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ADDENDA and CORRECTIONS

(ALL TIMES IN THIS BULLETIN ARE UTC)

SERIOUS INCIDENT

Aircraft Type and Registration:	Boeing 737-8AS, EI-DAL
No & Type of Engines:	2 CFM 56-7B26 turbofan engines
Year of Manufacture:	2003
Date & Time (UTC):	19 November 2009 at 2124 hrs
Location:	Runway 27, Bristol Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 6 Passengers - 135
Injuries:	Crew - None Passengers - None
Nature of Damage:	Underside of right engine cowl
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	32 years
Commander's Flying Experience:	3,553 hours (of which 3,248 were on type) Last 90 days - 209 hours Last 28 days - 87 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

The right engine nacelle made contact with the runway during a landing with a strong and gusty crosswind. The crew did not realise that the engine had made contact with the runway until they vacated the aircraft.

History of the flight

The aircraft was on a scheduled flight from Dublin, Ireland to Bristol Airport. The crew were both based at Bristol and aware of the local conditions prevalent during strong crosswind approaches and landings on Runway 27. The commander was the pilot flying, the runway surface was dry and it was dark.

Prior to the approach the crew received the ATIS information which gave the surface wind as 190°/20 kt. However, later in the descent the crew were advised by ATC that the wind was now gusting 30 kt.

Although the final approach was turbulent, the aircraft was stable at 500 ft radio altimeter height (RA). At about 350 ft RA, the aircraft encountered a strong downdraught which resulted in an EGPWS glideslope warning and three red lights indicated on the PAPIs. This was corrected and the approach continued. At one point, the co-pilot made a "speed" call as the IAS approached 159 kt; V_{APP} was 143 kt.

During the landing flare the commander decrabbed the

aircraft at 15 ft RA and closed the thrust levers at about 10 ft RA. The aircraft experienced a wing drop to the left, which the commander corrected, quickly followed by a more severe wing drop to the right as the right main landing gear touched down.

The remainder of the landing roll was completed uneventfully and the crew did not notice any abnormal aircraft indications. During the taxi to stand the co-pilot advised ATC that they had experienced a significant "wind shift" over the threshold. Although the crew did not believe an engine had contacted the runway the commander said to the co-pilot he would have a look after they shutdown.

The company engineers observed the landing and mentioned that it looked "pretty scary" and considered that the wingtip may have made contact with the runway. Whilst the passengers were disembarking the engineers inspected the aircraft and found damage under the right engine. They subsequently informed the crew who notified ATC. Further examination revealed that the damage was confined to the engine cowl and thrust reverser duct.

A runway inspection subsequently found evidence of contact from the engine nacelle abeam Taxiway Delta; 550 m from the threshold of Runway 27.

Weather information

During the approach the tower controller gave the crew instantaneous wind readouts of 180°/21 kt at 1,000 ft aal and 180°/24 kt at 500 ft aal.

Table 1 shows the recorded wind information at the windsock site located abeam the Runway 27 touchdown markings.

The incident occurred at 2124 hrs.

Recorded information

The CVR and FDR were removed by the operator and sent to the AAIB for analysis.

The FDR showed that just before touchdown there was 9° of left roll, followed by 11.4° of right roll with the right main landing gear compressed.

Discussion

The ATC wind reports and the recorded wind information show that the crosswind was unstable on short finals and during the landing. It is possible that, as the commander corrected the left wing drop and decrabbed the aircraft, the rudder input amplified the right roll to such an extent that the engine nacelle made contact with the runway.

Time	Wind Direction	Wind Speed
2110 hrs	188° Varying 165-206°	24 Gusting 15-35 kt
2120 hrs	186° Varying163-208°	22 Gusting 12-38 kt
2130 hrs	185° Varying170-208°	19 Gusting 10-32 kt

Table 1

Recorded wind information

Safety actions

The crew completed re-training in crosswind landing techniques in a simulator.

INCIDENT

Aircraft Type and Registration:	Bombardier Dash 8 Q400, G-JECZ
No & Type of Engines:	2 Pratt & Whitney Canada PW150A turboprop engines
Year of Manufacture:	2007
Date & Time (UTC):	16 December 2009 at 2030 hrs
Location:	Manchester Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 4 Passengers - 45
Injuries:	Crew - None Passengers - None
Nature of Damage:	Engine intake anti-ice heater mat destroyed
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	46 years
Commander's Flying Experience:	10,148 hours (of which 1,100 were on type) Last 90 days - 127 hours Last 28 days - 43 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and engineering examination by the operator

Synopsis

During the cruise a warning caption in the cockpit illuminated and an electrical burning smell was noted. The commander decided to divert to Manchester. During the descent the burning smell became stronger and was also reported to be in the cabin, which resulted in the commander declaring a PAN. Whilst on the approach two passengers saw sparks coming from the rear of the right engine and, when this was reported to the flight crew, the commander made a MAYDAY call. After an uneventful landing the aircraft was shut down on the runway and the passengers and crew evacuated without injury.

An engineering examination found that the right engine air intake heater adapter had overheated and mechanically failed.

History of the flight

Whilst in the cruise the cockpit ENGINE ADAPT HEAT NO 2 caption illuminated and an electrical burning smell was noted, which dissipated within seconds. The flight crew consulted the Emergency Check List which showed that no further action was required but which advised them to leave, and remain clear of, icing conditions. The commander consulted the cabin crew but they had not noticed any burning smells. He then contacted the flight crew of another company aircraft who advised him that there was significant icing between FL120 and

FL90 which they would encounter during the descent to their destination. The commander decided to divert to Manchester, which he could identify visually. He briefed the cabin crew about the intended diversion and made a passenger anouncement to this effect.

During the descent the smell returned more strongly and the cabin crew informed the flight crew that there was a strong smell in the cabin. The commander and the first officer, in turn, put on their oxygen masks. Initially they could not establish communications with each other. This was found to be the result of a microphone jack not being located in its socket, which was rectified. The commander declared a PAN and was given vectors for an ILS approach. During the approach two passengers saw sparks coming from the rear of right engine and they informed the cabin crew who, in turn, informed the flight crew. Upon receipt of this information the commander declared a MAYDAY. Following a normal landing the aircraft brought to a halt on the runway. The park brake was applied, the engines shut down and the passengers and crew evacuated the aircraft without injury.

Engineering examination

An engineering examination, carried out by the operator, showed that the right engine air intake heat adapter, part number 4100S028-03, had overheated, causing mechanical failure of the item. Both left and right engine air intake heat adaptors had been inspected and tested three days prior to this event. The unit was original fit and had operated in excess of 4,000 cycles.

SERIOUS INCIDENT

Aircraft Type and Registration:	DHC-8-402 Dash 8, G-JECN
No & Type of Engines:	2 Pratt & Whitney Canada PW150A turboprop engines
Year of Manufacture:	2005
Date & Time (UTC):	5 January 2010 at 0710 hrs
Location:	Near Southampton
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 4 Passengers - 23
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	47 years
Commander's Flying Experience:	6,000 hours (of which 2,000 were on type) Last 90 days - 100 hours Last 28 days - 27 hours
Information Source:	Aircraft Accident Report Form submitted by the commander and further enquiries by the AAIB

Synopsis

G-JECN departed from Southampton Airport without difficulty. However, during the climb to FL240 the co-pilot noticed an excessive climb rate on the pressurisation system which was shortly followed by the pressurisation fault annunciator. The flight crew attempted to correct the fault but were unsuccessful and so went on to oxygen. They declared a MAYDAY and completed an emergency descent. The MAYDAY was subsequently downgraded to a PAN and the aircraft safely returned to Southampton Airport. Cabin crew and passengers were checked and found to be fit and well. Post-incident investigation indicated that a faulty aft pressure outflow valve was the probable cause of the pressurisation failure.

History of the flight

The aircraft was on a flight from Southampton Airport, UK, to Dublin Airport, Ireland. The aircraft performed an uneventful takeoff and was cleared to climb to FL240 en route.

Flight crew recollections

On passing FL230, the PNF (pilot not flying) observed an excessive climb rate on the pressurisation system, which was shortly followed by the pressurisation fault annunciator. In an attempt to rectify the fault, the PF (pilot flying) selected pressurisation to MAN and then back to AUTO, but the fault persisted.

Both flight crew immediately donned oxygen masks.

The PNF declared a MAYDAY and the PF completed a standard operating procedure emergency descent in accordance with the emergency checklist. The aircraft then levelled at FL100 where the MAYDAY was downgraded to a PAN. The aircraft returned to Southampton without further incident.

Information from crew

Cabin crew

In their subsequent air safety report statements, both cabin crew members recalled that they had been completing bar services when they noticed that sandwich packets and coffee cup foils were beginning to burst. One cabin crew member stated "…as I was walking to the rear of the galley my ears were popping and I felt short of breath, my legs felt weak." Both cabin crew utilised oxygen bottles to regain composure and to refocus. One cabin crew member mentioned "I called the flight deck but there was no answer and I was worried that they were ok." Soon after, an announcement was made from the flight deck over the PA system saying, "this is the Captain, emergency descent is now complete." The cabin crew reported that several passengers complained of sore ears.

Commander

The commander's narrative description of events stated that pressurisation checks were normal during the climb when checked at FL100 and FL200. During the level off to FL240, the cabin rate of climb was observed to be 1,500 ft per minute and increasing. This was shortly followed by the pressurisation fault annunciator.

In his narrative, the commander explained that "the selection of pressure controller to MAN then back to AUTO was/is a known/approved method of clearing pressure fault light." When this did not appear to rectify the situation, both pilots went on to oxygen, just before the master warning sounded.

The commander also stated that neither member of the flight crew remembered hearing the call bell when the cabin crew attempted to contact the cockpit.

Recorded information

The information recorded on the FDR and CVR in relation to the depressurisation event, and the subsequent actions taken, is consistent with the information provided by the flight crew.

Engineering examination

Interrogation of the aircraft's Central Diagnostic System records identified the aft pressure outflow valve as the pressurisation failure mode. Following replacement of the suspected faulty valve, a functional test determined all operations of the component to be normal. In addition to replacing the outflow valve, all aircraft door seals and air conditioning ducts were inspected but no defects were evident. This was followed by a full operational test of the pressurisation system which was completed successfully and the aircraft has since been returned to service. After replacement of the aft outflow valve there was no recurrence of the reported event.

Following the incident, the aircraft operator returned the suspected faulty outflow valve to the component manufacturer for investigation. Fitted at build in 2005, the valve had completed 7,493 hours, 8,649 cycles at removal. Over the 12 months to 12/01/2010, the MTBUR (Mean Time Between Unscheduled Removals) for this part with this operator was 20,855 hours.

