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ADDENDA and CORRECTIONS

(ALL TIMES IN THIS BULLETIN ARE UTC)

SERIOUS INCIDENT

Aircraft Type and Registration:	Cessna 550 Citation II, G-JBIZ
No & Type of Engines:	2 Pratt & Whitney Canada JT15D-4 turbofan engines
Year of Manufacture:	1979
Date & Time (UTC):	14 March 2008 at 1433 hrs
Location:	On approach to Edinburgh Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	32 years
Commander's Flying Experience:	5,450 hours (of which 750 were on type) Last 90 days - 200 hours Last 28 days - 52 hours
Information Source:	AAIB Field Investigation

Synopsis

The fight crew experienced control difficulties during the descent, the reasons for which were not evident but are now suspected to be due to interaction with the autopilot. The subsequent approach and landing were conducted at speeds considerably higher than normal. Crew Resource Management issues were considered to be a contributory factor.

History of the fight

The aircraft was operating a public transport positioning fight from Palma de Majorca to Edinburgh with the commander as the handling pilot and the co-pilot operating the radios.

Prior to engine start at Palma a 'DOOR NOT LOCKED' caption illuminated, which the crew were unable to extinguish. After satisfying themselves that all doors were secure and that dispatch with this defect was allowed in the Minimum Equipment List, they continued with the preparations for departure. After engine start, the 'AIR DUCT O'HEAT' caption illuminated. The crew reportedly consulted with maintenance personnel by telephone for advice and the caption was cleared by actioning the relevant checklist. During the taxi for takeoff the 'FDR FAIL' caption illuminated, but as the aircraft had already dispatched, the commander elected to continue.

During the climb after departure from Palma the 'AIR DUCT O'HEAT' caption again illuminated intermittently,

but after passing 30,000 ft, it remained extinguished for the rest of the flight.

Evidence from the Cockpit Voice Recorder (CVR) was available from shortly before the top of descent. This evidence was used to assist in developing the remainder of the history of the flight. At the start of the recording the crew were discussing a 'FLT/HR EQUIP COOL' circuit breaker (CB), which had tripped. The commander made one attempt to reset it, despite the co-pilot's insistence that he should not, but it immediately tripped again and no further reset attempts were made. It was evident from the discussion on the CVR recording that the crew were very concerned about the state of the aircraft due to the number of perceived defects that had occurred since the start of the flight and that they wanted to land as soon as possible.

G-JBIZ was cleared by ATC to descend to FL 340 from its cruising altitude of FL 400. As the descent commenced with the autopilot engaged, the crew continued to voice their concerns about the state of the aircraft. Their comments to each other reinforced a joint perception that there was a significant underlying fault with the aircraft.

The crew then discussed what action would be appropriate if the 'AIR DUCT O'HEAT' caption reappeared, and mention was made of the checklist procedure. The descent checklist was commenced, during which a problem was encountered with the air conditioning system temperature control. The crew attempted both manual and automatic control of the air conditioning system in an attempt to resolve a problem with the supply of conditioned air to defog the windscreen and to the foot warmers. After reselecting the system to manual, the commander commented "JUST DREAD LOOKING BACK AND SEEING THAT THING BLACK DON'T YOU", apparently referring to the cabin rear bulkhead. They then completed the descent checklist. Two minutes later the commander stated "THERE'S OBVIOUSLY SOME HEATING ISSUES GOING ON THE CIRCUIT BREAKER FOR FLIGHT…FLIGHT RECORDER EQUIPMENT COOLING IN THE BACK YOU KNOW".

Over the next 11 minutes the crew switched the air conditioning system between manual and automatic to try and resolve the problem. Soon after this the commander suggested to the co-pilot that it would be worth inspecting the rear equipment bay after landing to see if there was any sign of heat generation, although he did not believe that there would be a problem.

The approach to Edinburgh was under the control of Scottish ATC, who provided radar vectors for Runway 24. At 38 nm from touchdown, G-JBIZ was cleared by ATC to descend from FL 80 to an altitude of 6,000 ft. Prior to descending the co-pilot said "…ALT SEL 6,000" after which the commander commented that they were below the clouds and that the descent should commence. Clearance was then given to descend to 4,000 ft and the commander recalled making an autopilot selection, but was surprised when the aircraft failed to respond, saying "WHERE'S MY AUTOPILOT?". He glanced down at the autopilot control panel and saw that the autopilot and yaw damper engaged lights were off. There had been no visual or aural annunciations that the autopilot had disengaged. He recalled reselecting the autopilot and yaw dampers, but the lights remained off.

