaneous groundspeed, track and altitude (amsl). The recording frequency of the data points could be manually adjusted from between 1 to 99 seconds. The unit was found in the default setting, which recorded a data point every 30 seconds.

GPS Data

The accident track log consisted of two data points, with the first data point recorded at 1541:18 hrs and the second at 1541:48 hrs. Figure 1 provides a plot of the two data points and the position of the accident site. The first data point was recorded when the aircraft was travelling at a ground speed of 23 kt on a track of 297º. Altitude was 173 ft amsl. From the low ground speed and terrain elevation, it can be assumed that the aircraft was on the ground when the first data point was recorded. The second data point was recorded after takeoff, at a height of approximately 250 ft agl. The aircraft's groundspeed was 44 kt and its track was 324º. The second data point position was about 290 meters from the accident site.

Video evidence of previous accident

The investigation of the accident to G-PULS[2], another Pulsar, used video evidence which showed the aircraft stalling from a height of approximately 200 ft. The impact sequence and distribution of the wreckage were similar to those identified in the case of G-BULM.

Medical and pathological information

The pilot held a valid NPPL declaration of medical fitness to fly countersigned by his general practitioner on 16 January 2003. His next medical assessment was due on 16 January 2008. Post-mortem examination confirmed that he died of multiple injuries sustained on impact. The pilot had no medical history of relevance to the accident. The accident was essentially non-survivable and it is unlikely that any additional or alternative restraint would have saved the pilot's life.

Techniques for handling a loss of power after takeoff

Evidence from previous accidents and theoretical analysis both suggest that an attempt to return to the departure runway in the event of a loss of power in a single-engine aircraft is unlikely to be successful if the failure occurs shortly after takeoff.

Transport Canada civil aviation document TP 13748E, *'An Evaluation of Stall/Spin Accidents in Canada 1999'*, which considered the altitude required before an 'engine-out turn' was initiated, states in part:

Footnote

[1] Honeywell Bendix / King Skymap II.

Footnote

[2] AAIB Bulletin 9/95, reference EW/C95/7/3.

'If an engine failure after takeoff results in an accident, the pilot is at least eight times more likely to be killed or seriously injured turning back than landing straight ahead.'

Safety Sense Leaflet 1a – *'Good Airmanship'*, published by the CAA, includes the following advice.

'In the event of engine failure after take-off, if the runway remaining is long enough, re-land and if not, never attempt to turn back. Use areas ahead of you and go for the best site. It is a question of knowing your aircraft, your level of experience and practice and working out beforehand your best option at the aerodrome in use. (One day, at a safe height, and well away from the circuit, try a 180° turn at idle rpm and see how much height you lose!).'

The 1994 paper *'The Possible "Impossible" Turn'*[3] used a simplified analytical model to examine the ideal flight path of a single-engine aircraft turning back after a loss of power during the takeoff phase of flight. It indicated that the optimum procedure involved a turn through approximately 190-220º using a 45º bank angle, flown at 5% above the stall speed.

The General Aviation Safety Information Leaflet (GASIL) 1 of 2006 stated:

'It is possible that in certain circumstances turning back to the aerodrome might be the option which minimises the risk of injury to the aircraft occupants, provided the pilot maintains a safe airspeed and sufficient height exists taking into account the extra drag from a windmilling propeller. However, in general, landing ahead is nearly always going to be the safest option in the event of an engine failure.'

Several AAIB Bulletins have explored this issue and can be viewed at www.aaib.gov.uk. The report of the investigation into the accident to G-BOIU[4] also considered the influence of a partial loss of power on a pilot's decision to return to the airfield:

'Although the principle of not turning back is well established in training, it is possible that some pilots are not sufficiently aware that a loss of power/performance can be insidious in nature and not always as easy to detect as the type of engine failure after takeoff generally practised at training organisations.'

Analysis

Engineering aspects

The ground marks and damage to the aircraft indicated that the aircraft crashed in a near vertical pitch attitude whilst moving laterally to the left and turning around the longitudinal axis in a clockwise (to the right) direction. This attitude is consistent with the aircraft entering a spin to the right with left rudder applied. Damage to the engine and the propeller support the witness' observation that the engine stopped in flight. There was no evidence of a problem with the control system which would have caused the pilot to lose control of the aircraft.

Whilst the pilot had previously been experiencing problems with the electrical charging system, this would not have caused the engine to stop as the

Footnote

[3] David F Rogers, United States Navy Academy, originally published in the AIAA Journal of Aircraft, Vol. 32 pp. 392-397, 1995.

Footnote

[4] AAIB Bulletin 12/2005, reference EW/C2004/08/05.

twin ignition system is independent of the charging system. Examination of the stator coil revealed that the resistance of the ignition coils was slightly high; however the engine manufacturer informed the AAIB that these values would have no impact on the engine performance. Given the extent of the disruption to the instrument panel, the Magneto 1 switch could have moved to the OFF position during the impact. It is also possible that there could have been an electrical short in the ignition system or a temperature-related fault in the EU. However, failure of one of the independent ignition systems would not cause the engine to stop and it is highly unlikely that both ignition systems would fail at the same time.

Witnesses described the engine spluttering before it stopped. There was no obvious pre-crash damage to the induction or exhaust system, the throttle cables were still connected, the fuel cock was found switched ON and the fuel/oil ratio in the fuel cans was correct. There was no debris in the fuel cock, gascolator or carburettors; however, with the fuel tank having been destroyed, the possibility that fuel contamination or a blockage in the fuel tank had caused the engine to stop could not be eliminated. The possibility that the aircraft ran out of fuel could also not be eliminated, though the strong smell of fuel at the crash site suggests that this is unlikely. Consideration was given to the impact of the wear on the float needle valve operating arms allowing the fuel level in the carburettor fuel bowls to be slightly higher than normal; this would reduce the head of pressure required to draw fuel into the venturi thereby making the fuel/air mixture richer. The engine manufacturer's judgement was that the amount of wear would make little difference to the mixture ratio. This assessment was supported by the colour of the pistons, cylinder head and spark plugs which all indicated that the mixture was correct. Nevertheless the manufacturer did state that the dimples in the operating arms was unusual and was an indication of engine vibration emanating from the engine mounting installation.

There is no evidence that the baggage compartment modification, or any of the equipment stowed in the compartment, played any part in the accident.

In summary, the engine appeared to have been correctly installed in the aircraft, which appeared to have been in an airworthy condition at the time of the accident. Whilst there is evidence that the engine was not rotating under power when the aircraft crashed, the investigation could not determine the reason why the engine stopped in flight.

Operational aspects

The turn observed by the witnesses and the alignment of the wreckage trail indicated that the pilot attempted to return to the airstrip following the first indication of a loss of power. The pilot might have been encouraged to do so if he perceived the failure to be partial. Insufficient height remained to complete this manoeuvre, however, and the distribution of wreckage, and the impact sequence this suggests, indicate that the aircraft probably stalled before impact. This stall is consistent with the pilot attempting to stretch the glide.

The maximum length (390 m) of the field in which the aircraft crashed was greater than the landing ground roll (243 m) estimated by the design organisation but the approach would have been substantially downwind and, at the point the aircraft commenced its turn away from the takeoff direction, it could not have made use of the full length of this field. Though shorter, the two fields north-north-west of the airstrip would have presented a longer useable landing run and some headwind during the approach. The shorter turn required to line up for either of these fields would also have used less of the height available after the pilot identified the failure.

A loss of power shortly after takeoff requires the pilot of a single-engine aircraft to decide very quickly where to land. Despite comprehensive advice to the contrary, the inclination to attempt a return to the departure airfield may be hard to resist, especially if the failure is partial and gives the impression of producing sufficient power to sustain flight. Whereas, theoretically, a return may be possible after the aircraft has climbed to several hundred feet, most single-engine aircraft are unlikely to complete this manoeuvre successfully unless the failure occurs considerably higher.

Safety Sense Leaflet 1a suggests that '*at a safe height, and well away from the circuit'* pilots might '*try a 180º turn at idle rpm and see how much height'* is lost. This exercise would provide a gross estimate of the height lost during a turn to parallel the departure runway. In the absence of a crosswind the aircraft would need to turn through more than 180º to become realigned with the departure runway, however. Also, having sufficient height to complete the turn would not guarantee that the aircraft could land on the runway. If, for example, the takeoff was conducted in a strong headwind the aircraft might overshoot.

All of the available evidence suggests that, following a loss of power in a single-engine aircraft, it is safest to land in open ground ahead. In the case of G-BULM there were two areas of open ground ahead of the aircraft which might have been suitable for a forced landing. There is a risk of damage when landing on other than a prepared runway, but such damage is likely to be less severe if the pilot can accomplish a touchdown while still in control of the aircraft. In this case the aircraft appeared to depart from controlled flight approximately 60 feet above ground. The ensuing high rate of descent combined with a turn and touchdown on the wingtip resulted in impact forces which neither the aircraft nor the pilot could withstand.

ACCIDENT

Aircraft Type and Registration:	Rans S6-116 Coyote II, G-BVOI
No & Type of Engines:	1 Rotax 582 piston engine
Year of Manufacture:	1995
Date & Time (UTC):	29 September 2007 at 1800 hrs
Location:	Adlingfield, near Goole, Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Left landing gear leg separated and propeller damaged
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	46 years
Commander's Flying Experience:	98 hours (of which 82 were on type) Last 90 days - 6 hours Last 28 days - 0 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

At approximately 50 feet, after takeoff, a gust of wind lifted the left wing and turned the aircraft to the right. The corrective action taken resulted in a further loss of airspeed. There was insufficient height to recover this airspeed and the left leg separated as it struck the top of a drainage ditch. A successful touchdown was made on one wheel and the aircraft slewed around to the left before coming to rest.

History of the flight

The aircraft had just been inspected for its Permit to Fly and the accident occurred on its test flight. The pilot, who was also the owner, felt he had insufficient experience to conduct the flight on his own, so he enlisted the help of an experienced pilot to assist him and act as observer.

Walkaround checks were carried out prior to the aircraft being taxied the full length of the runway to assess the wind speed and direction. The wind speed was light and in a northerly direction. The pilot elected to take off to the east, and the observing pilot enquired as to the last point along the runway the takeoff could be aborted, to which the pilot's reply was "half way".