Outflow valve history & related events

The operator perceived the reliability of the outflow valve on this aircraft type to be a continuing concern,

which it believed was being addressed by both the aircraft and component manufacturer. However, the aircraft manufacturer has stated that the reliability of the aft outflow valve is within tolerable limits according to its Failure Recording And Corrective Action System (FRACAS). The type of aft outflow valve fitted to G-JECN at the time of the incident was not the most recent revision of the component.

Since the build date of G-JECN, the aft outflow valve has been redesigned twice by the manufacturer. The first revision introduced a noise filter in the actuator part of the outflow valve software. The introduction of the noise filter was intended to improve reliability but this may not have had the desired effect[1]. The redesigned outflow valve was fitted on aircraft G-ECOB and to subsequent aircraft from production, but not to G-JECN. Of the seven aircraft delivered to the aircraft operator with redesigned valves, the operator had experienced at least five failures.

The aircraft manufacturer has recently released SB84-21-09 that introduces a further revised aft outflow valve, which corrects the issue introduced by the previous version.

Analysis

Outflow valve

The root cause of the suspected outflow valve failure on G-JECN had not determined by the component manufacturer at the time of writing. However, based upon evidence obtained from the Central Diagnostic System post-incident, in conjunction with G-JECN's uneventful return to service following replacing the suspected faulty part, it is probable that the aft outflow valve was the source of the depressurisation.

Passenger address and interphone system

After the incident flight, the passenger address and interphone system was tested and was found be operating satisfactorily. A review of the technical history of the system did not reveal any defects relating to an inability to hear the call bell in the cockpit.

Post-incident analysis of the CVR revealed that the audible call bell could be heard in the cockpit but neither member of the flight crew reacted to it. The call bell sounded shortly after the flight crew opted to use oxygen masks, during a period where they were busy trying to establish initial communications with each other. The CVR revealed that a member of the flight crew mentioned that he was experiencing pain with his ears as a result of the depressurisation, which may have been a contributory factor in not being able to hear the call bell. In this instance, the flight crew restored communications with the cabin crew upon reaching FL100, thereby allaying the concerns that the cabin crew had had for the welfare of the flight crew.

Footnote

[1] DH8-400-SL-21-014 refers.

ACCIDENT

Aircraft Type and Registration:	Agusta A109E, G-TYCN
No & Type of Engines:	2 Pratt & Whitney Canada PW206C turboshaft engines
Year of Manufacture:	2001
Date & Time (UTC):	18 January 2010 at 1115 hrs
Location:	Private field, Blandford Forum, Dorset
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Landing gear, tail rotor, tail rotor gearbox, left horizontal stabiliser
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	39 years
Commander's Flying Experience:	8,530 hours (of which 980 were on type) Last 90 days - 176 hours Last 28 days - 41 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

At approximately 100 ft agl during an approach to land, the pilot noticed an increased rate of descent, which he tried to arrest by raising the collective control and the aircraft nose. This had little effect and the aircraft landed heavily despite the application of maximum torque just before touchdown. The aircraft bounced into the air and swung through approximately 250° before coming to rest. It is likely that the aircraft entered a votex ring state from which it was unable to recover in the height available.

History of the flight

The aircraft took off at 1030 hrs from the private site at which the accident would later occur to fly to Henstridge to refuel. The pilot reported that as he departed the site there was little or no wind, good visibility, clear skies and "relatively low temperatures". After refuelling at Henstridge, the aircraft takeoff weight was calculated to be 1 kg below the maximum takeoff and landing weight of 2,850 kg. The aircraft departed from Henstridge at 1105 hrs to return to the private site.

The pilot was familiar with the ground features and obstacles at the private site and began a continuous right turn to intercept an approach angle similar to the one he had used when landing there an hour earlier. The approach continued normally until, at approximately 100 ft agl, the pilot noticed that the rate of descent had

"begun to increase markedly". He attempted to reduce the rate of descent by increasing collective pitch and raising the aircraft's nose slightly but by 30 ft agl the rate of descent had reduced only marginally. The pilot applied "maximum torque" and raised the nose further but, when it became clear that the aircraft was going to contact the ground, he levelled the aircraft attitude. The aircraft touched down heavily and skidded briefly before becoming airborne again, at which point a "rapidly increasing yaw" to the right developed. The yaw was not correctable using the anti-torque pedal and the pilot assessed that the tail rotor had probably struck the ground. He lowered the collective lever to reduce the yaw and the aircraft touched down again and came to rest after rotating through approximately 250°.

After exiting the aircraft, the pilot noticed that from time to time there were gusts of wind from the south which he estimated to be approximately 10 kt. He reported that the gusts were not present when he had departed the site approximately one hour earlier and he had seen no visual indication of them prior to landing. In assessing the cause of the accident, the pilot believed that the aircraft had entered a vortex ring state during the very late stages of the approach. He thought that flying a normal approach at high aircraft mass and low airspeed with a slight tail wind had led to the high rate of descent which he had been unable to arrest.

Vortex ring state

A vortex ring state requires a helicopter to have power applied while it descends at slow airspeed. Air re-circulates through the main rotor, which reduces total rotor thrust and increases rate of descent. A vortex ring state is more likely to be encountered at high aircraft mass and with a tailwind. The high aircraft mass increases the power requirement, and the tailwind leads to a higher rate of descent for a given approach angle. During the early stages of vortex ring development, recovery might be achieved by applying a large amount of excess power. However, if the rate of descent is high enough there might not be sufficient power available to arrest the rate of descent. Recovery can be accomplished by lowering collective pitch and increasing forward speed. Both methods require sufficient altitude to be successful.

SERIOUS INCIDENT

Aircraft Type and Registration:	Cessna 172M Skyhawk, G-ECON
No & Type of Engines:	1 Thielert TAE 125-01 piston engine
Year of Manufacture:	1975
Date & Time (UTC):	10 December 2009 at 1605 hrs
Location:	Bournemouth Airport
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - None Passengers - None
Nature of Damage:	Left wheel spat, hub and brake disc damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	70 years
Commander's Flying Experience:	132 hours (of which 3 were on type) Last 90 days - 5 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot and enquiries by the AAIB

Synopsis

During the landing roll the hub on the left wheel came apart, allowing the outer section of the wheel hub, the tyre and inner tube to depart the aircraft. Four of the six bolts that clamp both parts of the hub together had wound out of their locating holes in the inner section of the hub. The first two to three threads in the remaining two holes in the inner section of the hub had been stripped.

History of the flight

The pilot and two passengers had flown from Bournemouth to Dunkeswell and the incident occurred on the return flight to Bournemouth. The pilot found nothing unusual with the aircraft during the pre-flight inspection at Dunkeswell and the aircraft handled normally during the taxi to the runway. However during the takeoff run the pilot felt a bump, which he described as feeling as if one of the wheels had hit a pothole. Once airborne, the pilot and front seat passenger visually checked the mainwheels and spats, which appeared normal. The aircraft made a normal touchdown at Bournemouth, but after travelling approximately 200 m along the runway, there was a loud noise. The passenger in the rear seat then informed the pilot that the left mainwheel had departed the aircraft.

Debris found at Dunkeswell

The following morning a pilot lining up on Runway 05

at Dunkeswell informed the Air/Ground operator that there were pieces of fibreglass on the runway. These were later established as coming from the outboard section of a wheel spat, which had the same paint scheme as G-ECON. The airfield operator recovered the items and later informed the AAIB that the runway was in good condition, with no potholes.

Aircraft damage

The inner section of the wheel hub and the wheel bearing assembly had remained correctly attached to the axle by its retaining nut, but the outer section of the wheel hub, the tyre and inflated inner tube had departed the axle. The wheel spat had also broken away, in one piece, from its mounts on the landing gear and was found lying near the aircraft. Apart from some rubbing marks on the outer sidewall, the tyre was in good condition. The bottom of the inner wheel hub and brake disc had been abraded and slightly distorted as a result of rubbing along the surface of the runway.

Four of the six bolts which clamp the two parts of the hub together were recovered. The threads on all four bolts were found to be intact and undamaged. On one of the bolts the last two threads were found to contain sections of thread which had been pulled out of the holes in the inner section of the hub. Of the six threaded holes in the inner section of the hub, four were relatively undamaged and the first two to three threads had been stripped in the remaining two holes.

Maintenance

The hub was last assembled when the tyre was fitted on 10 July 2009, approximately 71 flying hours prior to the incident. The bolts clamping both parts of the hub together are required to be torqued to 190 to 200 lb-in; no locking compound or physical locking devices are used on the bolts. The wheels were last visually inspected, with the spats fitted, by the same maintenance organisation that had fitted the tyre, during the 50-hour inspection on 13 November 2009, approximately 19 flying hours before the incident.

Discussion

The condition of the bolts and threads in the inner hub suggests that either the bolts were not fitted correctly, or the torque on all the bolts released and vibration caused them to unwind until there were only two to three threads on two of the bolts clamping the hub together. G-ECON has a very distinctive colour scheme and it is highly likely that the pieces of wheel spat found at Dunkeswell came from this aircraft. This evidence is consistent with the pilot's account of feeling a bump through the landing gear during the takeoff run, which was probably the point at which the left wheel hub started to come apart. The pilot commented that it was difficult to inspect the wheels with the spats fitted (Figure 1).

Figure 1
G-ECON

ACCIDENT

Aircraft Type and Registration:	Piper PA-28-140 Cherokee, G-AVWJ
No & Type of Engines:	1 Lycoming O-320-E2A piston engine
Year of Manufacture:	1967
Date & Time (UTC):	19 February 2010 at 1300 hrs
Location:	Full Sutton Airfield, Yorkshire
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Nose landing gear collapsed; bent propeller and cowling
Commander's Licence:	Student
Commander's Age:	33 years
Commander's Flying Experience:	46 hours (of which 17 were on type) Last 90 days - 2 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

A student pilot undertaking a solo navigational exercise attempted to take off from Full Sutton Airfield. During the takeoff run, the aircraft veered to the left of the runway and came to rest in an adjacent ploughed field.

History of the flight

The instructor gave permission for the student pilot to undertake a solo navigation exercise following a number of instructional lessons earlier that day. During the lessons prior to the accident, the student had performed six takeoffs. As noted in the instructor's narrative, the weather was good, with light winds, and the grass runway was reported to be dry and firm.

Following pre-takeoff checks, the student pilot obtained clearance to line up on the runway ready for takeoff and was informed of a 5 kt crosswind by the controller.