The commander reported that he pressed the autopilot disconnect button on the left side of the yoke. He then attempted to disconnect the autopilot using the TCS[1]

Footnote

[1] Touch Control Steering - pressing the TCS button allows the pilot to interrupt the autopilot and make manual control inputs without cancelling any autopilot selected modes. Releasing the button re-engages the autopilot.

switch and the electric pitch trim, reportedly without success. He recalled that the controls felt "unresponsive and very stiff" and he directed the co-pilot to feel his controls. The co-pilot then said "IS THAT OFF?", to which there was no response from the commander.

The commander then took over the radio and informed Edinburgh Radar "WE'VE GOT SERIOUS FLYING CONTROL PROBLEMS SIR AND WE NEED TO GET IN AS SOON AS", requesting radar vectors for the runway. He directed the co-pilot to assist him on the controls. The descent continued below 4,000 ft with the commander overpowering the control resistance, with the co-pilot's assistance. There was no discussion between the crew about the possible cause of the control problem. The tone of both pilots' voices recorded on the CVR suggested that at this stage, they were extremely concerned about their safety and the controllability of the aircraft. The commander attempted to reassure the co-pilot and asked ATC to ensure the emergency services were present for the landing.

At 220 kt the aircraft reportedly initiated a full left rudder then full right rudder sequence. As the airspeed reduced to 210 kt, the aircraft began pitching up and down. The uncommanded control inputs became more severe and more frequent with decreasing airspeed and so the commander accelerated back to 220 kt, the minimum speed at which he felt control could be maintained.

ATC cleared the aircraft to descend to 3,000 ft and the radar controller stated "GOLF INDIA ZULU I'M BRINGING YOU IN FOR RUNWAY 30 THERE'S AN AIRCRAFT ITS NOT ON THE THRESHOLD ITS JUST ON THE ORP[2]." The commander accepted this runway, which allowed for an almost straight-in approach. At seven miles from Runway 30 the commander transmitted to ATC "JUST NEED TO GET ON THE GROUND AS SOON AS POSSIBLE WE'RE DESCENDING AT EH THOUSAND FEET PER MINUTE WITH ALMOST FULL FULL NOSE FORWARD". The controller made it clear that if the crew were uncertain of retaining control he would vector the aircraft out over the sea rather than over the city of Edinburgh, but the commander reassured the controller "NO WE'RE ER WE'RE OK SIR".

Some 30 seconds later, with considerable concern, the commander transmitted "WE ARE LITERALLY ALMOST OUT OF CONTROL HERE BUT STANDBY" and "GOT SERIOUS FLUTTER GOING ON". Given the control difficulties, the commander elected not to lower the flaps and landing gear. At just under four miles to touchdown, he informed ATC "…AND EH THIS IS A MAYDAY NOW GOLF INDIA ZULU WE'RE GOING TO HAVE TO TOUCHDOWN AT 200 KNOTS WITH THE GEAR UP." During the final few miles of the approach the commander handed over control of the throttles to the co-pilot and instructed him to maintain 200 kt. The commander flew a shallow, high-speed approach to Runway 30 with the aircraft in a clean configuration.

Approximately 2 nm from the runway, the commander called "GEAR DOWN GEAR DOWN" to the co-pilot, who actioned the command. ATC cleared the aircraft to land, passing the surface wind of 250°/11 kt. A number of Enhanced Ground Proximity Warning System (EGPWS) aural warnings were recorded by the CVR as the approach continued. The co-pilot selected idle thrust and deployed the speed brakes just prior to touchdown, which occurred at around 193 kt, close to the threshold of Runway 30. Both pilots applied maximum wheel braking, bringing the aircraft to a stop around 50 metres from the end of the runway. The commander called for an evacuation, but the evacuation checklist was not carried out. The

Footnote

[2] Operational Readiness Platform, an area of hard standing immediately adjacent to the runway, often found at ex military airfields. At Edinburgh the Runway 30 ORP forms part of a parking area known as 'Block 33'.

crew shut down the aircraft and exited expeditiously via the cabin door.

The Airport Fire and Rescue Services (AFRS) were in immediate attendance. A thermal imaging camera did not reveal any evidence of a fre on the aircraft. The pilots inspected the rear equipment bay under the supervision of the AFRS and although they were unable to determine any obvious damage, they reported that there was a strong smell of electrical burning.