The pilot reported that, on takeoff, the aircraft became airborne approximately halfway along the runway. At about 50 ft a gust of wind from the north lifted the left wing and the aircraft turned to the right. The pilot took corrective action to lower the left wing, but in doing this the airspeed dropped and the aircraft stalled. The pilot immediately lowered the nose to regain airspeed but there was insufficient height remaining to recover. The aircraft had passed the end of the runway and struck a drainage ditch at the far end of the next field, separating the left landing gear leg. The aircraft then made a successful touchdown in the next field on one landing leg, before the left wing grounded and slewed the aircraft to the left. The aircraft came to rest and, after turning off the master switch, the occupants vacated the aircraft normally via the doors.

The pilot recalls being eager to become airborne, possibly due to the experience of the observing pilot. He commented that the airspeed was only just above the stalling speed during takeoff, and the angle of attack was too high.

ACCIDENT

Aircraft Type and Registration:	Reims Cessna F152, G-BIUM
No & Type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1980
Date & Time (UTC):	16 November 2007 at 1435 hrs
Location:	Netherthorpe, South Yorks
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to nose landing gear and engine bulkhead
Commander's Licence:	Student Pilot
Commander's Age:	54 years
Commander's Flying Experience:	73 hours (of which 73 were on type) Last 90 days - 6 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

After completing an approach to Runway 24, the aircraft 'ballooned' during the flare and the pilot, a solo student, initiated a go-around. After applying full power, he inadvertently fully retracted the flaps instead of the intended reduction of 10°. The aircraft descended rapidly, landing on its nosewheel, damaging the nose landing gear leg and the engine bulkhead.

History of the flight

The pilot, a student completing a solo training exercise, had completed an approach to land on Runway 24, with 30° of flap set. During the flare the aircraft 'ballooned' and the pilot initiated a go-around. After applying full power the pilot had intended to retract the flaps by 10° but inadvertently moved the flap selector to 0°. The aircraft descended rapidly and landed on its nosewheel. The aircraft was brought to a halt on the runway and the pilot was uninjured. Later examination showed that the nose landing gear had been damaged, together with the bulkhead to which it attached.

The CFI of the training organisation confirmed that the student would receive additional training in the correct techniques to avoid 'ballooning' in the flare, and in how to conduct a low level go-around.

ACCIDENT

Aircraft Type and Registration:	Reims Cessna F152 Aerobat, G-BFZT
No & Type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1979
Date & Time (UTC):	2 November 2007 at 1445 hrs
Location:	Near Weston, Shropshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Nosewheel broken off. Damage to fuselage, wings and propeller
Commander's Licence:	Student Pilot
Commander's Age:	59 years
Commander's Flying Experience:	102 hours (of which 97 were on type) Last 90 days - 37 hours Last 28 days - 18 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The student pilot was on a solo navigation exercise during which he encountered carburettor icing. The engine ran increasingly roughly on the application of the carburettor heat and the pilot returned it to the cold setting before carrying out a forced landing. After touchdown the nose leg broke off and the aircraft overturned.

History of the flight

The student was conducting a solo navigation exercise and, having had difficulty finding his first turning point, decided to abandon the exercise and return to Shobdon Airfield. He had flown the planned route with his instructor the previous day, during which they encountered carburettor icing. The student stated that on his solo flight the aircraft again suffered from carburettor icing requiring frequent applications of carburettor heat. During the return leg to Shobdon the engine ran more roughly and the use of carburettor heat seemed less effective. The pilot returned the carburettor heat to the cold setting and decided to make a precautionary landing in a field.

He commenced an approach to his chosen field but went around when he realised there were sheep in it. An approach was made to a different field and he shut down the engine and switched off the fuel, master switch and magnetos when he was committed to land.

Touchdown appeared normal but the aircraft slowed rapidly before the nose leg dug into the ground and the aircraft pitched forward onto its back. Ground marks suggest the main wheels touched down first and that the nose gear collapsed after touch down as a result of digging in to the soft ground or hitting a hole.

The pilot, who was wearing a four-point harness, received only minor injuries and was able to release himself from the harness and climb out of the aircraft through the passenger window. He had not made any distress calls over the radio but a passing motorist contacted the emergency services.

Comment

The forecast weather for the route predicted a temperature of +12ºC and a dew point of +11ºC. This gives the potential for serious carburettor icing, irrespective of the power setting used (see Figure 1). The instructor had considered this when deciding whether the weather was suitable for the exercise. He decided the weather was suitable because the student had been trained to deal with carburettor icing and had dealt with it correctly the previous day. The instructor has now revised his briefing to students on the use of carburettor heat to include the fact that should the engine initially run more roughly, carburettor heat should still be maintained until the ice has cleared and the engine returns to normal.

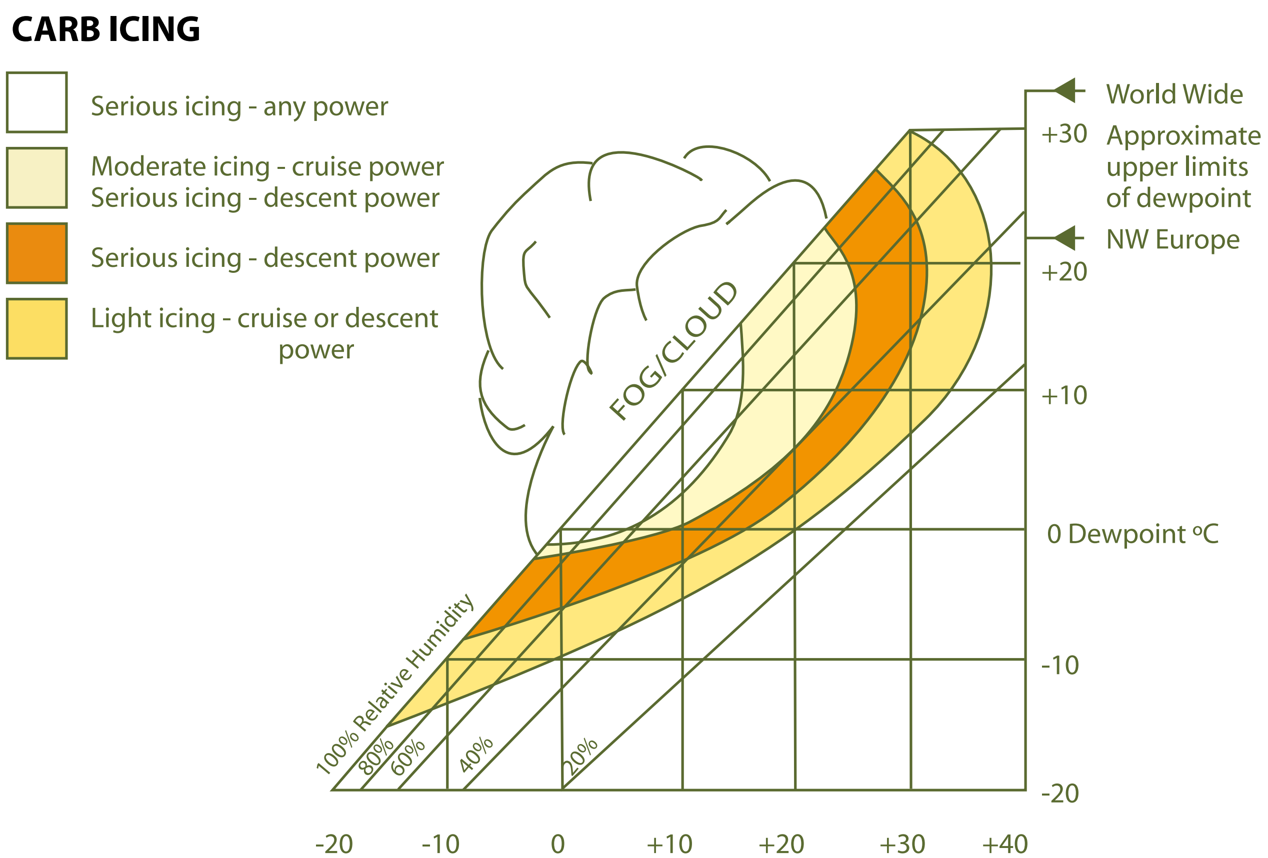

Figure 1

Chart taken from: CAA Safety Sense Leaflet No 14b

ACCIDENT

Aircraft Type and Registration:	Socata TB10 Tobago, G-TEDS
No & Type of Engines:	1 Lycoming O-360-A1AD piston engine
Year of Manufacture:	1979
Date & Time (UTC):	23 October 2007 at 1310 hrs
Location:	Bruntingthorpe Airfield, Leicestershire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Minor) Passengers - None
Nature of Damage:	Damage to nosewheel leg, propeller, engine mount, cabin roof, wingtips, tailplane and rear fuselage
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	73 years
Commander's Flying Experience:	573 hours (of which 165 were on type) Last 90 days - 11 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft landed 'slightly long' on damp grass and then turned off the runway near the end into soft ground, or a hidden hole, causing the aircraft to invert.

History of the flight

The Socata TB10 is a four-seat aircraft with a low wing and tricycle landing gear. The pilot was returning to Bruntingthorpe airfield after a local flight. Bruntingthorpe is an unlicensed airfield with a 3,000 m paved runway and a 800 m grass runway alongside it. The pilot was on an approach to the grass Runway 24. The wind was light and variable, and the visibility was greater than 5 km with no cloud below 3,000 feet. The surface condition of the runway at the time was firm but damp.

The aircraft approached the runway at about 75 KIAS with full flap. The pilot reported that he touched down at about 70 KIAS, approximately 200 m beyond the runway threshold. The aircraft did not decelerate at the expected normal rate so he applied the brakes and initiated a left turn onto the grass turning area to the left side of the runway. The aircraft slowed down but the nosewheel dug into soft ground or a hidden hole in the grass, causing the aircraft to flip upside down. The pilot and his passenger were able to exit the inverted aircraft via the main door.

Pilot's assessment of the cause

The pilot believed that the damp grass may have reduced its friction and increased the aircraft's ground roll. He was also not familiar with the grass area on to which he then turned, as he normally turned off the runway 50 m before the end.