On commencing the takeoff run, the student pilot applied power and the aircraft quickly veered to the left. The student applied right rudder to counteract this, but in his opinion, the control input he made was too vigorous. The student then applied left rudder even harder to try to correct, causing the aircraft to leave the runway. The nose gear collapsed and the aircraft came to rest in an adjacent ploughed field, damaging the propeller and forward section of the aircraft.

The student pilot exited the aircraft safely, with only

a minor injury to his hand occurring as a result of the accident.

In his description of events, the student pilot believed that the accident was as a result of overly vigorous control inputs and not reducing the throttle quickly enough to prevent the aircraft from departing the runway into the adjacent field.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28R-180 Cherokee Arrow, G-CSWH
No & Type of Engines:	1 Lycoming IO-360-B1E piston engine
Year of Manufacture:	1968
Date & Time (UTC):	19 February 2010 at 1442 hrs
Location:	Abbots Bromley, Staffordshire
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to undercarriage and right wing detached
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	45 years
Commander's Flying Experience:	10,500 hours (of which 22 were on type) Last 90 days - 81 hours Last 28 days - 40 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot intended to take off from Runway 22 at Abbots Bromley. The grass runway is 680 m long and is upsloping either side of the centre. The runway surface was reportedly firm and covered with 1 to 2 cm of snow from a recent shower; the aircraft itself was free of snow. The initial acceleration appeared normal and the aircraft lifted off approximately halfway along the runway. It immediately drifted to the left, which the pilot corrected. It then touched down twice on the now upsloping runway. It failed to climb and passed through two hedges before coming to rest in a field with its right wing detached. Neither occupant was injured and both vacated the aircraft through the main door.

The pilot reported that the airfield's black windsock was difficult to see and that after the accident the wind direction appeared to have changed, perhaps as a result of the recent shower. He also considered that the additional drag of the snow on the runway may have reduced the aircraft's acceleration. His decision to continue with the takeoff was partly influenced by the fact that the aircraft did not have brake pedals fitted to the right hand seat position from which he was flying.

INCIDENT

Aircraft Type and Registration:	Piper PA-34-200 Seneca, G-AZOL
No & Type of Engines:	2 Lycoming IO-360-C1E6 piston engines
Year of Manufacture:	1971
Date & Time (UTC):	14 July 2009 at 1000 hrs
Location:	Stapleford Flying Club, Essex
Type of Flight:	No intention of flight
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Propeller blades and dent in leading edge of wing
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	51 years
Commander's Flying Experience:	11,587 hours (of which 4,100 were on type) Last 90 days - 82 hours Last 28 days - 31 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Whilst starting the aircraft's right engine, in order to move the aircraft which was obstructing the fuel pumps, it unexpectedly moved forward and its right propeller struck a parked van.

Sequence of events

Although this incident is classified as non-reportable, as there was no intention of flight, there is a significant safety message which warrants the publication of a report by the Air Accidents Investigation Branch.

The flying club had three PA-34 aircraft, two of which were fitted with footbrakes in both pilot positions and one aircraft, G-AZOL, which only had footbrakes fitted in the left pilot's position. An instructor at the club noticed that G-AZOL had been parked on the taxiway near the fuel pump, preventing other aircraft from being refuelled. The instructor, who was current on the PA-34, assumed that G-AZOL had been parked there for refuelling and that an engine had probably flooded, which would have made it difficult to start. He climbed into the right seat, visually checked that the parking brake was on and proceeded to start the right engine. As it started, the aircraft began to move forward. The instructor attempted to apply the footbrakes, when he realised that they were not fitted to the right pilot's position on this aircraft. The aircraft swung to the left and its right propeller struck the bonnet and radiator grille of a van which had been parked close by. After shutting down the engine, the instructor checked the

parking brake and discovered that it could be pulled on another notch.

Actions following the incident

Following this incident, footbrakes have been fitted to the right pilot's position on G-AZOL such that all the PA-34 aircraft at the club are now of the same standard. Aircraft are no longer allowed to be parked in the area of the fuel pumps and the airfield has reviewed its policy on the parking of vehicles.

ACCIDENT

Aircraft Type and Registration:	Pitts S-12 Special, G-PXII
No & Type of Engines:	1 Ivchenko Vedeneyev M-14P piston engine
Year of Manufacture:	2006
Date & Time (UTC):	14 May 2009 at 1205 hrs
Location:	White Waltham Airfield, Berkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Serious) Passengers - N/A
Nature of Damage:	Fuselage, wings and engine cowling damaged; landing gear and propeller destroyed
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	37 years
Commander's Flying Experience:	747 hours (of which 25 were on type) Last 90 days - 33 hours Last 28 days - 11 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft failed to complete a 'cobra' aerobatic manoeuvre, possibly as a result of slow engine acceleration in the climb and subsequently impacted the ground.

History of the flight

The pilot was practicing an aerobatic 'flat sequence' over the airfield, intended for performance below 1,000 ft agl. Actual meteorological conditions included scattered cloud above 2,700 ft and a light wind from the north east. Witnesses saw the aircraft pitch up almost vertically before entering what was described by most as a stall turn and by others as a wingover, near the apex of which the engine was heard to "cough". After exiting the manoeuvre with its nose pointing downwards the aircraft pitched up to an approximately level attitude. The flight path remained downwards, however, and the aircraft struck the ground with a high rate of descent. It bounced, leaving behind parts of the landing gear, propeller and engine cowlings, before coming to rest upright near the threshold of the grass Runway 29, approximately 250 m southeast of the initial impact. There was no fire and the fuselage was substantially intact but the pilot, who was wearing a seven-point harness and helmet, sustained serious injuries.

Information provided by the pilot

The pilot described himself as a full-time display pilot with considerable knowledge of aerobatics including at low level. He stated that he held an 'unlimited' level display authorisation and had experience in several Pitts types and other aircraft powered by the Ivchenko M14. Interviewed several months after the occurrence, he could not recall the flight but concluded that during the manoeuvre described by witnesses, he was probably attempting a figure that he referred to as a "cobra". This involved slowing the aircraft to below approximately 80 mph using idle power, then applying full throttle while pitching the aircraft nose-up to achieve a near vertical attitude for a short period. Recovery would be affected by pitching nose-down and flying out of the manoeuvre as the aircraft accelerated.

The pilot commented that if control was lost at the apex of a cobra manoeuvre with full power applied, the aircraft tended to roll and yaw to the right and sometimes pitched inverted. He added that when applying full power rapidly from idle the engine might respond slowly and that a momentary lack of power in the climbing phase of the manoeuvre would make it harder to complete successfully. He usually aimed to enter the manoeuvre at between 750 ft and 850 ft but had done so at 600 ft in training.

Additional information

The AAIB contacted other pilots, including a co-owner of the accident aircraft, who had conducted this manoeuvre in aircraft powered by the M14 engine. They concurred that the engine could be slow to respond to rapid opening of the throttle and stated that they would normally conduct the manoeuvre at a minimum height of 600 ft, much of which would be required to affect a recovery if control was lost at its apex.

The co-owner commented that at high engine power the ailerons of the Pitts S-12 had insufficient authority to maintain roll control of the aircraft if forward airspeed fell below 40 mph, which might occur rapidly if insufficient power was available in the climbing phase of a cobra manoeuvre. He added, however, that witness reports of the aircraft being almost vertical indicated that full power had been available at some point in the manoeuvre because insufficient pitch control would have been available without it.

One witness stated that the aircraft entered the manoeuvre at a height of approximately 300 ft but the lack of any onboard or radar recording meant that there was no means of assessing it accurately. Other witnesses did not offer an opinion.

Analysis

Witness statements were consistent with the aircraft failing to complete a cobra manoeuvre in a manner characteristic of loss of control at its apex. Slow engine response to rapid throttle opening probably caused an unexpectedly rapid loss of airspeed which, when full power was achieved, resulted in insufficient flight control authority. The aircraft did not return to a safe flight path in the height remaining.

Comment

All of the pilots consulted during the investigation, including the accident pilot, emphasised the importance of entering a manoeuvre at a height from which recovery was possible in the event of failure to complete it as planned. The British Aerobatic Association refers on its website to Safety Sense Leaflet 19 – *'Aerobatics'*, published by the Civil Aviation Authority, which considers this issue. The leaflet states in its summary *'start with sufficient height to give plenty of margin if things go wrong'*.

ACCIDENT

Aircraft Type and Registration:	Reims Cessna FR182 Skylane RG, G-NOCK
No & Type of Engines:	1 Lycoming O-540-J3C5D piston engine
Year of Manufacture:	1979
Date & Time (UTC):	20 October 2009 at 1121 hrs
Location:	Cambridge Airport, Cambridgeshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to propeller and forward fuselage
Commander's Licence:	Private Pilot's Licence
Commander's Age:	59 years
Commander's Flying Experience:	1,606 hours (of which 120 were on type) Last 90 days - 25 hours Last 28 days - 6 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft was on approach to Cambridge Airport. When the pilot selected the landing gear down, the gear down green light did not illuminate. The control tower confirmed that the nose gear had not deployed. The pilot followed the emergency procedures in the Pilot's Reference Handbook, which included use of the hand pump, but was still unable to deploy the nose gear. He made a MAYDAY call and landed on Runway 10, which is grass. The aircraft settled onto its nose, resulting in damage to the propeller and forward fuselage. The pilot was unable to identify why the nose gear failed to deploy, but intends to have the nose gear actuator overhauled and to replace the hydraulic hoses.

ACCIDENT

Aircraft Type and Registration:	Robin HR200/120B, G-BYSG
No & Type of Engines:	1 Lycoming O-235-L2A piston engine
Year of Manufacture:	1999
Date & Time (UTC):	9 February 2010 at 1205 hrs
Location:	Sibson Airfield, Cambridgeshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Nose gear leg collapsed and damage to propeller
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	79 years
Commander's Flying Experience:	227 hours (of which 129 were on type) Last 90 days - 3 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot was making an approach to Runway 33 at Sibson Airfield in turbulent wind conditions. The wind was from 360° at 12 kt. The aircraft encountered sink late in the approach and the pilot did not apply the throttle quickly enough to counter it, with the result that the nose gear struck an airfield boundary fence. The fence was approximately 40 m from the white markings that denote the threshold for Runway 33. The aircraft touched down on the grass runway and the nose gear collapsed. The pilot, who was uninjured, believed that the aircraft had lost height due to windshear. A flying instructor at the airfield recalled that there was a shower in the area at the time of the accident, which may have contributed to the difficult wind conditions.