Aircraft examination

General

Examination of the aircraft at Edinburgh by the AAIB did not reveal any evidence of fre or overheat damage. Two CBs in the cockpit had tripped; the frst, located on the left CB panel, was labelled 'FLT/HR EQUIP COOL'. The second, on the right CB panel, was apparently labelled 'PHONE AC SWITCH'.

The frst of these CBs protected the circuits for two avionics cooling fans located in the aircraft's nose compartment, a cooling fan behind the instrument panel, the defog fan and the Hobbs meter. The second CB was in fact the 'AC SWITCH' CB, and should have been labelled as such. However, the CB directly above it had a panel fastener above it, in the location where the 'PHONE' legend for the CB would be expected to have been located. The legend was therefore put below it, with the effect that the 'AC SWITCH' CB below was apparently labelled 'PHONE AC SWITCH'.

The 'AC SWITCH' protected, amongst other circuits, the autopilot engaged and yaw damper engaged switch-lights, located on the autopilot control panel, below the thrust lever quadrant. It also protected the audio disconnect warning horn for the autopilot and the fashing autopilot disconnect warning light below the glare shield. Consequently, none of these operated when the autopilot was functioned on the ground. Once the CB was reset, the autopilot and yaw damper engaged switch lights illuminated when each system was selected on and the autopilot disengage visual and aural annunciations operated normally.

Autopilot

The basic autopilot functions operated correctly when tested. With the exception of the right 'go around' switch on the thrust levers, the various methods of disconnecting the autopilot also functioned correctly.

The autopilot pitch channel operated normally when tested. The autopilot uses elevator to recover from short-term pitch perturbations. If full elevator travel is reached, the autopilot will then begin to trim the aircraft nose-up or nose-down, using the full range of available pitch trim. According to the aircraft manufacturer, overpowering autopilot pitch inputs with the aircraft in trim would require a force of only 15 lbs +/-5 lbs. The control forces for an out-of-trim condition would be considerably higher.

When the autopilot computer was tested at the manufacturer's UK service and repair base, no faults were found. However, on reinstallation in the aircraft, intermittent uncommanded roll inputs occurred when the 'TEST EACH FLT' button on the autopilot control panel was operated on the ground. When this computer was installed in another Citation 2 aircraft, similar uncommanded roll inputs occurred during ground testing.

A loan autopilot computer was installed on G-JBIZ and two proving fights were fown. The aircraft behaved normally on both fights and the air duct overheat warning did not reappear.

Flight controls

The fight controls and pitch trim system operated

normally when tested. No faults were found within the rudder and yaw damper systems that could have caused uncommanded rudder movements. The aircraft manufacturer estimated that a force of 55 lbs +/-6 lbs would be required to overpower autopilot rudder inputs.

'FDR FAIL' caption

The FDR system is designed such that it will only operate if the door sensors indicate that the doors are locked. Examination of the microswitch on the nose baggage compartment right door revealed that its striker plate was sufficiently out of alignment that a door locked indication was not provided, even when the door was physically locked. As a consequence, the FDR did not record any data for the incident flight. After readjusting the striker plate, the 'DOOR NOT LOCKED' and 'FDR FAIL' captions extinguished when all doors were closed.

'FLT/HR EQUIP COOL' CB

This CB was reset and although it did not trip again during extensive system functional checks, it was replaced as a precaution. The Hobbs meter was found to be inoperable and was disconnected. The defog fan switch was found to be cracked internally and was also replaced.

Recorded information

Recorded data from the flight were available from the CVR (presented in the History of the flight), the EGPWS and radar.

The EGPWS is a system which provides pilots with alerts and warnings aimed at preventing the aircraft from colliding with terrain. The unit fitted to G JBIZ was removed from the aircraft and the contents of its memory were downloaded by the manufacturer. When an EGPWS warning is generated, a number of aircraft parameters are logged from 20 seconds prior to the warning until 10 seconds after. Three EGPWS warnings were recorded on the incident flight. The data show that the landing gear was recorded as locked down at an airspeed of 207 kt, just under 2 nm from the runway threshold. The final data point recorded placed the aircraft around 200 metres from the runway threshold at a radio altitude of 26 ft and an airspeed of 193 kt.

Flight crew information

The commander held a valid ATPL and a Class 1 medical certificate. He had completed his last Operator Proficiency Check (OPC) in October 2007. The check was carried out in G JBIZ and the duration of the flight was 50 minutes.

The co-pilot, aged 33, held a valid CPL(A) and a Class 1 medical certificate. His total flying experience was 647 hours, of which 430 hours were on type.

Both crew members' previous rest period was approximately 17 hours.