ACCIDENT

Aircraft Type and Registration:	Tipsy Nipper T.66 Series 3 Nipper, G-ONCS
No & Type of Engines:	1 Volkswagen 1834 piston engine
Year of Manufacture:	1972
Date & Time (UTC):	13 August 2007 at 1745 hrs
Location:	Between West Mersea and Tollesbury, Essex
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to nose, tail, landing gear and left wing
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	47 years
Commander's Flying Experience:	3,404 hours (of which 35 were on type) Last 90 days - 205 hours Last 28 days - 61 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot, and follow-up inquiries to pilot, LAA and others

Synopsis

After intentionally entering a spin, the aircraft adopted a flat attitude, from which the pilot found it difficult to recover. After some 26 turns, he effected a recovery and made an emergency landing on to marshy ground; the aircraft came to rest inverted. Data gathered by a webcam and a laptop computer, fitted to the aircraft by the pilot in order to 'self critique' his aerobatic routines, allowed an analysis of the spin to be made.

History of the flight

The purpose of the flight was to carry out a practice aerobatic sequence, beginning with an intentional spin. After carrying out a clearing turn and completing the 'HASSELL' checks at a height of approximately 3,500 ft, the pilot initiated a spin to the right by closing the throttle and allowing the aircraft to decelerate to approximately 30 kt indicated airspeed. Then, at the onset of the stall, he applied and held full aft stick, combined with full left aileron and full right rudder. Immediately on entering the spin he noted, with some surprise, that the aircraft had not adopted its usual 60º to70º nose-down attitude and, by the time it had completed the first rotation, he realised that the spin 'had gone flat'.

The pilot had not encountered a flat spin before so responded initially by applying the normal spin recovery actions, ie, neutral ailerons, left rudder and then full forward stick. This had no effect. He reported that after about three to four turns, he removed and re-applied these inputs, again with no effect. After a further couple of turns, he applied a series of short bursts of engine power, but this too had no discernible effect, so he closed the throttle and centred the controls before reverting to normal recovery actions. After about 10 turns in total, the engine stopped and, because normal recovery actions appeared to be having no effect, he decided to try 'full in-turn controls', comprising full forward stick, full right rudder, and full right aileron. He estimated that after a further six turns or so in this condition, the mode of the spin reverted to its usual steep nose-down mode, from which he was able to recover normally into a steep dive.

On pulling out from the dive at an estimated height of 500 ft to 700 ft, he found himself disorientated and unable to focus properly. However, after an estimated three seconds, he was able to re-orient himself and start looking for a suitable emergency landing site. The engine was not fitted with an electric starter and had not re-started during the post-recovery dive. As the local area comprised sea and marshland, he turned into wind with the intention of making a forced landing, by stalling into the marshy ground with as little forward speed as possible. During the stall, whilst in a nose-high attitude, the main gear contacted a wire fence that he had not seen previously, and the aircraft flipped over and came to rest inverted in a marshy hollow.

The pilot was uninjured but could not open the canopy because it was resting on the ground. After assessing that there was no immediate danger of fire, he transmitted a 'MAYDAY' on 121.50 MHz, but received no response. As he was unsure as to the integrity of the radio or its antenna, he switched frequency to Essex Radar in the hope that aircraft in the near vicinity working that frequency might receive his calls. After a while, a Ryanair flight acknowledged his 'MAYDAY' and passed on his details. He then reverted to listening-out on 121.50 MHz and, because he was unsure of his exact position, broadcasting at about three minute intervals to assist with direction finding. A short while later, a BA flight also acknowledged his 'MAYDAY' at about the same time as a Police Air Support unit helicopter arrived. With two of its crewmembers lifting the tail of the aircraft, he was able to extricate himself and emerged completely unhurt.

The pilot commented that he had begun all of his previous spins with more of a 'flick', as this provided a much more positive and predictable entry. On this occasion, he allowed the aircraft to stall wings level and used a rapid rudder input. However, G-ONCS was reluctant to spin with ailerons neutral and, for this reason, he habitually used left aileron to encourage a positive entry; on this occasion, however, he believes that he had probably held the ailerons for longer than normal. On all his previous spins in G-ONCS, the aircraft had always recovered within ½ to ¾ of a turn of normal spin recovery actions, ie stick neutral with full opposite rudder, followed by stick forward.

At the time of the accident, the aircraft was fitted with a 'webcam' light-weight video camera connected to a laptop computer, installed in the luggage area behind the pilot's seat. This was to allow the pilot to review and critique his aerobatic manoeuvres on completion of the sortie. He has stated he was confident that the aircraft's weight and Centre of Gravity (CG) position had both been within the specified limits of 685 lbf (the aerobatic weight limit) and 14.4" to 16.5" aft of the wing leading edge datum, respectively. As the aircraft had not suffered any major damage in the accident that could have altered its weight distribution, the pilot reported that after recovery, the aircraft's CG was physically checked with the same quantity of the fuel on board and with the camera and laptop installed. He found the CG position to be, by calculation and demonstration, 15.82" aft of the datum.

At the request of the AAIB, the pilot provided an extract from the video recording covering the relevant period from the initial clearing turn prior to initiating the spin, up to the time of his first 'MAYDAY' call.

Recorded data analysis

The characteristics of the spin

It is clear from the pilot's account that G-ONCS entered a much flatter mode of spin than he had experienced previously, which he was not expecting. It is also clear that when this particular mode of spin did not respond immediately to his usual recovery actions, he felt compelled to try a range of alternatives in the hope of finding some combination that would have the desired effect. Ultimately, it appears that his use of full right rudder, with full right (in-spin) aileron and full nose-down elevator, maintained for a full six turns or so, caused the spin to steepen into a more normal mode from which he was able to recover in the usual way.

Video analysis of the spin

The camera was fixed to the coaming, looking forward, and consequently did not record any control inputs or instrument displays. The image quality was good during the clearing turn prior to the spin, but the camera's auto-exposure system was unable to cope initially with the sudden change in lighting conditions between the entry to the spin, which was made in a nose-high attitude pointing into a bright sun, and the much darker landscape visible during the spin. As a consequence, the image during the initial four turns was completely blacked-out, except for brief pulses of sunlight reflected off the top of the engine cowl. By the time of the fifth rotation, however, the exposure system had managed to adapt and the image quality thereafter was good.

A detailed analysis of the video confirmed broadly the pilot's account of the sequence of events during the spin. Because there was no viable image during the first four turns of the spin, all that could be gleaned from this part of the video was the rate of turn, based on the frequency of the brief pulses of reflected sunlight. From the fifth rotation until the aircraft pitched into its more nose-down attitude just prior to the start of the recovery, it was possible to use a combination of reference points in the visible terrain to study the motion of the spin in terms of both rotation rate and relative changes in pitch attitude.

The plot at Figure 1 shows that from the fifth to the ninth turn, and very probably during the first four turns for which no visual reference was available, the pitch attitude flattened progressively. It then steepened somewhat for couple of turns before flattening again. It then remained substantially unchanged, albeit with some slight oscillations in pitch, for a further 10 turns. At that stage, some 23 turns after entering the spin, the aircraft pitched down rapidly to a much steeper attitude as it began to recover.

The plot at Figure 2 shows an initial rotation rate of the order of 175º per second, increasing progressively to around 250º per second by turn four or five. The actual rotation rate for turn five could not be established as there was no common reference feature in the video from which to determine the relevant time interval. Thereafter, the rotation rate varies between 225º and 275º per second until turn 22 or 23, after which it decays briefly to its initial rate of around 175º per second. The spin ceased altogether some 26 turns, and 40 seconds, after spin entry.