ACCIDENT

Aircraft Type and Registration:	Aeroprakt A22-L Foxbat, G-NJTC
No & Type of Engines:	1 Rotax 912 ULS piston engine
Year of Manufacture:	2006
Date & Time (UTC):	12 December 2009 at 1500 hrs
Location:	Glassonby Airfield, Cumbria
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to propeller, nose gear and engine
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	57 years
Commander's Flying Experience:	368 hours (of which 154 were on type) Last 90 days - 10 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft veered to the left shortly after becoming airborne from Runway 36 at Glassonby Airfield. Despite the application of full right rudder, the pilot was unable to regain control of the aircraft and he decided to abort the takeoff at a height of approximately 6 ft above the ground. The aircraft touched down to the side of the runway, sustaining damage to its propeller, nose gear and engine. The pilot and passenger were uninjured. The aircraft was subsequently inspected by an engineer experienced on this type of aircraft; no defects were found that could have contributed to the accident.

ACCIDENT

Aircraft Type and Registration:	Flight Design CTSW, G-CGHE
No & Type of Engines:	1 Rotax 912ULS piston engine
Year of Manufacture:	2009
Date & Time (UTC):	6 February 2010 at 1330 hrs
Location:	Wyken Road Private Strip, Suffolk
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Fuselage and wing roots cracked; nosewheel collapsed
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	48 years
Commander's Flying Experience:	78 hours (of which 33 were on type) Last 90 days - 3 hours Last 28 days - None
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft had just returned from a local flight and approached the airfield in light winds. As the aircraft touched down, it bounced on its main wheels, followed by a second heavy impact which caused significant damage, including the collapse of the nose landing gear. It then rolled onto the left and the right wing before coming to rest. The pilot, who had been wearing a full harness, was uninjured.

The pilot considered that the bounce at touchdown was caused by flaring the aircraft too late. After becoming airborne again he attempted to lessen a second impact by pitching the nose up. He considered that this then lead to a stall and the subsequent heavy landing. In a frank statement he indicated that, in hindsight, he should have applied full power and gone around after the first bounce.

ACCIDENT

Aircraft Type and Registration:	Jabiru UL-D, G-JAAB
No & Type of Engines:	1 Jabiru Aircraft Pty 2200B piston engine
Year of Manufacture:	2006
Date & Time (UTC):	12 September 2007 at 1541 hrs
Location:	Upper Dean, 10 nm north of Bedford, Bedfordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Landing gear and left wing damaged
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	39 years
Commander's Flying Experience:	175 hours (of which 131 were on type) Last 90 days - 34 hours Last 28 days - 18 hours
Information Source:	AAIB Field Investigation

This investigation was conducted in parallel with the investigation into G-CEED, also published in this AAIB Bulletin, 5/2010.

Synopsis

Approximately two hours into the flight the pilot noticed the sudden onset of vibration. He reduced the engine power, which reduced the vibration but the aircraft was unable to maintain altitude. He made a MAYDAY call to ATC and during the approach to a field the engine stopped. During the landing roll the nosewheel dug into soft ground, causing the aircraft to turn right and come to a rapid halt. Examination of the engine revealed that the No 3 cylinder exhaust valve had failed in fatigue and the remaining three exhaust valves had fatigue cracks in the same area. The engine had operated for 121 hours since manufacture and had the changes in Jabiru Service Letter JSL 002-1, '*Jabiru Engine Economy Tuning',* embodied.

During this investigation, items from another, similar, Jabiru 2200 engine, fitted to a Thruster microlight, G-CBIP, were examined following a failure of No 1 cylinder exhaust valve. The metallurgical examination of all four exhaust valves indicated a failure mode and fatigue cracking very similar to those from G-JAAB. The engine had operated for approximately 300 hours since the valves were replaced and had the changes in Jabiru Service Letter JSL 002-1 titled '*Jabiru Engine Economy Tuning'* embodied.

History of the flight

The pilot/owner carried out a full pre-flight inspection which included topping up the engine oil and filling the fuel tank with 100/120LL Avgas. A full tank gave approximately 5 hours endurance. The pilot flew an uneventful flight from Rochester to Manchester Barton where he refuelled the aircraft, again filling the tank, with Avgas. After approximately an hour on the ground at Barton the pilot returned to the aircraft, carried out a pre-flight inspection, started the engine and departed back to Rochester. Approximately two hours after departing from Barton the pilot felt a sudden vibration from the engine. He reduced power and the vibration reduced and he was able to maintain 1,800 rpm with moderate vibration. The pilot made a PAN call to Cranfield ATC, reported what had happened and that the aircraft was unable to maintain altitude. He also set the transponder code to 7700. Cranfield ATC asked the pilot if he intended to land at an airfield but as the aircraft was descending through 1,000 ft amsl, and there was a built-up area to transit to the nearest airfield, he decided to carry out a forced landing in a suitable field.

After declaring a MAYDAY the pilot noticed a large helicopter circling what appeared to be a grass strip suitable for microlight aircraft. He made an approach to the apparent microlight strip but soon realised that it was not long enough for a safe landing and instead opted for a nearby large ploughed and tilled field. During the approach the engine stopped. Touchdown was at a normal aircraft attitude but on a piece of rough ground. As the airspeed reduced the nosewheel dug into the soft ground, causing the aircraft to turn to the right and the left wing to contact the ground. The aircraft rapidly came to a halt and settled onto all three landing gears. The pilot turned off the electrics and fuel before exiting the cockpit. After establishing that there was no fire or fuel leak he re-entered the cockpit, turned on the electrics and attempted to make radio contact with Cranfield ATC to inform them of his position and that he was uninjured. Although he could hear Cranfield they could not hear him. Eventually another aircraft, that was airborne, acted as a relay.

Engine description

The Jabiru 2200 is a four-stroke horizontally-opposed four cylinder piston engine, normally aspirated and air cooled. The displacement is 2200 cc which produces nominally 85 hp at 3,300 rpm. The fuel specified is either Avgas 100/130 (preferred) or Mogas with an octane rating of 95 or above. The carburettor is pressure compensated and is mounted to a plenum chamber in the sump casing by a flexible rubber coupling. From the plenum chamber the fuel/air mixture is delivered to the cylinders via individual inlet pipes. There is no fuel mixture control in the cockpit. The fuel/air mixture is set up during manufacture, installation or maintenance. There is one cylinder head temperature sensor, mounted under the No 4 cylinder spark plug, which is connected to a gauge in the cockpit.

The engine is fitted to a wide range of manufactured and home built Light Sport Aircraft worldwide.

Engineering examination – G-JAAB

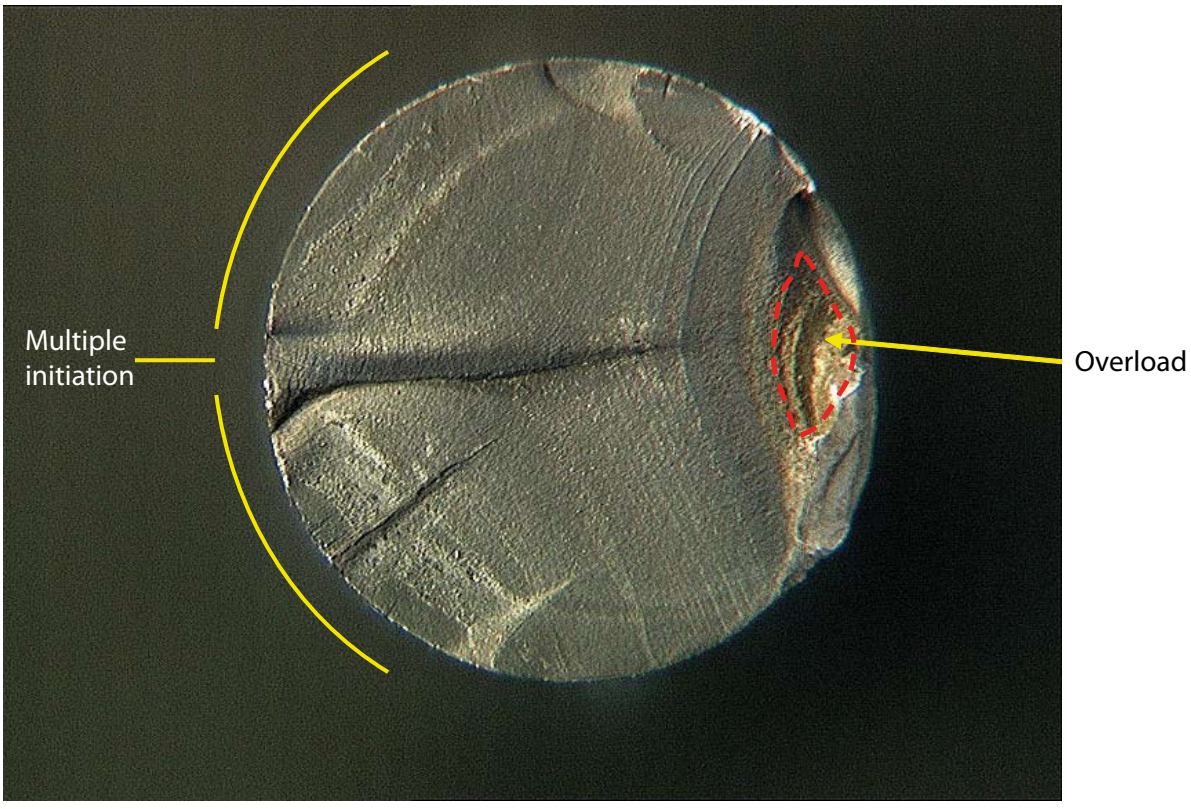
The engine was taken to the manufacturers' UK agent for strip examination. This examination revealed that the head of the No 3 cylinder exhaust valve had broken away from the valve stem. The cylinder heads and their inlet and exhaust valves were taken to QinetiQ for detailed metallurgical examination.

Examination of the No 3 exhaust valve showed that the fracture occurred in the stem of the valve adjacent to

the head radius. It was noted that the stem-side fracture was coated with a dark deposit unlike the head-side, which was relatively clean. Detailed examination of the stem-side deposit under high power optical microscopy revealed the presence of bright discrete globular metallic particles amongst the deposit. The particles were soft and could be smeared, which suggested that they could be particles of lead. After cleaning, the fracture surface of the stem side was examined and seen to exhibit beachmarks, which are characteristic of failure due to fatigue crack growth (Figure 1). Multiple fatigue crack initiation sites were present around the majority of the valve circumference, although crack growth appeared to have been predominantly from one side of the valve. A small area of overload was present at the end of the fatigue.

Visual examination of the remaining section of the exhaust valve stem revealed secondary cracking adjacent to the fracture surface (Figure 2).