CRM training

At the time of this incident the requirements for the operation of commercial aircraft (previously contained in JAR-OPS, now EU-OPS) included a requirement for pilots and cabin crew to undertake Crew Resource Management (CRM) training. This training is intended to teach crews behaviour that will allow them to make the optimum use of the resources available to them. It provides a structured approach for dealing with situations (and abnormal situations in particular), placing emphasis on the importance of communication between crew members.

The requirements state that pilots must receive an initial CRM course within one year of commencing work

for an operator. Both pilots involved in this incident had worked for the operator concerned for less than 12 months and had not yet received from them their initial CRM training course. The commander may have received initial CRM training at a different operator, but no evidence to confirm this was available.

In January 2009, the European Aviation Safety Agency (EASA) released a Notice of Proposed Amendment (NPA) covering the rules for Air Operators. This NPA included the requirement for pilots of multi-crew aircraft to have completed initial CRM training before commencing unsupervised line flying.

Both pilots had attended a CRM recurrency training course at a large third party training provider. The commander completed this training in March 2007. The training provider, in accordance with the guidance provided in CAA publication CAP 737, spread the recurrency training over a three-year cycle. The recurrent training syllabus is designed as a refresher and covers topics in less depth than the initial CRM course.

The training provider reported that the crew had received training in the use of the 'DODAR' system as a decision-making aid. The acronym DODAR stands for 'Diagnose, Options, Decide, Assign and Review'. A crew is expected to apply this structured approach to decision making when faced with abnormal situations. It is intended to assist crews in assessing the situation, making best use of the available information and in considering the possible outcomes before deciding on a course of action.

Airport information

Edinburgh Airport (EGPH) has two runways. Runway 06/24 is 2,557 metres long by 46 metres wide, of grooved asphalt construction, and is ILS-equipped. Runway 12/30 is 1,798 metres long by 46 metres wide and asphalt-surfaced. It is not equipped with an ILS.

Analysis

General

No evidence of overheat damage was found on examining the aircraft and the air duct overheat warning could not be reproduced during subsequent testing. The 'FDR FAIL' message was attributable to a misaligned striker plate on the right door of the nose baggage compartment; this also accounts for the fact that the FDR did not record any data for this flight.

Once reset, the 'FLT/HR EQUIP COOL' and 'AC SWITCH' CBs did not trip again during subsequent testing. The reason for them initially tripping could not be established with any certainty.

Once the 'FLT/HR EQUIP COOL' CB had tripped, there would have been insufficient airflow from the windscreen defog vents due to the defog fan becoming inoperative. The cooling fan behind the instrument panel would also have ceased to operate. This may have influenced the cooling airflows in the cockpit/windscreen areas and may explain the pilots' concerns about the air conditioning system during the early part of the descent. It is possible that the cooling flow issue caused the temperature in the region of the right hand CB panel to increase. It is understood that older CBs of the type used in this aircraft can be sensitive to local temperature. The possibility that an elevated temperature in this area had caused the 'AC SWITCH' CB to trip therefore could not be ruled out.

Once the 'AC SWITCH' CB had tripped, there would have been no visual or aural warnings available to the crew to indicate whether the autopilot and yaw damper were engaged or disengaged.

The crew reports of the aircraft's behaviour indicated that there were difficulties in pitch and yaw control. Although the autopilot computer intermittent defect could not be explained, it only manifested itself in the roll axis and therefore did not appear to be associated with the control problems reported by the crew. No defects were found that could account for the reported uncommanded rudder inputs.

Crew reaction to event

Perceived overheat condition

It was apparent from the CVR recording that the crew were very concerned about the serviceability of the aircraft prior to the incident.

The recording shows that the crew believed that there was a potential overheat condition in the rear equipment bay. This theory was based on the evidence of the air duct overheat warnings that they had received before departure and during the climb. The tripping of the 'FLT/HR EQUIP COOL' CB, which the commander took to be related to the flight recorders, located in the rear of the aircraft, served to reinforce this hypothesis. This was reflected in his comment to the co pilot "JUST DREAD LOOKING BACK AND SEEING THAT THING BLACK". It was evident from the crew's discussions on the CVR recording that they wished to land the aircraft as soon as possible.

Control difficulties

The event that led to the incident started with the autopilot apparently not responding to input commands. The situation would undoubtedly have been extremely confusing to the crew, as all of the autopilot visual and aural annunciations were inoperative. There would therefore not have been any unambiguous way of determining whether or not the autopilot was engaged. The commander may have unknowingly disengaged and re-engaged the autopilot during the initial stages of the event and it is possible that the subsequent flight control difficulties were caused by the crew and the autopilot working against each another, possibly with the aircraft out of trim, which would have significantly increased the pitch control forces.