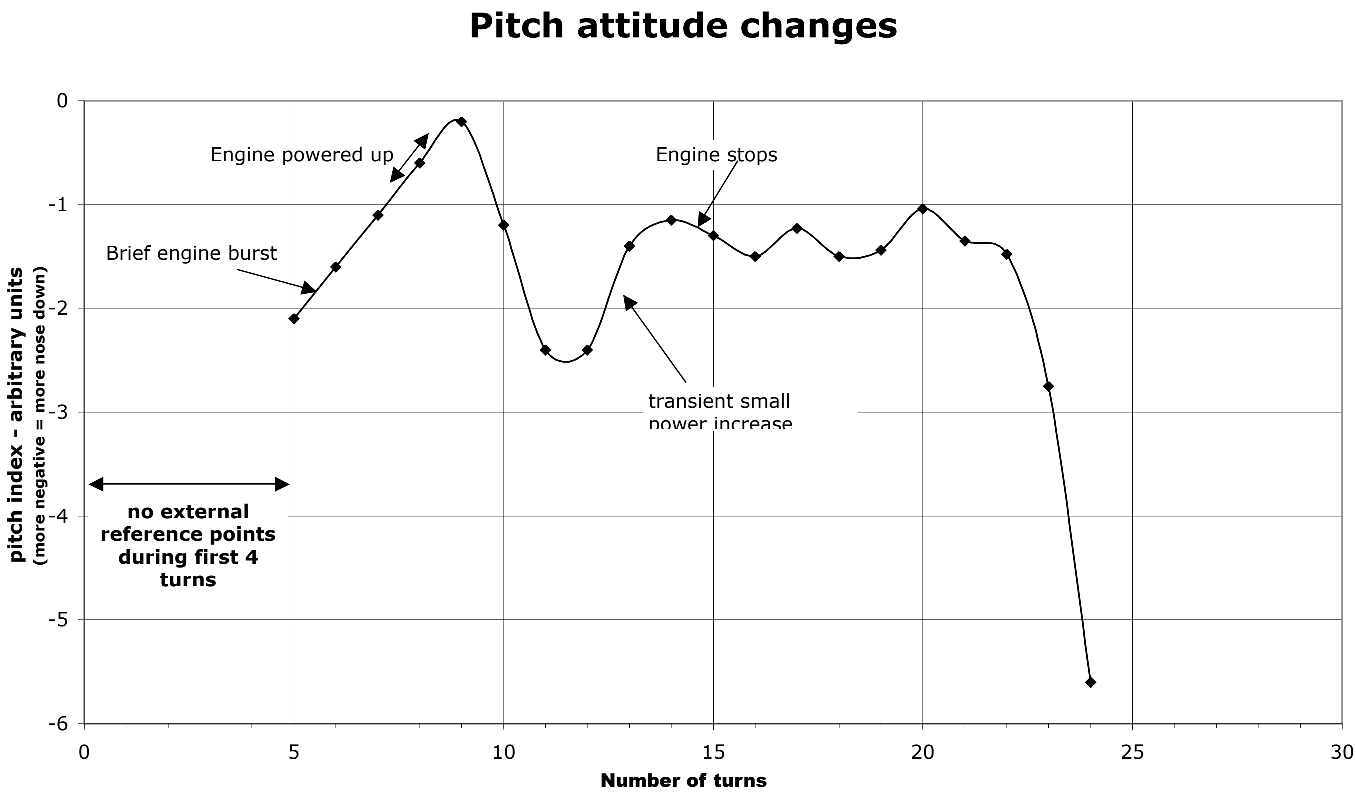

Figure 1

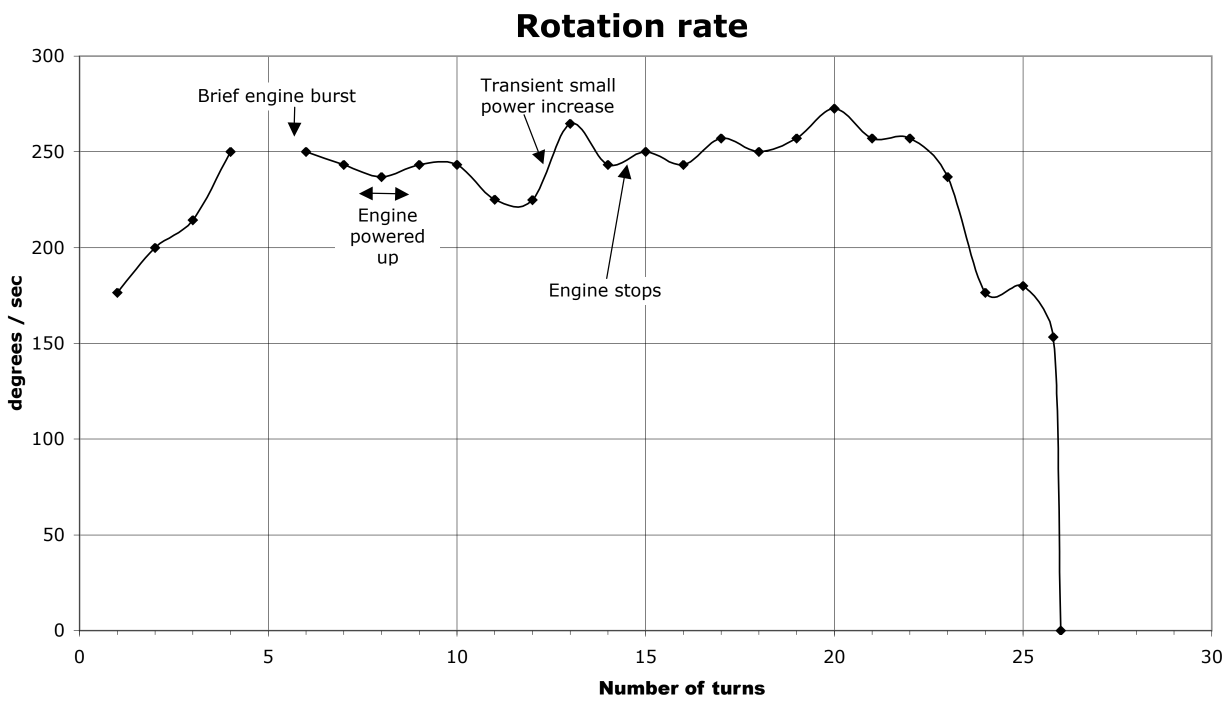

Figure 2

It is possibly significant that the pitch rate was trending towards a flattened attitude during the periods when power increases were made. However, there is insufficient data to draw any convincing inferences as to the precise effect, if any, which the changes in engine power might have had on the aircraft's motion. Nor is there any obvious correlation between the pilot's reported control inputs and the motion of the aircraft.

Video analysis – the post-spin recovery and landing

The video showed that as the rotation stopped, the aircraft entered a vertical dive and it is evident from wind noise on the soundtrack that the airspeed was, and subsequently remained, very high during the pull-out.

The aircraft levelled approximately 43 seconds after spin entry. This was followed by a period of approximately 15 seconds of level flight, incorporating a series of turns to left and right using bank angles of 15º to 30º, presumably as the pilot tried to find a viable landing ground. However, it is apparent in the video that the terrain in the area comprised marshland intersected by numerous water channels, and that his options were limited. The aircraft then rolled briskly into a steep turn to the left at a bank angle initially of between 55º and 60º, which was held for about eight seconds. The bank angle then reduced to around 30º, as individual pieces of vegetation started to become discernible in the video. About three seconds later, the aircraft's nose started to rise and the wings were levelled. This was followed by a brief lowering of the nose and a pitch up coincident with the impact some two seconds later. The total elapsed time between entering the spin and the impact was 73.5 seconds. The first 'MAYDAY' call was made a little over 30 seconds after impact.

Video analysis – descent rates

It was not possible from the video evidence to determine the height of the aircraft as it levelled out after recovering from the spin. The pilot estimates that his height at that time was between 500 ft and 700 ft above the ground. If correct, this would imply a height loss (between spin entry and the recovery to level flight) of the order of 2,750 ft and 3,000 ft. The height consumed during the recovery dive is not known, but if a figure of 300 ft were to be assumed then that would suggest an average height loss of the order of 100 ft per turn and an average rate of descent during the spin of between 3,600 ft/min and 4,000 ft/min.

The time interval between levelling out from the post-recovery dive and impact was approximately 30 seconds. If the aircraft had levelled at 500 ft to 700 ft as the pilot believes, then that would imply an average rate of descent from the time he levelled up to the time of impact of between 1,050 ft/min and 1,400 ft/min. This confirms the strong visual impression given by the video that both airspeed and rate of descent remained high throughout the 'glide' descent and the initial part of the steep left-hand turn immediately preceding touchdown. Excess speed appears to have bled off only as the bank angle was reduced and the nose raised during the pilot's attempt to flare the aircraft back towards a stalled condition at touchdown.

Issues of general relevance to spinning

The generic term 'spin' applies not to a single condition but rather to a complex family of conditions involving, potentially, a range of modes, the individual characteristics of which can vary markedly. The key factors in what is conventionally defined as a spin are as follows:

(i) The incipient stage will involve what is essentially a departure (ie a loss of aerodynamic control) in all three axes simultaneously, which precipitates the motion leading to the fully developed spin that follows. When the spin is unintentional, this departure most often takes the form of an asymmetric stall in which one wing drops before the other, and so becomes more deeply stalled than the other, particularly when this occurs with an already existing yaw imbalance towards the dropped wing.

(ii) Once established in the spin, the aircraft will adopt a self-sustaining, stable, tightly spiralling descent in a stalled condition about a vertical axis of rotation, its path through the air being akin to descending on a very steep helter-skelter, possibly with oscillations in pitch, during which the following conditions will apply:

- The incidence to the local airstream will be such that the wings will be in a substantially stalled state, though not necessarily, and indeed probably not, uniformly stalled across the whole of the lifting surfaces.
- The aircraft will be descending with a high rate of descent, and with a relatively low horizontal velocity component.
- It will be yawing at a high rate about an axis of rotation either within the aircraft's span, or at most within a few semi-spans from the aircraft's centre of mass.
- The overall motion will comprise a stable auto-rotation, sustained by the combination of dynamic, aerodynamic, and gravitational forces acting on the aircraft.

Type-specific factors influence how a given aircraft will tend to spin. These include not only its aerodynamic characteristics, especially the configuration and positioning of the tail, but also its mass moments of inertia about all three axes, and the position of its centre of mass (CG position). For propeller driven aircraft, the direction of rotation will also have an influence, tending to favour a spin to the left for propellers turning clockwise (from behind), and to the right for propellers turning anti-clockwise. The rotational inertia of the propeller will give rise to gyroscopic precessional forces, which can also have an influence. Minor variations in these physical characteristics between individual examples of a given type can also affect spinning behaviour, in the same way that different aircraft of the same type can exhibit variations in stall characteristics, particularly the tendency to drop a wing.

The manner in which the spin is entered can also have a strong influence on the characteristics of the spin that results, in particular:

- Attitude (pitch, yaw and bank angles)
- rates of pitch, roll and yaw (determining the aircraft's momentum about these axes at the critical point as it stalls)
- control inputs, including not just displacement but also the manner and timing of their application (ie gradual, or snap-application;

the precise point during the entry sequence that the input is made; how long the input is maintained, etc.)

- propeller rotation speed

Precisely how all of these factors combine to influence an aircraft's spinning characteristics is highly complex and beyond the scope of this Bulletin; suffice to say that extensive flight trials are usually required before a given type's spin characteristic can be fully understood. During such trials, it is common practice to fit the aircraft with an anti-spin parachute or rocket devices which can be activated in an emergency, to help force the aircraft out of its stable autorotative state.

Through careful design, and by imposing limitations on aircraft weight and CG, designers and certificating authorities endeavour to ensure that aircraft certificated for spinning can be relied upon, firstly, to adopt a predictable mode of spin and, secondly, to be amenable to recovery using either standard spin recovery actions or an appropriate alternative laid down in the flight manual. Very often, a lack of elevator authority at the stall will result in aircraft showing a marked reluctance to spin at all. When such aircraft do spin, the limited ability to raise the nose high at the point of stall during spin entry, will encourage it to adopt a nose-down attitude in the spin, from which recovery is usually straightforward. However, as alluded to above, it should not be presumed that such aircraft could not be made to adopt other, possibly much less benign, spinning modes, some of which may not be amenable to recovery using standard spin recovery techniques. Indeed, in such circumstances, standard recovery methods may actually be counter-productive.