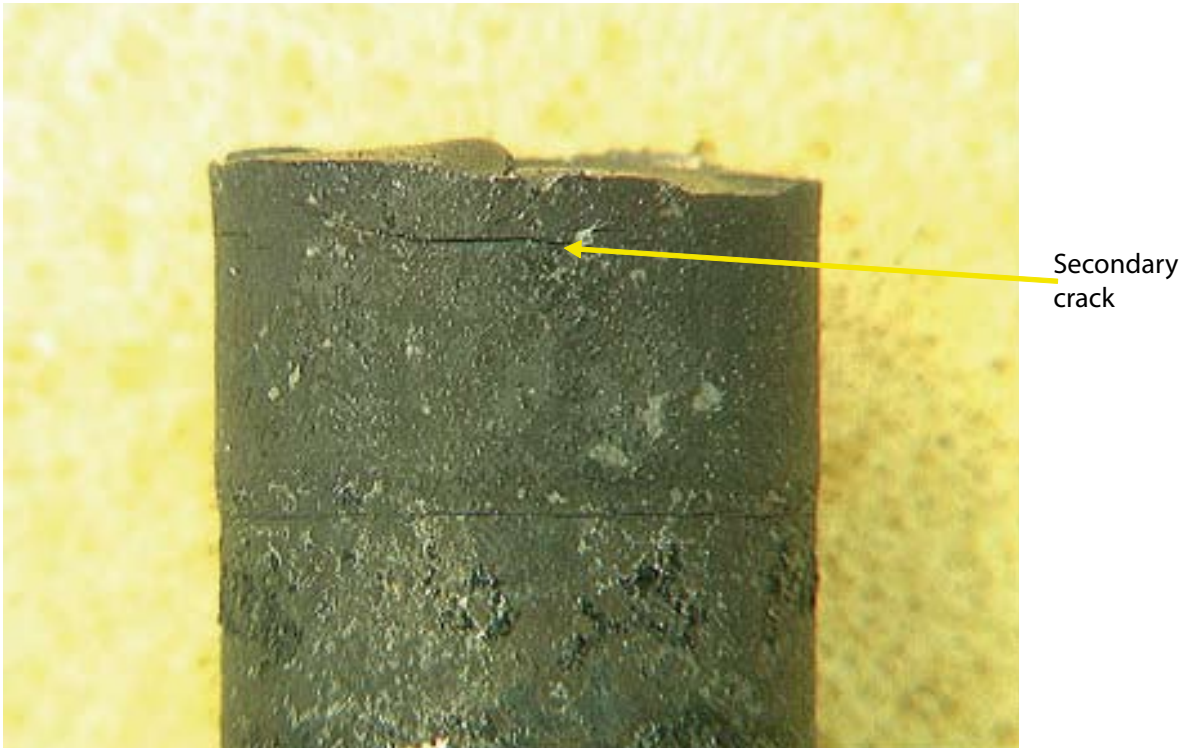
Examination of the cylinder head showed extensive mechanical damage on the internal surface caused by repeated impacts of the head of the exhaust valve after detachment from the stem; this pattern of mechanical damage was also observed on the piston crown. Detailed examination of the exhaust port on the cylinder head showed evidence of globular metallic particles similar to those observed on the fracture surface of the exhaust valve.



Courtsey of QinetiQ

Figure 1

Fracture surface of No 3 exhaust valve from G-JAAB after cleaning



Courtsey of QinetiQ

Figure 2

Stem of No 3 exhaust valve from G-JAAB adjacent to fracture showing secondary cracking

Exhaust valves 1, 2 and 4 exhibited small transverse cracks (Figure 3) at the edge of the head radius, in a position similar to the fracture point of the exhaust valve from cylinder No 3, indicating that all the cylinders had experienced similar high temperatures.

Energy dispersive X-ray (EDX) analysis was carried out in a scanning electron microscope (SEM) on the fracture surface of the No 3 exhaust valve prior to cleaning to determine the composition of the deposit. The EDX spectrum identified elements such as iron, manganese and chromium from the underlying valve steel. However, large amounts of lead, phosphorus and bromine were present, with carbon and oxygen. A metallurgical section of the valve stem was subjected to EDX analysis and the spectrum obtained was consistent with 21-4N valve steel. The SEM examination showed that the microstructure was typical of a 21-4N valve steel, showing an austenitic[1] microstructure structure containing carbide stringers[2]. Adjacent to the failure area, secondary cracking was observed. Corrosion was observed on the surface of the stem and the microstructure showed evidence of grain boundary precipitates[3].

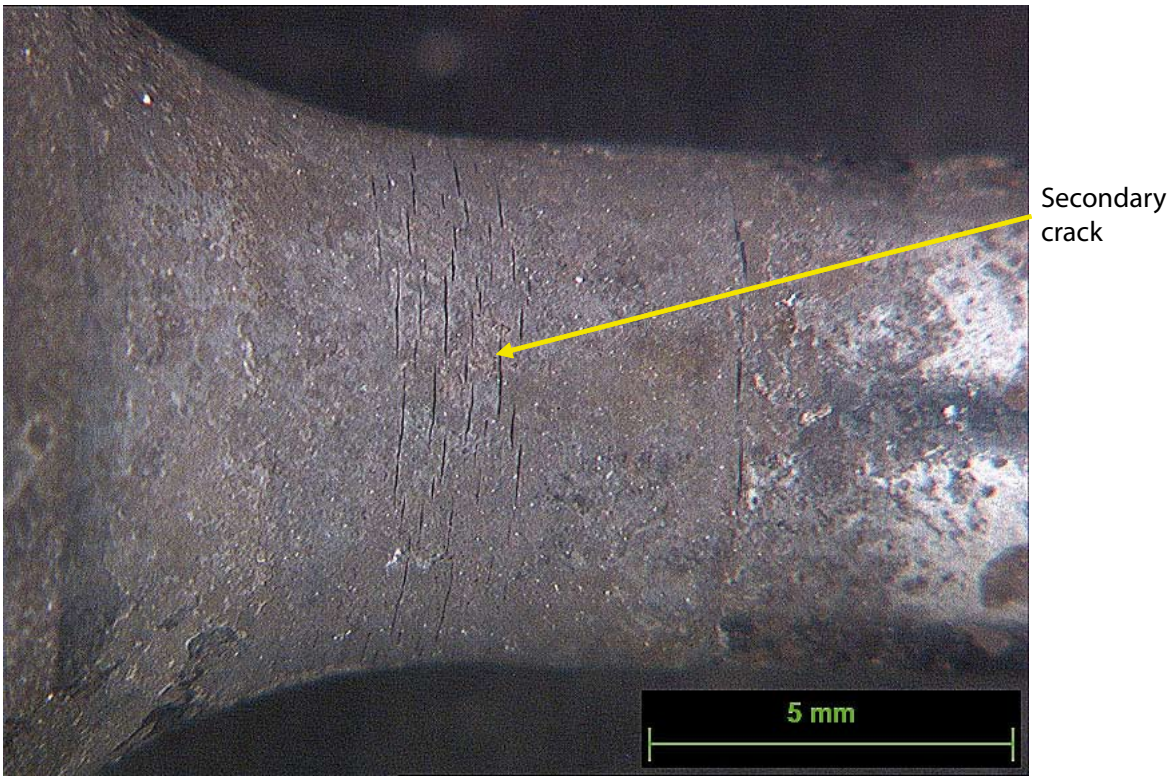
Hardness testing was carried out at a number of points on the No 3 exhaust valve and all values were above the specified minimum hardness for 21-4N material.

Footnote

[1] A nonmagnetic solid solution of ferric carbide or carbon in iron, used in making corrosion-resistant steel.

[2] Carbide stringers are chain-like rows of carbide precipitates (formed from combination of a metal + carbon) that are stretched out in the direction of working.

[3] Grain boundary precipitation is the result of diffusion within the material, the rate of which is controlled by time and temperature. As temperature increases, the rate of diffusion increases and grain boundary precipitation occurs within a shorter time period.



Courtsey of QinetiQ

Figure 3

No 4 cylinder exhaust valve from G-JAAB showing secondary cracking

Other information – G-JAAB

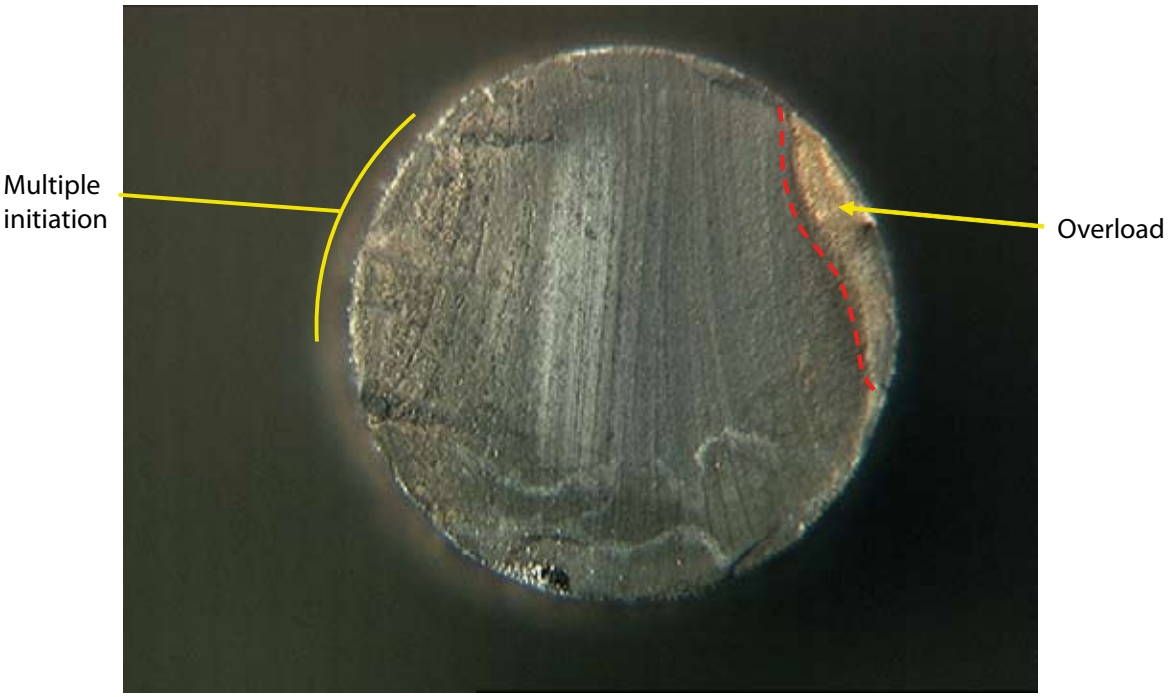
The engineering examination did not show any indication of significant leaks at the cylinder head seals, inlet or exhaust systems and no restriction within the engine oil supply system. The engine had a total of 121 hours in use since it was installed into the aircraft as a new unit and had a 100-hour maintenance check carried out in August 2007 in accordance with the manufacturers' requirements.

The engine was found to have been configured in accordance with Service Letter JSL 002-1 titled '*Jabiru Engine Economy Tuning'* which was issued in December 2004. The owner stated that the engine had only been run using 100 LL Avgas.

Failure of exhaust valve from G-CBIP

During the investigation of the exhaust valves from G-JAAB, the No 1 cylinder head and piston from another Jabiru 2200 engine, fitted to a Thruster T600N microlight G-CBIP, was taken to QinetiQ for examination. The cylinder head contained the inlet valve and the fractured stem of the exhaust valve: the head of the fractured valve was embedded in the piston crown. It was reported that this engine had run for approximately 300 hours. The three other exhaust valves were also examined.

The cylinder head exhibited extensive mechanical damage on the internal surface caused by repeated impacts by the head of the exhaust valve after detachment from the stem, similar to that in G-JAAB. As with G-JAAB, the fracture surface was covered with a dark deposit and globular metallic particles were present



Courtsey of OinetiQ

Figure 4

Fracture surface of No 1 exhaust valve from G-CBIP

within the exhaust port. Figure 4 shows beachmarks clearly visible on the fracture surface, characteristic of fatigue crack growth. The fatigue appeared to have initiated from multiple points on one side of the valve and propagated across the majority of the valve stem before final overload failure occurred.

Examination of the stem surface adjacent to the fracture showed evidence of multiple secondary cracking (Figure 5) similar to that observed in G-JAAB.

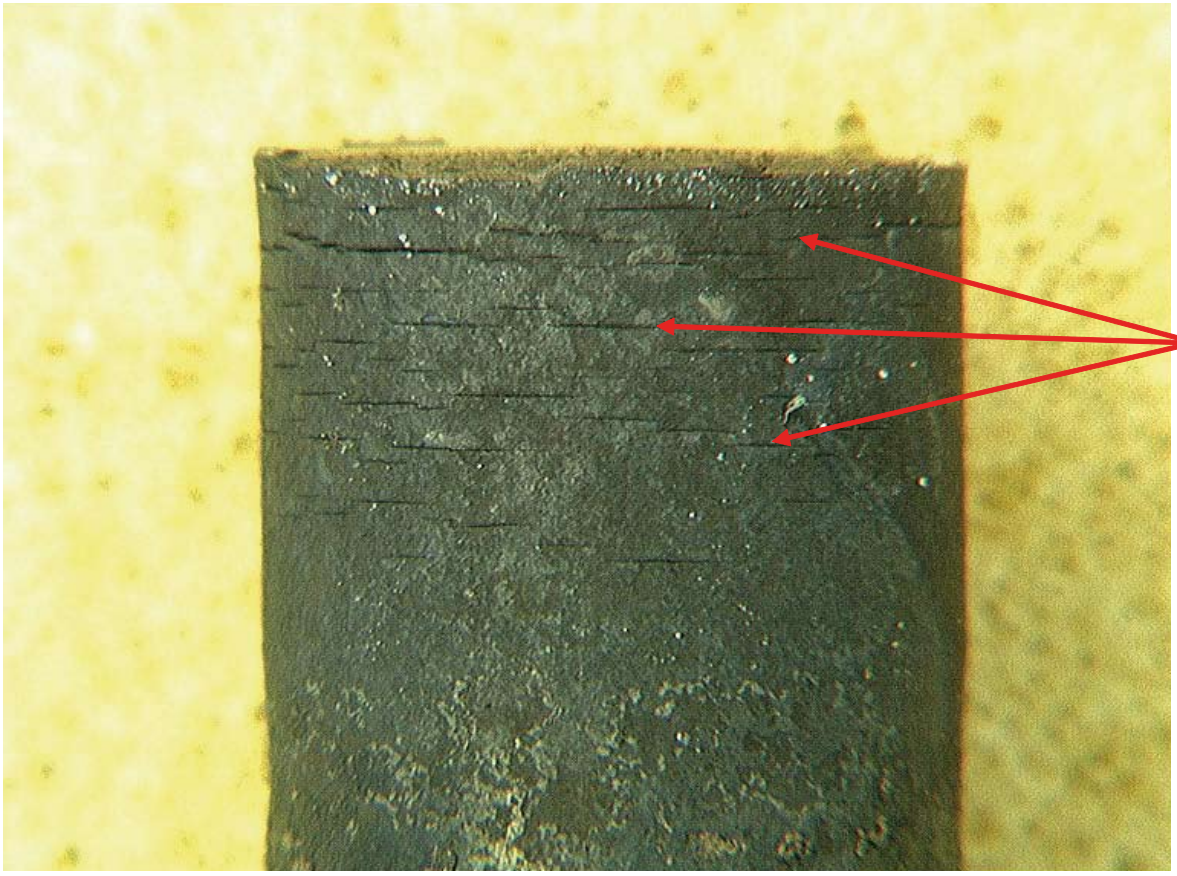
Examination of the three remaining exhaust valves from G-CBIP showed two of the three valves exhibiting small transverse cracks at the edge of the head radius, in a position similar to the fracture point of the exhaust valve from the No 1 cylinder. The cracking was similar to the secondary cracks observed in G-JAAB.

EDX analysis carried out on the fracture surface of the No 1 exhaust valve showed a spectrum similar to the deposit on the No 3 exhaust valve of the engine from G-JAAB, with large deposits of lead and bromine and some phosphorus. The lead and bromine were consistent with combustion products of 'anti-knock', and other, agents in Avgas fuel.

This engine had also been configured in accordance with Service Letter JSL 002-1 '*Jabiru Engine Economy Tuning'* and the owner stated that the engine had been run on both Avgas and Mogas of 95 octane rating and above (approximately 150 hours on each).

Other information and further valves

An intact exhaust valve, removed from a Jabiru 2200 engine during a 1,000-hour maintenance check, was sectioned longitudinally and polished to reveal the microstructure. It was seen that at the base of the stem, the location of the failures and secondary cracking in the valves from G-JAAB and G-CBIP, the material 'etched' differently from further up the stem, indicating



Courtesy of QinetiQ

Figure 5

Secondary cracking in the failed No 1 cylinder exhaust valve stem from G-CBIP

a change in microstructure in this area. The area at the base of the stem showed evidence of extensive grain boundary precipitation, similar to G-JAAB and G-CBIP. Examination at the base of the stem identified two small cracks emanating from corrosion pits at similar positions on opposite sides of the stem, cracks in a similar position to the failures in the valves from G-JAAB and G-CBIP.

A new exhaust valve, supplied by the valve manufacturer, was sectioned longitudinally and examined. The microstructure showed an austenitic grain structure containing carbide stringers similar to the general microstructure of the upper stems of the exhaust valves fitted to the engines from G-JAAB and G-CBIP. At the base of the stem there was some grain growth apparent, but no evidence of the grain boundary carbides seen in the failed and 'used' valves. The microstructure appeared typical of an as-forged 21-4N component.

The typical maximum operating temperature for 21-4N valve steel is in the region of 725-750°C and the microstructures of the failed exhaust valves were discussed with the valve manufacturer. From their experience, they considered that the premature grain boundary precipitation observed in the failed valves indicated that they had been operating in the region of 750-800°C, although this operating temperature could not be verified as no aging or precipitation information could be found for this particular material.

Jabiru Service Letter JSL 002-1

Jabiru JSL 002-1 was issued on 13 December 2004, titled '*Jabiru Engine Economy Tuning'* which introduced the '*Economic Tuning Kit'*. This kit contained new idle, needle and main carburettor jets, a new needle and fitting instructions. This Service Letter introduced 'lean burn' jets into the carburettor to improve fuel consumption at cruise power.

Jabiru Service Bulletin JSB 018-1

Jabiru JSB 018-1 was issued on 5 October 2007, titled '*Jabiru Engine Tuning*'. The Service Bulletin introduced richer running jets into the carburettor to replace those introduced by Service Letter JSL 002-1.

Discussion – G-JAAB and G-BCIP

Examination of the two failed exhaust valves showed in both cases that failure was a result of fatigue crack propagation initiating at multiple origins at the base of the exhaust valve stems. Examination of the valve stem surfaces in the regions of failure identified pitting and general surface corrosion, with secondary cracking. The fatigue cracking probably initiated from corrosion pits on the surface of the stems, which would act as stress concentrators. Examination of the intact valves also showed evidence of corrosion and cracking.

Metallographic examination of the new exhaust valve showed that the microstructure was austenitic with carbide stringers through the grains, typical for 21-4N valve steel. Examination of the failed valves showed a similar microstructure to this 'new' valve towards the stem tip, but closer to the region of failure, the microstructure exhibited grain boundary carbide precipitation along with a lamellar structure within the grains. The degree of grain boundary precipitation increased as the failure location was approached until, at the point of failure, the microstructure exhibited an extensive network of grain boundary precipitates.

Examination of the microstructure of the intact '~1,000 hrs' valve showed evidence of grain boundary precipitation along the length of the stem, not just at the base, which suggests that, at 'typical' operating temperatures, diffusion after approximately 1,000 hours is sufficient to cause grain boundary precipitation along the length of the stem. The failed exhaust valves exhibited grain boundary precipitation at the base of the stem after much shorter periods of time (lowest 120 hours), which suggests that the temperature of the exhaust valve at the base of the stem must have been higher than 'typical'. It is accepted that the base of an exhaust valve stem generally experiences the highest temperatures within a piston engine. Therefore, it is expected that microstructural changes will occur first at the stem base, the hottest part of the valve. However, failures occurring after as little as 120 hours suggests that, in those instances, the exhaust gas temperature was higher than 'typical' - that the engines were running hot and the exhaust valves were overheating.

Grain boundary precipitation and lamellar growth within the grains produces a microstructure that is more susceptible to corrosion in 21-4N valve steel and increased temperature increases the corrosion rate. Therefore, increased exhaust gas temperature increases the temperature at the base of the valve stem, which increases the diffusion rate and hence the rate at which the microstructure changes. The changed microstructure, which is more susceptible to corrosion along with the increased temperature of the exhaust gas, which is itself more corrosive, combine to cause premature corrosion of the exhaust valves, which leads to fatigue crack initiation and eventual failure.