Over the years, many aircraft types which were believed initially to have predictable and safe spinning modes were found subsequently to exhibit other (usually flatter) modes of spin from which recovery was difficult, or even impossible. These aircraft usually required modification by the addition of anti-spin strakes on the rear fuselage, for example, and/or changes to the tail configuration, to effect a cure. Usually, these more unusual modes of spin were associated with very specific entry conditions, often achieved unintentionally on the first occasion, and exploited subsequently. An accident involving one such example, which has direct relevance to this accident, occurred in 1976 and was subject of AAIB Aircraft Accident Report No 3/77, G-BCCO.[1]

Issues specific to G-ONCS' spin

The direction of spin was that which the direction of propeller rotation would have pre-disposed it to adopt. It would seem that the combination of the CG position towards the aft limit, together with the sustained application of full out-spin (left) aileron during entry, were critically important in precipitating the flat mode of spin which followed. The former would have helped to overcome the inherent lack of elevator authority at the point of the stall, and encouraged a more nose-up attitude subsequently; the latter would have promoted a more pronounced right wing drop by causing the wing on the 'inside' of the spin to become more deeply stalled, and that on the 'outside' to be less so, thereby increasing the autorotative moment due to asymmetric lift. Together with additional aileron drag and associated adverse yaw, this would have tended to yaw the aircraft to the right at the point of stall and through the incipient stages of the spin. The result was a classical flat spin, involving a highly stable, high rate, autorotation with a small radius of gyration and a relatively small bank angle.

Footnote

[1] See AAIB web site at: www.aaib.gov.uk

The first requirement in recovering from any fully developed spin is to stop the yaw: only when the yaw has been stopped and stable autorotation ceases, can the stalled condition of the aircraft be addressed to complete the recovery. Rudder effectiveness is therefore a key requirement in spin recovery generally. However, a flat spin can, potentially, reduce the effectiveness of the rudder. The tail configuration of the Tipsy Nipper is such that a flattening of the pitch attitude in the spin may have affected the aircraft in this way, as shown in Figures 3a and 3b, due to the blanking effect of turbulent air in the wake from the (stalled) tailplane and elevator. It can be seen that in a flat mode of spin (Figure 3a), not only would this blanking be potentially more severe than at steeper pitch angles, but would have been exacerbated by application of full forward stick.

Indeed, it is possible that the use of full forward stick in this particular case may have critically reduced the rudder's effectiveness below the threshold required to overcome the auto-rotational yaw, preventing or delaying recovery until it was complemented by the adverse yaw associated with in-spin aileron.

It is notable that the Tipsy Nipper Owners Manual applicable to G-ONCS, and indeed (as far as could be established) the equivalent manuals for other marks of the Nipper, lists spins as one of the permitted aerobatic manoeuvres. However, it provides no specific guidance as to how the spin should be entered, save for the entry speed which, in G-ONCS' case, is listed as 38 mph. Additionally, it states under the heading '*Spinning'*:

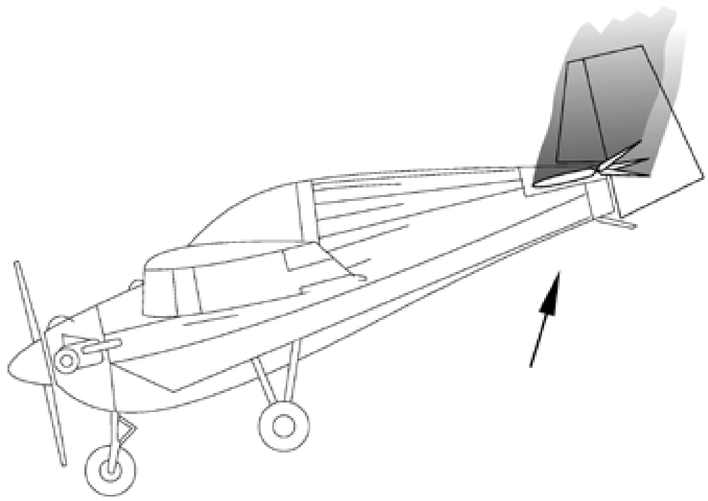

Figure 3a

Flat spin attitude

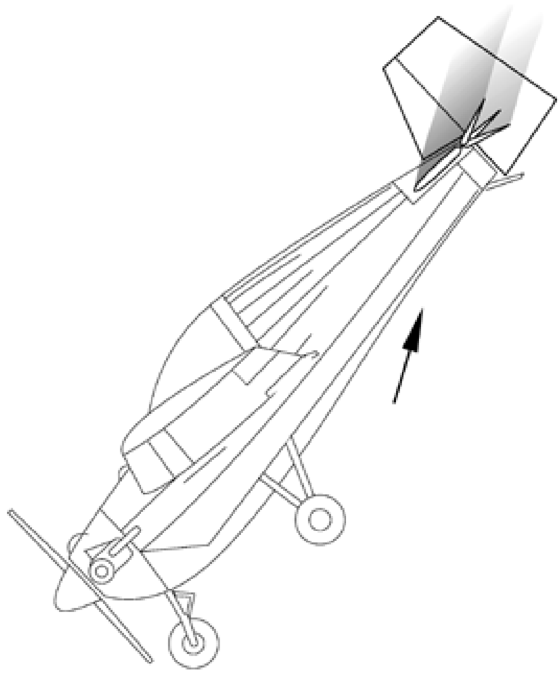

Figure 3b

Steep spin attitude

'The aircraft is very reluctant to enter a spin and just as reluctant to maintain it. Normal recovery methods are quire adequate, and the action is immediately effective.'

Additional information

Spin recovery

Advice was sought from a highly experienced pilot about the spinning characteristics of the Tipsy Nipper. He had for many years, not only displayed the aircraft and competed in aerobatic competitions, but also had wide experience of its spinning behaviour, including flat spins. He advised that, provided the entry was progressive, using a little power helps the effectiveness of the controls. Applying full back stick and in-spin rudder as the nose drops and, if needed, momentary out-spin aileron (neutralised as soon as rotation starts), followed by closing the throttle once the spin starts, results in spin (up to three turns) that is consistent and predictable. Recovery usually occurred within a quarter of a turn of applying standard recovery actions. However, he also advised that the Nipper can be readily induced into a flat spin with full use of out-spin aileron - effectively to increase the drag on the in-spin wing and accelerate rotation. The progressive use of forward stick will further increase the rate of rotation and hence is totally counter-productive in initial recovery. In addition, the use of engine power will flatten the spin further and also oppose recovery.

He found that full out-spin rudder combined with full in-spin aileron and aft stick, with the throttle closed, gave optimal recovery from a flat spin, but stressed that it nevertheless could still take up to four turns before the rotation stopped, even without an aft CG. He emphasised that whilst he had found these actions to be effective in recovering from a flat spin in a Nipper, it should not necessarily be assumed that they would be appropriate for other aircraft types. He also commented that it was not unusual for normally aspirated engines to stop during a spin.

Disorientation

The pilot of G-ONCS reported that he became disorientated and unable to focus on the instruments for a period after the aircraft recovered from the spin. This condition is associated with Type III disorientation which can lead to failure to recover an aircraft into normal flight.

Type III disorientation can manifest itself in the following way:

> If an object is held stationary, and one's head is moved around, the eyes can easily focus on the object; indeed it is difficult to avoid this happening. This is because the eyes share a neuronal connection with the body's vestibular system (the balance system in the inner ear) such that the vestibular apparatus causes eye movement opposite to the direction of head rotation. This involuntary eye movement is called the vestibulo ocular reflex (VOR), and is caused by inner ear fluid remaining static inside the 'moving' semicircular canals (which are fixed in relation to the head). When a pilot is subject to spinning, the VOR moves the eyes in opposition to the direction of rotation. However as the spin continues, the eyes soon reach the extent of their travel. At this point, the eyes quickly reset, and the VOR starts again; this process repeats itself for the duration of the spin and is called ocular nystagmus. Ocular nystagmus normally helps the pilot maintain awareness of orientation but, if prolonged, it can get out of phase, causing a

disorientating condition called vestibulo-ocular disorganisation (VOD) and can lead to difficulty in initiating a recovery from the spin.

After stopping a prolonged spin, inner ear fluid continues to move for a period, due to its inertia, despite the head (and hence the semicircular canals) now being still. The relative movement between the fluid and the semicircular canals causes further nystagmus after the spin has stopped, and is referred to as post-rotatory nystagmus. This can lead to a false feeling that the aircraft has begun spinning the opposite way and can prompt inappropriate control actions, such as full rudder, thus risking inadvertent spin re-entry, particularly if the airspeed has yet to increase. Additionally, the nystagmus makes reading instruments extremely difficult. The process is easily demonstrated by a person performing ten rapid turns on the spot and stopping, then immediately trying to read from a page of text.

Spinning accidents

The subject of spinning accidents in General Aviation has been addressed in various AAIB reports over recent years. Relevant extracts from two such reports, one concerning a glider (HCD, Bulletin 1/2005), the other an aerobatic single engine aircraft (G-BUUD, Bulletin 10/2007), are reproduced below for information.

One of the recommendations made to the British Gliding Association in the report concerning HCD, for pilots and instructors intending to perform intentional spins, included the following:

> *'……………that instructors and pilots establish and brief students on, minimum entry heights, minimum recovery initiation heights and minimum recovery heights, whenever intentional spinning is planned. These heights should take into account the characteristics of the glider type being flown, the experience and ability of the crew, and the possible need to abandon the glider.'*

Glider pilots normally wear parachutes on all aerobatic, recreational and training flights.

In the report on the accident to G-BUUD, the following was included:

> *'The CAA General Aviation Safety Sense Leaflet 19a, entitled Aerobatics, advises pilots who are learning to fly aerobatics to become familiar with the entry to and recovery from a fully developed spin since a poorly executed aerobatic manoeuvre can result in an unintentional spin. Training in recovery from incorrectly executed manoeuvres and unusual attitudes is essential.*
>
> *Following a spinning accident to G-BLTV on 3 November 2002, the AAIB made the following recommendation: 'The Civil Aviation Authority should conduct a review of the present advice regarding the use of parachutes in GA type aircraft, particularly those used for spinning training, with the aim of providing more comprehensive and rigorous advice to pilots.'*

This was accepted by the CAA and an updated Safety Sense Leaflet 19a *Aerobatics* was published containing the following information on parachutes:

'While there are no requirements to wear or use specific garments or equipment, the following options are strongly recommended:

..... Parachutes are useful emergency equipment and in the event of failure to recover from a manoeuvre may be the only alternative to a fatal accident. However, for physical or weight and balance reasons their carriage may not be possible or practicable, the effort required and height lost while exiting the aircraft (and while the canopy opens) must be considered. If worn, the parachute should be comfortable and well fitting with surplus webbing tucked away before flight. It should be maintained in accordance with manufacturer's recommendations. Know, and regularly rehearse, how to use it, and remember the height required to abandon your aircraft when deciding the minimum recovery height for your manoeuvres.'