In summary, the evidence from these valve failures indicates that overheating of the valves was at least a contributory factor and this was consistent with the timing of Jabiru JSL 002-1, which introduced 'lean burn' jets into the carburettor to improve fuel consumption at cruise power. However, Jabiru JSB 018-1, issued in October 2007, introduced richer running jets into the carburettor to replace those introduced by Service Letter JSL 002-1.

Safety action

Following the failures of a number of Jabiru 2200 engines in the UK (including G-CEED (10/07), G-CEFY (2/08) and G-JAAB (9/07)) the AAIB informed the engine manufacturer. A number of overheat-related failures occurred in France at about the same time. The engine manufacturer has a continuing programme of product quality improvement and the number of such events reported to the AAIB and the LAA (Light Aircraft Association) has decreased since that period.

ACCIDENT

Aircraft Type and Registration:	Montgomerie-Bensen B8MR, G-CBSV
No & Type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	2002
Date & Time (UTC):	19 November 2009 at 1200 hrs
Location:	Damyns Hall Aerodrome, Upminster, London
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to rotor and propeller
Commander's Licence:	Private Pilot's Licence (Gyroplane)
Commander's Age:	62 years
Commander's Flying Experience:	Not provided
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot was practising flying circuits with tight left turns and short landing rolls. On the accident circuit the autogyro had insufficient height to complete the final turn and it touched down with right slip, causing it to roll onto its side. The pilot was uninjured.

ACCIDENT

Aircraft Type and Registration:	Pegasus Quantum 15, G-MZJN
No & Type of Engines:	1 Rotax 582-40 piston engine
Year of Manufacture:	1997
Date & Time (UTC):	3 March 2010 at 1630 hrs
Location:	Park Hall Farm, near Ilkeston, Derbyshire
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Minor) Passengers - 1 (Minor)
Nature of Damage:	Trike unit and wing
Commander's Licence:	Private Pilot's Licence
Commander's Age:	58 years
Commander's Flying Experience:	2,680 hours (of which 2,000 were on type) Last 90 days - 35 hours Last 28 days - 14 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Following a standard join and circuit for Runway 19, a glide approach was set up. The instructor reported that his student pilot under instruction initiated the flare, but there was no consequent reduction in the aircraft's rate of descent. Despite pitching up further, and applying full power, the aircraft continued to descend and made heavy contact with the ground, damaging the nose section of the trike unit.

The wind at the time was reported as east-southeast at 5 to 7 kt, which placed the touchdown point on the runway downwind of adjacent farm buildings and a small copse. The instructor attributed the heavy landing to severe turbulence at low level.

ACCIDENT

Aircraft Type and Registration:	P & M Aviation QuikR, G-CFOO
No & Type of Engines:	1 Rotax 912 ULS piston engine
Year of Manufacture:	2008
Date & Time (UTC):	19 February 2009 at 1201 hrs
Location:	Park Hall Farm, near Ilkeston, Derbyshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - 1 (Minor)
Nature of Damage:	Trike, wing and propeller damaged
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	37 years
Commander's Flying Experience:	505 hours (of which n/k were on type) Last 90 days - 3 hours Last 28 days - 2 hours
Information Source:	Air Accident Report Form submitted by the pilot.

The aircraft drifted to the left during the takeoff roll, but not sufficiently to cause the pilot concern. He continued with the takeoff initially, but the aircraft failed to attain flying speed. On realising that the aircraft could not become airborne he braked heavily, but was unable to prevent the aircraft from colliding with a hedge to the left of the runway. The passenger suffered a broken foot, but the pilot was uninjured.

ACCIDENT

Aircraft Type and Registration:	Quik GT450, G-CEGV
No & Type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	2006
Date & Time (UTC):	11 December 2009 at 1510 hrs
Location:	Cromer (Northrepps) Airfield, Norfolk
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Extensive damage to the trike and wing
Commander's Licence:	Private Pilot's Licence
Commander's Age:	63 years
Commander's Flying Experience:	185 hours (of which 10 were on type) Last 90 days - 6 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

While landing on a wet grass runway, the microlight veered to the right and entered a field of crops. The nosewheel dug in to the soft ground and the aircraft rolled onto its right side. The pilot, who was uninjured, was converting from three-axis to flex-wing aircraft and believed that he applied too much force to the brakes and, in doing so, may have turned the nosewheel to the right. The pilot's flying instructor was watching the landing and stated that the approach, flare and touchdown appeared normal and that it was only after the aircraft was fully on the ground that it veered to the right.

ACCIDENT

Aircraft Type and Registration:	Savannah Jabiru, G-CEED
No & Type of Engines:	1 Jabiru Aircraft Pty 2200 piston engine
Year of Manufacture:	August 2006
Date & Time (UTC):	20 October 2007 at 1030 hrs
Location:	Near Mergate Hall, Bracon, Norfolk
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Nose landing gear bent backwards, slight indentation on the underside of the engine cowling and forward fuselage
Commander's Licence:	Private Pilot's Licence
Commander's Age:	51 years
Commander's Flying Experience:	247 hours (of which 11 were on type) Last 90 days - 4 hours Last 28 days - 1 hour
Information Source:	AAIB Field Investigation

This investigation was conducted in parallel with the investigation into G-JAAB, also published in this AAIB Bulletin, 5/2010.

Synopsis

About 5 minutes after takeoff the pilot of G-CEED performed a 'FREDA' check and saw that the engine indications were normal. Immediately after completing this check she saw smoke in the cabin and less than a minute later the engine seized. The pilot established the aircraft in a glide and landed in a nearby field. The approach and landing were smooth but the surface was rough, causing the nose landing gear to fold backwards. The pilot and passenger exited the aircraft without injury and there was no fire.

Another aircraft (G-CEFY) with a Jabiru 2200 engine suffered a similar engine failure. Both engines had less than 50 hours of usage since manufacture and the failures were caused by high temperatures generated within the cylinders, softening the piston material which led to the piston rings becoming trapped in their grooves. This allowed engine lubricating oil (or vapour) to enter the combustion chamber, which allowing pre-ignition to occur, leading to burn-through of the piston crown and for oil to be expelled overboard.

Both engines had been modified at manufacture to comply with Jabiru Service Letter JSL 002-1 titled '*Jabiru Engine Economy Tuning'* which introduced lean burn jets into the carburettor.

History of the flight – G-CEED

The pilot of G-CEED carried out a pre-flight inspection and topped up the fuel tank with premium unleaded Mogas. She noticed that the engine oil level was within limits. About 5 minutes after takeoff the pilot carried out an after-takeoff/cruise 'FREDA' check and saw that all the engine indications were normal. Immediately after completing this check she saw smoke in the cabin and less than a minute later the engine seized. The pilot established the aircraft in a glide and landed in a nearby field. The approach was smooth but the landing was into a rough agricultural field, which caused the nose landing gear to fold backwards. The pilot and passenger exited the aircraft without injury and there was no fire.

Engine description

The Jabiru 2200 is a four-stroke horizontally-opposed four cylinder piston engine, normally aspirated and air cooled. The displacement is 2,200 cc which produces nominally 85 hp at 3,300 rpm. The fuel specified is either Avgas 100/130 (preferred) or Mogas with an octane rating of 95 or above. The carburettor is pressure compensated and is mounted to a plenum chamber in the sump casing by a flexible rubber coupling. From the plenum chamber the fuel/air mixture is delivered to the cylinders via individual inlet pipes. There is no fuel mixture control in the cockpit. The fuel/air mixture is set up during manufacture, installation or maintenance. There is one cylinder head temperature sensor, mounted under the No 4 cylinder spark plug, which is connected to a gauge in the cockpit.

The engine is fitted to a wide range of manufactured and home-built Light Sport Aircraft worldwide.

Engineering examination – G-CEED

The engine was taken to the manufacturer's UK agent where a strip examination was carried out under AAIB supervision. When the engine was stripped the No 3 piston was found to have burnt through from top to bottom (Figure 1). There was evidence of piston seizure and partial seizures within the cylinders and excessive heat discolouration of the crankshaft and connecting rod bearings, indicative of the engine having run with insufficient lubricating oil. External examination of the engine did not reveal evidence of an oil leak but there was evidence of oil having been blown out of the engine breather pipe.

All four pistons and cylinders were submitted to the Materials Department at QinetiQ for a detailed metallurgical examination. Examination of the No 3 piston showed pre-ignition to be the most likely cause of the burn-through; pre-ignition occurs when the fuel/air mixture in the cylinder ignites before the plug sparks. The fuel burns and expands before the piston is in the correct position, which causes large stresses in the engine and can cause localised heating sufficient to burn through the piston crown as was seen in this case. The QinetiQ report stated that common causes of heat build-up are:

- Carbon deposits.
- Wrong spark plug heat range.
- Lean fuel mixture.
- Combustible contaminants within the combustion area (oil, diesel, kerosene).
- Insufficient engine cooling (air or oil).

Carbon deposits were unlikely to be the cause in this case; no carbon build-up was observed in the cylinders and the engine was relatively new (43 hours since manufacture). The spark plugs in the cylinders received

Courtesy of QinetiQ

Figure 1

No 3 piston from G-CEED showing pre-ignition damage and burn-through

were NGK D9EA, those specified by the manufacturer. For the pistons to seize, the excessive heat must have been present prior to the piston crown burning-through, possibly caused by a lean fuel mixture and/or insufficient engine cooling. Excessive heat can cause pre-ignition. After the piston rings seized, engine oil could have entered the combustion chamber causing, or contributing to, pre-ignition.

Metallurgical checks carried out on pistons 2 and 3 indicated that they had been overheated. Energy dispersive X-ray (EDX) analysis showed that the pistons were manufactured from a high-silicon aluminium alloy, typical of automotive pistons. Hardness testing indicated that both pistons Nos 2 and 3 had been affected by overheating, which had reduced their strength and piston No 3 had been affected more than piston No 2. The piston rings of pistons Nos 1, 3 and 4 were all seized in the grooves. It is possible that a loss of strength in the pistons allowed the grooves to close up, trapping the rings.

The examination of the four exhaust valves did not identify thermal cracking or corrosion, associated with hotter than typical exhaust gases, seen in other Jabiru engines. As the engine in G-CEED was virtually new, it may be that the exhaust gases were hotter than typical, but it was too early in the valves lives to develop fatigue cracks.

Other information – G-CEED

The engineering examination did not show indications of significant leaks at the cylinder head seals, inlet or exhaust systems and no restriction within the engine oil supply system. The engine had a total of 43 hours in use since it was installed into the aircraft as a new unit and had a 25-hour maintenance check carried out in accordance with the manufacturer's requirements.