Conclusions

It is evident that the pilot of G-ONCS had not appreciated fully the potential for his aeroplane to adopt a mode of spin outside his experience and understanding, or the factors likely to pre-dispose it to do so. In this regard, he is likely to have been no different from large numbers of pilots in general aviation and. indeed, commercial pilots. However, the fact that he was able to remain calm in a stressful situation and apply different control configurations which eventually effected the spin recovery, and had sufficient height to overcome his disorientation, meant that a more serious outcome was avoided.

Although there is no shortage of information available concerning intentional spinning and the avoidance of, and recovery from, unintentional spins, from various AAIB reports, the CAA, flying training organisations and various organisations associated with sporting and general aviation, the following Safety Recommendation is made:

Safety Recommendation 2007-115

It is recommended that the Civil Aviation Authority, in conjunction with the Light Aircraft Association, should publish information relating to UK registered aircraft approved for spinning, with a view to ensuring that guidance is given on how a spin should be entered, so as to maximise the probability of the aircraft spinning in a predictable manner, one that is amenable to recovery using standard actions.

ACCIDENT

Aircraft Type and Registration:	Aeroprakt A22 Foxbat, G-VROD
No & Type of Engines:	1 Rotax 912 ULS piston engine
Year of Manufacture:	2003
Date & Time (UTC):	16 January 2008 at 1300 hrs
Location:	Kilkeel, County Down
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Nose landing gear collapsed and propeller damaged
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	31 years
Commander's Flying Experience:	228 hours (of which 43 were on type) Last 90 days - 11 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

As the pilot rotated the aircraft on takeoff, it ran into a wet patch on the grass runway and lost speed. Although it subsequently became airborne, an uncontrollable yaw caused the pilot to abandon the takeoff. It departed the side of the runway and struck a hedge at low speed.

History of the flight

The pilot reported that there had been heavy rain over the days prior to the accident but fine conditions between showers appeared to offer an opportunity for a local flight. He arrived at the airfield and walked the length of the grass runway, assessing that it was damp with occasional wet patches.

The takeoff proceeded normally until the pilot began to rotate, at which time the main wheels ran onto a wet patch on the runway, causing slight deceleration. He held the nosewheel off the ground, the aircraft gained speed again and became airborne. The aircraft then yawed right and as he was unable to correct the yaw, the pilot closed the throttle and abandoned the takeoff. It touched down on undulating ground to the side of the runway, ran into a hedge at low speed and came to a stop. The pilot shut the aircraft down and both occupants disembarked without difficulty.

The pilot assessed the cause of the accident as loss of airspeed on rotation which led the aircraft to be airborne closer to the stall than usual.

ACCIDENT

Aircraft Type and Registration:	Pegasus Quantum 15-912, G-CCWO
No & Type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	2004
Date & Time (UTC):	14 October 2007 at 1500 hrs
Location:	Plaistows Farm, Hertfordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to pod, nosewheel, sail, wingspar
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	53 years
Commander's Flying Experience:	64 hours (of which 4 were on type) Last 90 days - 4 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft departed the left-hand edge of the runway on landing in a gentle crosswind.

History of the flight

The pilot stated that during the approach to the grass Runway 33 at Plaistows Farm, the aircraft drifted right shortly before touchdown. He attempted to execute a go-around but was unable to climb away before the aircraft landed and proceeded towards the left-hand edge of the runway. The aircraft was damaged when it continued into an adjacent ploughed field, coming to rest upright. The pilot was uninjured.

Other information

The pilot reported that at the time of the accident there was good visibility and a surface wind from 240º/3 kt (3.5 mph). The Quantum 15 *Operator's Manual* states that the maximum crosswind component for operation of this aircraft is 10 mph but recommends that for pilots with between 10 and 100 hours in command of the type, this should be reduced to 5 mph. Uncorrected, the gentle crosswind from the left would have caused the aircraft to drift to the right of the runway centreline and, on touchdown, induce a slight left turn. The pilot has sought assistance with his technique from a flying instructor familiar with the aircraft.

ACCIDENT

Aircraft Type and Registration:	Pegasus Quik, G-CEML
No & Type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	2007
Date & Time (UTC):	30 December 2007 at 1500 hrs
Location:	Anwick, Linconshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to wing, pod and landing gear
Commander's Licence:	Private Pilot's Licence
Commander's Age:	53 years
Commander's Flying Experience:	562 hours (of which N/K on type) Last 90 days - 30 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The pilot landed with his foot inadvertently resting on the brake pedal, which resulted in the microlight skidding to the left on landing. It departed the left side of the runway and ran into a ploughed field, causing it to roll onto its side, damaging the wing, the fuselage pod and the nose landing gear. The pilot was unhurt.

History of the flight

Whilst returning to his departure airfield, Heckington, the pilot decided to land at a private landing strip at Anwick to meet a friend. The runway at Anwick comprises a grass strip 5 m wide and 600 m long, orientated east to west. Immediately after landing the microlight veered to the left, entering a ploughed field at the side of the runway. It rolled onto its side, damaging the wing, fuselage pod and nose landing gear. The pilot, who was unhurt, attributed the incident to landing the aircraft with his foot inadvertently resting on the brake pedal which caused him to lose control and skid off the runway.

ACCIDENT

Aircraft Type and Registration:	Pegasus XL-Q, G-MTTD
No & Type of Engines:	1 Rotax 447 piston engine
Year of Manufacture:	1988
Date & Time (UTC):	4 August 2007 at 1930 hrs
Location:	Langstone, Hampshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to nose leg, pod underside, wing leading edge and wing battens
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	45 years
Commander's Flying Experience:	168 hours (of which 100 were on type) Last 90 days - 3 hours Last 28 days - 0 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The nose leg collapsed during the landing run.

The accident

The pilot reported that he utilised a fairly short field as a landing strip. This was approximately 200 metres long, was orientated north-south and terminated in a chain-link fence. Beyond was a coast path and the waters of Langstone Harbour. The pilot reported the wind as variable at less than two knots and it was twilight. During the ground run the nose leg collapsed backwards. This allowed the front of the aircraft pod to come into contact with the ground, causing the aircraft to tip over on its right side.

The pilot stated that, once on the ground, he had increased deceleration by pressing the brake lever fairly hard. He subsequently considered that his lever force was excessive and that this may have deformed the front tyre, locking the wheel and causing collapse of the nose leg.

ACCIDENT

Aircraft Type and Registration:	Quad City Ultralights Challenger II, G-MYRJ
No & Type of Engines:	1 Rotax 582 piston engine
Year of Manufacture:	1995
Date & Time (UTC):	29 October 2006 at 0950 hrs
Location:	Clench Common, Wiltshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to left main and nose landing gears
Commander's Licence:	Private Pilot's Licence
Commander's Age:	39 years
Commander's Flying Experience:	130 hours (of which 4 were on type) Last 90 days - 15 hours Last 28 days - 7 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and additional AAIB enquiries

Synopsis

A failure of the poorly maintained engine shortly after takeoff resulted in damage to the aircraft during the subsequent forced landing. The cause of the failure was not identified.

History of the flight

The owner/pilot had recently acquired the aircraft and the accident occurred on what the pilot recalls was probably his third flight. The aircraft took off from Clench Common and made a right turn onto the cross-wind leg of the circuit when, at a height of approximately 300 ft, the engine suddenly stopped. The pilot put the aircraft into a turn to the left and landed in the nearest available field. However, the surface was soft from recent rain, causing the wheels to sink into the ground; this resulted in the left main and nose landing gears collapsing as the aircraft came to rest.

Engine examination

The pilot subsequently removed the engine from the aircraft, which had achieved a total flight time of approximately 40 hours, and took it to an overhaul agent, who discovered that it had seized. In his view, both pistons had seized as a result of expansion, as opposed to a lack of oil. The reason for the seizure was not apparent, but could have been the result of, for example, high temperatures due to an abnormally weak mixture.

Further examination of the engine revealed evidence of poor maintenance in a number of areas.

- The heads of two of the cylinder bolts were worn as a result of an incorrect size of socket having been used;
- The bolt that mounted the disc valve, the component that controls the admission of the fuel/air mixture into the lower crankcase, had been stripped and a replacement bolt of incorrect length had been used in its place;
- One of the small-end bearings had previously been assembled with one of the rollers missing.

In addition, it was found that the connections between the cross-shaft gear chamber and its associated oil reservoir, had been reversed.[1] The effect of this was to prevent normal charging/bleeding of the cross-shaft gear chamber. However, there was sufficient oil in the chamber to have prevented any distress to the gear components.

Whilst the foregoing represents an unacceptable standard of maintenance, of which the pilot was unaware, none of these defects appeared to have any relevance to the engine failure.

The engine and aircraft were subsequently repaired, since when no further problems have been reported.

Footnote

[1] The cross-shaft is positioned transversely across the crank case, with one end driving the coolant pump and the other driving the disc valve. The shaft is driven via a worm gear in the centre of the crankshaft, in a sealed chamber between the two cylinders.

ACCIDENT

Aircraft Type and Registration:	Rans S6-ESD XL (Modified) Coyote II, G-MZNV
No & Type of Engines:	1 Rotax 503-2V piston engine
Year of Manufacture:	1998
Date & Time (UTC):	23 November 2007 at 1515 hrs
Location:	A field 3 miles east of Popham
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to propeller, nose wheel, cowlings and tail cone
Commander's Licence:	Private Pilot's Licence
Commander's Age:	56 years
Commander's Flying Experience:	487 hours (of which 423 were on type) Last 90 days - 18 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The engine of G-MZNV failed during cruise flight. During the subsequent forced landing, the nose gear collapsed and the aircraft overturned.

History of the flight

While in the cruise at 1,200 ft amsl returning to Brimpton, Berkshire from a 'land away' at Sandown, Isle of Wight, the engine stopped. The failure was preceded by a smooth though rapid rundown from cruise power. The pilot successfully restarted the engine four times but each time it ran only briefly before cutting out. The fuel pressure (measured just before the carburettor) remained normal throughout the incident and the aircraft had sufficient fuel for the flight. While attempting to restart the engine the pilot was able to turn into wind and successfully touch down approximately half way into a large open field of short crop. After a ground run of 25 m, the nose gear collapsed causing the nose leg to dig into the soft soil. As a result, the aircraft overturned and came to rest inverted. The pilot and passenger, who were wearing three point seatbelts, were uninjured and able to vacate the aircraft using the normal exit door. There was a slow fuel leak from the tank breather but this was in an area with no ignition source and no fire resulted.

Engineering investigation

The air-cooled Rotax 503 engine fitted to G-MZNV was not equipped with carburettor heating and the possibility of engine failure due to carburettor icing was considered. The METAR for RAF Odiham, (approximately 12 miles north east of the accident site) at 1450 hrs gave a temperature of +5ºC and a dew point of +0ºC. Applying these figures to the chart in the CAA Safety Sense leaflet 14 '*Piston Engine Icing*' suggests a risk of moderate to serious icing at cruise power. According to the Rotax UK distributer, the 503 draws its induction air past the cylinder head and in a cowled configuration (such as the S6) is thought unlikely to require carburettor heating. The 503 is widely used in uncowled configurations on other aircraft and an electric heater kit which heats the body of the carburettor was available from the UK distributor. They report that they sold this kit in large numbers for 20 years before discontinuing it and received no reports of carburettor icing from aircraft using this system.

ACCIDENT

Aircraft Type and Registration:	Thruster TST Mk 1, G-MVDF
No & Type of Engines:	1 Rotax 503 piston engine
Year of Manufacture:	1988
Date & Time (UTC):	21 October 2007 at 1315 hrs
Location:	Rayne Hall Farm, near Braintree, Essex
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Broken right landing gear spring, broken propeller tips, and cracked pod
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	53 years
Commander's Flying Experience:	100 hours (of which 88 were on type) Last 90 days - 2 hours Last 28 days - 0 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

On touching down for the second time during a 'bounced' landing, the right landing gear was damaged, the aircraft pitched forward and the propeller made contact with the ground.

History of the flight

The pilot reported that, after an uneventful flight with a fellow pilot, he carried out a normal approach for a 'wheeler' type landing, but the aircraft 'ballooned' off the initial touchdown. Believing the situation to be recoverable, he continued with the landing but, on touching down again, the aircraft bounced violently back into the air. Power was applied for a go-around but before it could take effect, the aircraft landed heavily, breaking the right landing gear spring. The aircraft slewed to the right whilst simultaneously pitching forward causing the propeller to contact the ground.

The occupants were uninjured and able to vacate the aircraft unaided.

The pilot attributed the accident to his failure to go-around after the first bounce.

ACCIDENT

Aircraft Type and Registration:	UP Makalu wing and Sup'air X-Alps harness
No & Type of Engines:	None
Year of Manufacture:	2003
Date & Time (UTC):	26 May 2007 at 1402 hrs
Location:	Wether Fell, Hawes, North Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Fatal) Passengers - N/A
Nature of Damage:	None
Commander's Licence:	Pilot (Hill)
Commander's Age:	45 years
Commander's Flying Experience:	Regular flying since 2002, actual hours unknown
Information Source:	AAIB Field Investigation

Synopsis

At a height of less than 100 ft above a steeply sloping hill the wing of the paraglider suffered an asymmetric collapse over approximately 60% of its area. The wing had partially re-inflated when the pilot impacted a rock imbedded in the hillside. The wing was found to be serviceable and the collapse was probably caused by air turbulence.

History of the flight

On the day of the accident there had been a hang glider competition at the hill site, alongside which several paragliders were also flying. Earlier in the afternoon a hang glider had suffered an unrelated accident, as a result of which emergency services were already in attendance. At the time of the subsequent accident to the paraglider, most of the competition pilots had landed and conditions were described as turbulent, with "lively thermal conditions". The accident pilot was seen by other paraglider pilots to be flying at a height of between 50 and 100 ft above the local terrain and was presumed to have become airborne shortly beforehand.

As the paraglider proceeded in a south-westerly direction along the ridge, it sustained an asymmetric collapse over approximately 60% of its area, originating from the left (ridge side) wing tip, causing it to drop and turn towards the slope. The canopy began to re-inflate almost immediately, swinging the pilot towards the slope. With approximately 50% of the canopy remaining collapsed, he impacted the hill laterally, hitting a rock at a point where the terrain sloped at an angle of approximately 70° to the horizontal. Other pilots who ran to assist him found him conscious and conversant. After receiving first aid from the emergency services, the pilot was placed on a stretcher and raised up the steep slope using ropes to an area of flatter ground. Approximately 30 minutes after the accident he was taken to hospital by an air ambulance.

Medical and pathological information

Though serious, the pilot's injuries were not thought by those who first attended him to be life threatening. However, the complicated injuries to his pelvis caused severe bleeding to which he later succumbed.

Aircraft information

The paraglider comprised a wing and harness, manufactured separately.

Wing

The UP Makalu Extra Large wing used by the pilot had a DHV[1] 1-2 classification, indicating that it had 'good-natured flying characteristics' and was considered likely to recover positively from a partial collapse with little or no control input from the pilot. The Extra Large wing is typically used for dual flying, with an ideal suspended weight range of 110 – 150 kg. The pilot's weight fell within this range however and the wing was therefore suitable for him to operate solo.

Harness

The harness was a Sup'air X-Alps Large which incorporated under the seat protection against vertical impact but no protection from side impacts. When worn on the ground and not under flight loads the harness of a paraglider is suspended from the pilots shoulders by padded straps. In the air the pilot is also secured within the harness by leg straps and a chest strap.

Figure 1

Typical harness layout

The chest belt performs the further function of adjusting the distance between the two risers. Correct setting of this strap is important in determining the flight characteristics of the wing. Fully tightened, it gives the sensation of more security but can make the paraglider easier to spin. Too 'open' a setting (whereby the risers are held relatively far apart) makes the wing less stable, less likely to recover automatically from a partial collapse and makes recovery from spiral dives and partial collapse less certain – no longer within the parameters of a certified glider.

Footnote

[1] Deutscher Hangegleiterverband, the German Hang Gliding and Paragliding Federation, the technical department of which conducts type tests on flying equipment and accessories to assess their safety characteristics and airworthiness.

Examination of wreckage

The wing and harness were found to be serviceable, unmodified and in a condition commensurate with their age. It was not possible to determine the harness chest strap setting used during the accident flight, because it had probably been loosened during efforts to assist the pilot.

Location

Wether Fell rises in the Pennine Uplands south of the town of Hawes. On the day of the accident flying was conducted on the steep west-facing slope which ascends from a narrow valley at 290 ft amsl, to a summit, Drumaldrace, at 614 ft amsl. The surface is mostly well drained rough grass with several areas of exposed earth where the terrain is particularly steep. The few rocky outcrops are small and well dispersed. A series of parallel dry stone dykes, spaced at intervals of approximately 200 m, form the only man-made obstacles in the area over which the pilot was flying. On the day of the accident the ground was described as slippery and spongy but "not particularly wet".

Mixed hang gliding and paragliding activities are commonplace at this site, with clearly defined landing and takeoff zones for each discipline.

Meteorological information

Pilots reported a wind of 6 to 15 kt with gusts up to 21 kt in the 'compression zone'[2]. Winds of this magnitude are considered likely to cause turbulence sufficient to induce asymmetric collapse of a paraglider wing.

Footnote

[2] The 'compression zone' is that part of the airflow closest to a hillside where acceleration of the airflow is greatest and wind speed will be greater than the free stream value measured some distance from the hill. The BHPA refers to this as 'the zone of accelerated airflow'.

Pilot information

The pilot gained his Club Pilot (Hill) qualification on 12 September 2002 and his Pilot (Hill) rating on 6 February 2004. He was also a club coach. Possession of these qualifications indicates that a pilot has passed theoretical examinations in air law, meteorology, airmanship and navigation. Pilots are examined on their understanding of an asymmetric collapse and how to effect a recovery.

Wing categorisation

The DHV certification scheme is divided into different categories, indicating the passive safety characteristics of a paraglider. The DHV recommends that pilots use a paraglider from a particular category, according to their experience level. According to the DHV website the lowest categories for paragliders, class DHV 1 and DHV 1-2 are deemed to be suitable for pilots with very little experience and:

> *'should have a good chance of avoiding a crash, should the paraglider suffer a collapse close to the ground.'*

The BHPA commented that these characteristics can only be guaranteed if the pilot flies with the harness chest strap set correctly.

Asymmetric collapse

Causes

Asymmetric collapse can be caused by turbulence associated with thermal activity or by the effects of strong wind passing over local terrain. It can also be initiated by any pilot input that reduces significantly the angle of attack of one side of the wing compared to the other, such as pulling down on a front riser.

Control

A paraglider is fitted with two control or brake lines which pull down on the trailing edge of each side of the wing. To initiate a turn, the pilot pulls down on the brake line on the side he wishes to turn towards. The pilot can assist the turn by shifting his weight to the same side.

Avoiding turbulence is considered the best way to prevent collapse because any wing confronted with a sufficiently strong vertical gust will collapse. A wing loaded towards the top of its certified weight range will be the most resistant. The pilot can assist recovery by applying a smooth 'pump' (a long pull and release of the brake) on the affected side, whilst maintaining direction by shifting weight away from the collapse and applying brake opposite to the collapse. Weight shifting has the advantage of controlling the tendency of the wing to turn towards the collapse whilst minimising height loss. Height loss of at least 50 ft is typical.

Many participants and manufacturers advocate 'active flying' whereby the pilot maintains light brake application, making constant adjustments through each brake line in response to relative slackness on that side to restore tension. Active flying is taught as part of the BHPA Club Pilot course.