The engine was found to have been configured in accordance with Service Letter JSL 002-1 titled '*Jabiru Engine Economy Tuning'* which was issued in December 2004. A fuel sample was taken from the aircraft and analysis showed that it was 95 octane unleaded gasoline (ULGAS, BS EN 228:2004), with no evidence of contamination from another fuel product.

Incident to Jabiru 2200 engine fitted to G-CEFY

This incident occurred 3 February 2008 at Brookfarm airfield, Lancashire. Following an uneventful pre-flight inspection by the pilot/owner, which included checking the engine oil level, the engine was started and power checks carried out. After a normal taxi, takeoff and climb to 500 ft at full power, the pilot lowered the nose, reduced the power to 2,600 rpm and continued in a shallow climb to 1,000 ft. Following a gentle turn the engine 'tone' suddenly changed, as if a spark plug had failed. The pilot returned to the airfield and landed safely. Two witnesses at the airfield are reported to have said that they observed a trail of smoke behind the aircraft.

Engineering examination – G-CEFY

The engine, which had completed 48.9 hours since manufacture, was removed from the aircraft and sent to an aircraft engineering organisation for examination. The examination did not show any evidence of an oil leak, significant leaks at the cylinder head seals, inlet or exhaust manifold systems and no restriction within the engine oil supply system. There was, however, good evidence of the onset of piston seizure within the cylinders and burn-through of the No 3 piston (Figure 2).

Three cylinders and their associated pistons were taken to the Materials Department at QinetiQ for detailed metallurgical examination. Examination of the three cylinders showed that No 3 piston and cylinder exhibited characteristics similar to the No 3 piston and cylinder from G-CEED. The piston/cylinder head interface exhibited sooting on one side of the cylinder, with the corresponding edge of the piston exhibiting burn-through (Figure 2). The internal surface of the cylinder showed evidence of minor wear and material pick-up from the piston at the point of the piston burn-through. Skirt wear was observed on the piston similar to that observed in the examination of the engine from G-CEED. Minor wear was observed below the burn-through with the opposite skirt exhibiting more severe wear. The other two pistons both exhibited skirt wear similar to the No 3 piston. One of the pistons showed evidence of damage to the edge of the piston crown with reciprocating wear and material pick-up on the internal surface of the cylinder. The damage appeared to be purely mechanical, with no evidence of burn-through as seen in the No 3 piston.

Examination of the piston rings and oil scraper rings showed that the lower piston ring was seized in the closed position on one of the pistons and on another the upper ring was seized at the area of the damage, so that it was flush with the piston edge. The other end of the piston ring was free to move. On the No 3 piston both the lower piston ring and oil scraper ring were seized in the closed position.

Courtesy of QinetiQ

Figure 2

No 3 piston from G-CEFY showing pre-ignition damage and burn-through

The visual examination of the three pistons and cylinders showed that an engine failure similar to that of G-CEED. In both cases the engines exhibited seized piston and oil scraper rings, piston skirt wear and burn-through.

The engine in G-CEFY was found to have been configured in accordance with Service Letter JSL 002-1 titled '*Jabiru Engine Economy Tuning'* which was issued in December 2004. Jabiru Service Bulletin JSB 018-1 titled '*Jabiru Engine Tuning*' had not been installed and was not a mandatory requirement. The aircraft's owner stated that only 95 octane unleaded Mogas had been used since the engine was installed as a new unit.

Jabiru Service Letter JSL 002-1

Jabiru JSL 002-1 was issued on 13 December 2004, titled '*Jabiru Engine Economy Tuning'* which introduced the '*Economic Tuning Kit'*. This kit contained new idle, needle and main carburettor jets, a new needle and fitting instructions. This Service Letter introduced 'lean burn' jets into the carburettor to improve fuel consumption at cruise power.

Jabiru Service Bulletin JSB 018-1

Jabiru JSB 018-1 was issued on 5 October 2007, titled '*Jabiru Engine Tuning*'. The Service Bulletin introduced richer running jets into the carburettor to replace those introduced by Service Letter JSL 002-1.

Carburettor mounting effect on cylinder head temperature

A UK CAA-Licensed Aircraft Maintenance Engineer, and owner of a Jabiru-engined aircraft, conducted tests with differing angles of mounting the carburettor to the plenum chamber, and at the same time monitoring cylinder head temperatures (CHT) and exhaust gas temperatures (EGT). He found that by tilting the carburettor 10° to 15° left and right he could obtain a rise and fall in CHTs between Nos 1 & 3 cylinders and Nos 2 & 4 of up to 50°C and EGTs up to 120°C.

Discussion – G-CEED and G-CEFY

This investigation was conducted in parallel with the investigation into G-JAAB, also published in this AAIB Bulletin, 5/2010. The evidence from the valve failures in the Jabiru 2200 engines in G-JAAB and G-BCIP indicated that overheating of the valves was at least a contributory factor and this was consistent with the timing of Jabiru JSL 002-1, which had introduced 'lean burn' jets into the carburettor to improve fuel consumption at cruise power. However, Jabiru JSB 018-1, issued in October 2007, introduced richer running jets into the carburettor to replace those introduced by Service Letter JSL 002-1.

From the similarity of the events and their timing, it is likely that the same overheating mechanism that appeared to have affected the valves in G-JAAB and G-BCIP was present in the piston failures in G-CEED and G-CEFY.

Safety action

Following the failures of a number of Jabiru 2200 engines in the UK (including G-CEED (10/07), G-CEFY (2/08) and G-JAAB (9/07)) the AAIB informed the engine manufacturer. A number of overheat-related failures occurred in France at about the same time. The engine manufacturer has a continuing programme of product quality improvement and the number of such events reported to the AAIB and the LAA (Light Aircraft Association) has decreased since that period.

ACCIDENT

Aircraft Type and Registration:	Shadow Series CD, G-MWEZ
No & Type of Engines:	1 Rotax 503-2V piston engine
Year of Manufacture:	1989
Date & Time (UTC):	28 June 2009 at 1522 hrs
Location:	Plaistows Airfield, Hertfordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Nosewheel leg broken; underside of nose slightly damaged and tail boom bent
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	56 years
Commander's Flying Experience:	232 hours (of which 150 were on type) Last 90 days - 58 hours Last 28 days - 35 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft was damaged during a heavy landing at the pilot's home airfield. The pilot had observed the windsock prior to landing, at which time there appeared to be no wind, and had chosen to land on Runway 33, which has an uphill slope. After landing he became aware that the wind was blowing. Luton Airport, some 10 nm away, reported a wind of 110° at 6 kt at the time.

ACCIDENT

Aircraft Type and Registration:	Skyranger 912(2) 3-axis microlight, G-CDFJ
No & Type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	2005
Date & Time (UTC):	19 December 2009 at 1225 hrs
Location:	Sandown Airport, Isle of Wight
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Minor) Passengers - 1 (Minor)
Nature of Damage:	Damage to nosewheel, rear fuselage, tailplane, windscreen, engine cowling and propeller
Commander's Licence:	Private Pilot's Licence
Commander's Age:	58 years
Commander's Flying Experience:	860 hours (of which 13 were on type) Last 90 days - 26 hours Last 28 days - 12 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft was landing on Runway 05 at Sandown. The reported wind was 7 kt from a direction of 315°. The aircraft travelled approximately halfway along the runway before touching down. It then bounced before touching down again, whereupon the nosewheel sank into the grass runway surface. The nosewheel detached and the nose landing gear leg dug into the ground, causing the aircraft to tip over. The pilot considered that the accident was caused by two factors: the tailwind component and a soft runway surface. He also considered that he should have applied full power after the initial touchdown and gone around.

ACCIDENT

Aircraft Type and Registration:	X'air Hawk, G-CESJ
No & Type of Engines:	1 Jabiru Aircraft PTY 2200A piston engine
Year of Manufacture:	2008
Date & Time (UTC):	21 February 2010 at 1420 hrs
Location:	Whiterashes Airfield, Aberdeenshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Landing gear nose leg collapsed and damage to left landing gear leg, broken propeller and engine shock loaded, damage to left wing
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	71 years
Commander's Flying Experience:	302 hours (of which 80 were on type) Last 90 days - 14 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Whilst boarding the aircraft with the engine running the pilot accidentally set full power, causing the aircraft to leave the runway and collide with a wall and earth dyke.

History of the flight

The two owners of the aircraft decided to fly circuits at the airfield where the aircraft was based. The aircraft had not been flown for a couple of months and, despite having previously charged the battery, required the use of jump leads to start the engine.

One of the owners then flew three circuits before landing and stopping on the runway to hand the aircraft over to his colleague. Due to the earlier problems starting the engine, it was decided to keep it running during the change of pilots, with the wheels being chocked as a precaution. The second pilot reported that, after the first pilot had vacated the aircraft, he was boarding when the leg of his overalls caught the throttle lever, causing it to apply full power. The pilot was not in a position to close the throttle and apply the wheelbrakes and the aircraft jumped the chocks, leaving the edge of the runway and hitting a low stone wall and earth dyke. This collapsed the landing gear nose leg and broke the propeller. It also bent the left

landing gear leg and damaged the left wing. The pilot, who was not strapped in, was uninjured and managed to isolate the fuel and magnetos before vacating the aircraft.

Comment

The aircraft is flown from the left seat as the wheelbrakes are only accessible from that side. This meant that it would not have been possible for the first pilot to have remained at the controls whilst his colleague boarded the aircraft.

Shuting down the engine, although inconvenient, would mitigate the effect of inadvertent throttle movement.

FORMAL AIRCRAFT ACCIDENT REPORTS ISSUED BY THE AIR ACCIDENTS INVESTIGATION BRANCH

2008

6/2008 Hawker Siddeley HS 748 Series 2A, G-BVOV
at Guernsey Airport, Channel Islands
on 8 March 2006.

Published August 2008.

7/2008 Aerospatiale SA365N, G-BLUN
near the North Morecambe gas platform, Morecambe Bay
on 27 December 2006.

Published October 2008.

2009

1/2009 Boeing 737-81Q, G-XLAC, Avions de Transport Regional ATR-72-202, G-BWDA, and Embraer EMB-145EU, G-EMBO
at Runway 27, Bristol International Airport
on 29 December 2006 and on 3 January 2007.

Published January 2009.

2/2009 Boeing 777-222, N786UA
at London Heathrow Airport
on 26 February 2007.

Published April 2009.

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

Published May 2009.

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

Published August 2009.

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

Published September 2009.

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

Published October 2009.

2010

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

Published February 2010.

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http://www.aaib.gov.uk