Conclusion

It is likely that the pilot had sufficient experience and training to fly the equipment, which was found to be serviceable and appropriate for his weight. The strong wind and thermal activity produced turbulence sufficient to induce an asymmetric collapse, which occurred at a height from which the pilot was unable to effect a recovery. As the left side of the wing began to recover the pilot swung towards the slope, which he impacted sideways on an isolated rock. It is unlikely that the provision of additional side impact protection would have altered the outcome.

The BHPA advises paraglider pilots to cease flying activities when thermal activity and wind speed is sufficient to cause turbulence leading to a collapse.

Safety action

The BHPA, through its own publications and registered paragliding schools, intends to raise awareness of the risks of flight in turbulent conditions.

AIRCRAFT ACCIDENT REPORT No 4/2008

This report was published on 26 February 2008 and is available on the AAIB Website www.aaib.gov.uk

REPORT ON THE INCIDENT TO AIRBUS A320-214, G-BXKD AT RUNWAY 09, BRISTOL AIRPORT ON 15 NOVEMBER 2006

Registered Owner and Operator:	Thomas Cook Airlines UK Ltd
Aircraft Type:	Airbus A320-214
Serial No:	735
Nationality:	British
Registration:	G-BXKD
Place of Incident:	Runway 09, Bristol Airport
Date and Time:	15 November 2006 at 1932 hrs

Synopsis

The Air Accidents Investigation Branch (AAIB) was notified by the Bristol Tower ATC watch supervisor on 16 November 2006 of an incident involving a diversion of an A320 aircraft, G-BXKD, to Manchester Airport. The diversion resulted from a landing gear malfunction after takeoff from Bristol Airport. Subsequent enquiries revealed that the landing gear had been damaged during the previous landing at Bristol on 15 November. The following Inspectors participated in the investigation:

Mr R J Tydeman	Investigator-in-Charge
Mr R W Shimmons	Operations
Mr P A Sleight	Engineering
Mr A Burrows	Flight Data Recorders

The A320 aircraft had landed at Bristol Airport in a strong crosswind, with associated turbulence. During the shutdown procedure the crew were presented with an automatically generated aircraft warning indicating that certain parameters had been exceeded during the landing. The crew recorded the exceedence in the Technical Log. A type-qualified engineer met the aircraft on arrival and complied with his understanding of the technical checks required after the generation of such a warning. Substantial damage had occurred to the landing gear, but this damage was not detected before the aircraft was cleared for a further flight. On that flight the crew experienced landing gear problems after takeoff, together with other warnings, and diverted to Manchester Airport. Following further engineering activity, the aircraft was again released for flight without the damage being detected; this resulted in a repeat of the gear problems and other warnings after takeoff. The damage to the landing gear was eventually discovered after the subsequent landing at Manchester.

The investigation identified the following contributory factors:

1. The A320 aircraft landed at Bristol Airport in a strong crosswind with associated turbulence; the landing was classified as 'hard' because specified parameters were exceeded at touchdown.

2. The autopilots were disconnected about 100 ft above the runway threshold. In the prevailing turbulent conditions, this allowed insufficient time to separate the piloting tasks of taking control of the aircraft and flaring the aircraft to land.

3. The engineers maintaining the aircraft at Bristol had not received adequate training in the use of the computer software supporting the operator's aircraft manuals.

4. The Airbus aircraft manuals did not differentiate, in their effectivity coding, how the implementation of Service Bulletins affected specific aircraft.

5. No connection was made between the previous LOAD <15> report and the subsequent 20GA sensor failure, indicating the internal damage to the landing gear.

6. Guidance provided in the aircraft manuals required to interpret the LOAD<15> report was unclear and differences existed between sections, particularly with regards to corrective action.

Four Safety Recommendations have been made.

Findings

3.1.1 Flight operations

1. The flight crew that landed the aircraft at Bristol were licenced, qualified to operate the flight, and were in compliance with applicable flight and duty time limitations.

2. The aircraft's weight and centre of gravity were within limits for the landing at Bristol.

3. The landing at Bristol Airport was conducted in significant turbulence.

4. Both autopilots were disconnected at about 208 ft radio altitude, which corresponds to about 102 ft above the runway threshold.

5. When the autopilots were disconnected the crosswind was recorded to be 38 and 40 kt, whereas the maximum demonstrated crosswind for landing is 33 kt, gusting to 38 kt.

6. The crosswind just prior to touchdown was approximately 30 kt.

7. The pitch attitude at touchdown was approximately 5.5º. A maximum pitch attitude of 6.7º was recorded just after, together with a peak normal acceleration of 2.9g as both right and left main gear oleos compressed within a second of each other (right main first).

8. After the LOAD <15> report had been generated, indicating a hard landing, the aircraft commander entered the report activation into the Technical Log and passed a copy of the report to the engineer; the commander then filed an Air Safety Report.

9. After completing his inspection the engineer released the aircraft into service.

10. After the subsequent takeoff, the flight crew experienced problems in raising the landing gear, together with a number of ECAM warnings: they then diverted to Manchester Airport.

11. The landing gear problems, together with the ECAM warnings, were repeated after takeoff on the following flight; the flight crew returned to land at Manchester Airport.

3.1.2 Engineering aspects

1. The aircraft was certified, equipped and maintained in accordance with existing regulations and approved procedures. There was no evidence of any pre-existing defect with the aircrafts landing gear.

2. The right main landing gear suffered a rupture of the upper diaphragm tube following the heavy landing at Bristol.

3. Whilst the aircraft was on the ground the damage to the landing gear was not visible externally, and only became evident following the jacking of the aircraft.

4. There was no other damage to the aircraft.

5. A LOAD <15> report was generated following the heavy landing.

6. The engineer at Bristol had not seen a LOAD <15> before.

7. The aircraft manuals for G-BXKD were on a computer based system known as AirN@V.

8. The engineer at Bristol had only used AirN@V once before and had not received any formal training on the system.

9. The engineer had previously used the manuals in PDF format.

10. The engineer attempted to interpret the LOAD <15> report and used the flow chart in AMM 31-37-00, which directed him to the heavy landing check.

11. Using the AirN@V navigation menus the engineer selected '*05-51-11 PB 601 – INSPECTIONS AFTER HARD/ OVERWEIGHT LANDING – INSPECTION/ CHECK*'.

12. When using AirN@V the selection of the Page Block gave the first check in that section.

13. The engineer thought that he had the correct check, and printed it out using the 'print job card' selection on the print menu.

14. The inspection he carried out was as described in AMM 05-51-11-200-004; this did not require, nor lead to, jacking of the aircraft.

15. The engineer was not made aware of a later task AMM 05-11-200-004A.

16. AMM 05-51-11-200-004A was a more up to date check, which would have called for the jacking of the aircraft.

17. AMM 05-51-11-200-004A is available on AirN@V by either expanding the menu, scrolling through the pages or using search and hot links.

18. Scrolling through jobs is not easy to do in AirN@V, in comparison to PDF.
19. The engineer at Bristol did not consult the operator's Maintrol at Manchester.
20. The effectivity coding of AMM 05-51-200-004 indicated that it was effective for G-BXKD, there was no mention of any SBs.
21. AMM 05-51-200-004A was also effective for G-BXKD, but only POST SB 32-1124.
22. SB 32-1124 had been accomplished on G-BXKD, in November 2001.
23. Airbus manuals do not state if a section is for PRE SB aircraft in their effectivity coding.
24. The operator's Maintrol were not aware of the LOAD <15> report prior to G-BXKD's arrival at Manchester.
25. Following the aircraft's arrival at Manchester, troubleshooting led the engineers to a fault with sensor 20GA.
26. The apparent fault with 20GA was due to the overextension of the landing gear oleo after take off from Bristol.
27. During the troubleshooting no link was made between the sensor fault and the LOAD <15> report.
28. Although the engineers were aware of the LOAD <15> report for the landing at Bristol, the technical log had been cleared following the inspection so they did not pursue this further.
29. The AirN@V troubleshooting manual, for the faults described on the PFR and LGCIU BITE, would have required the aircraft to be jacked.
30. There was no mention in the AMM that a landing gear sensor fault, following a LOAD <15> report, could indicate internal damage to the landing gear.
31. Interpretation of the LOAD <15> report is not easy without the use of the AMM.
32. The flow chart in AMM 31-37-00, page block 201, does not provide the same categories, for the various events, as those in AMM 05-51-11-200-004A
33. The LOAD <15> report presents various figures that require decoding and is not in plain text.

Safety Recommendations

The following safety recommendations were made:

Safety Recommendation 2007-105

Airbus amend their maintenance documentation effectivity coding to clearly state if the relevant section is only applicable to 'PRE SB' aircraft, as well as those that are already marked as being 'POST SB'.

Safety Recommendation 2007-106

Airbus amend the A319/A320/A321 AMM to highlight the possibility of internal damage to the landing gear and to recommend the jacking of an aircraft following a fault of sensor 20GA or 21GA on a subsequent flight, after the generation of a LOAD <15> report.

Safety Recommendation 2007-107

Airbus amend the A319/A320/A321 AMM ATA 31-37-00 to incorporate the classifications of landings quoted in AMM 05-51-11-200-004A into the text and the flow chart and to directly reference 05-51-11-200-004A as the more comprehensive check.

Safety Recommendation 2007-108

Airbus amend the LOAD <15> report to describe clearly the classification of the event that generated the report, similar to those defined in AMM 05-51-11-200-004A.

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2007

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

Published March 2007.

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

Published May 2007.

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

Published September 2007.

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

Published December 2007.

6/2007 Airbus A320-211, JY-JAR
at Leeds Bradford Airport
on 18 May 2005.

Published December 2007.

7/2007 Airbus A310-304, F-OJHI
on approach to Birmingham
International Airport
on 23 February 2006.

Published December 2007.

2008

1/2008 Bombardier CL600-2B16 Challenger
604, VP-BJM
8 nm west of Midhurst VOR, West
Sussex
on 11 November 2005

Published January 2008.

2/2008 Airbus A319-131, G-EUOB
during the climb after departure from
London Heathrow Airport
on 22 October 2005

Published January 2008.

3/2008 British Aerospace Jetstream 3202,
G-BUVC
at Wick Aerodrome, Caithness, Scotland
on 3 October 2006.

Published February 2008.

4/2008 Airbus A320-214, G-BXKD
at Runway 09, Bristol Airport
on 15 November 2006.

Published February 2008.

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