According to the aircraft manufacturer, 15 lbs +/-5 lbs of force is required to overcome autopilot pitch inputs. If the aircraft was out of trim, the increased pitch control forces would have helped to reinforce the crew's belief that there was a serious control problem. No defects were found with the autopilot system that could otherwise account for the handling problems reported by the crew.

CRM issues

The crew were already highly concerned about the state of the aircraft when the incident occurred. When the control problems appeared, they were already under some degree of stress and this had a detrimental effect on their ability to deal with the situation. They did not make any combined effort to diagnose the problem and the commander responded to the situation by overpowering the controls, with the co-pilot's assistance. The fact that the commander was considering performing a gear-up landing on Runway 30 at 200 kt, suggests that he believed that the aircraft was in serious danger.

Had the crew applied the principles of CRM, and the 'DODAR' method in particular, it may have helped them better to deal with the situation. Even if it did not enable them to diagnose the cause of the control difficulties,

it would have provided structure to their response and would have slowed the decision-making process, giving them the opportunity to arrive at a less risky solution than landing at 193 kt.

Conclusions

The crew were already concerned about the possibility of an overheat condition in the rear of the aircraft when they encountered control difficulties, the reason for which was not obvious. The situation would have been confusing, given the lack of autopilot visual and aural annunciations. Subsequent examination of the aircraft did not highlight any defects which could explain the reported control problems.

The crew did not make any joint attempt to diagnose the problem and did not apply the principles of CRM, which could have allowed them to arrive at a less risky solution. It is likely that, had they received more comprehensive CRM training, they would have been better placed to manage their response to the incident.

Given that the EASA has already issued an NPA for a requirement for pilots of multi-crew aircraft to have completed initial CRM training before commencing unsupervised line flying, no AAIB Safety Recommendation is considered necessary.

ACCIDENT

Aircraft Type and Registration:	Cessna Citation Mustang, PH-TXI
No & Type of Engines:	2 Pratt & Whitney PW615F turbofan engines
Year of Manufacture:	2007
Date & Time (UTC):	21 August 2009 at 1430 hrs
Location:	Runway 23 at Cambridge Airport
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - 2
Injuries:	Crew - None Passengers - None
Nature of Damage:	Scratches to underside of aircraft, damage to drain masts and antenna, detached flap inboard hinges (both sides) and right flap centre hinge
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	45 years
Commander's Flying Experience:	9,461 hours (of which 132 were on type) Last 90 days - 26 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

The landing gear was not lowered on the downwind leg. The co pilot flared for touchdown and there was a "grinding" sound from the rear of the aircraft. The commander took control and went around. The aircraft landed subsequently without further incident. The landing gear warning horn had been triggered on the downwind leg and had been cancelled by the commander. The co-pilot remembered hearing the landing gear warning horn again briefly during the final approach. The commander, however, believed that the warning system had not reset and there had been no further warning. It was not possible to determine with any certainty whether or not the warning system had reset.

History of the flight

The aircraft was on the downwind leg in a clean configuration prior to an approach to Runway 23 at Cambridge Airport. The approach was to be flown by the co pilot with the flaps selected to TAKEOFF/APPROACH instead of to LANDING. The weather was wind from 220°/12 kt, more than 10 km visibility, few clouds at 4,000 ft amsl and a temperature of 18°C. The co-pilot reduced power to slow the aircraft and, as it decelerated through 130 kt, the landing gear aural warning was triggered because the thrust was below approximately 85% N_2 and the landing gear was selected UP. The commander cancelled the warning immediately after it sounded. The co-pilot asked for the approach checklist

to be carried out by the commander who did so by memory rather than by using the usual 'challenge and response' technique. This particular checklist does not call for the landing gear to be selected down. The landing gear was not selected DOWN on the downwind leg.

On the final approach the co pilot had difficulty reducing speed towards V_{REF} but thought it was because the reduced flap setting was causing less drag than normal. He stated later that the landing gear aural warning was triggered during the final approach and was cancelled immediately although this differed from the commander's account. The landing checklist was also completed by the commander from memory rather than by 'challenge and response'.

During the flare, the co pilot heard a "grinding" sound from the rear of the aircraft. He applied some power and raised the aircraft nose sufficiently to remain airborne. The commander took control and lowered the landing gear while maintaining approximately 95 kt and flying along the runway at an estimated height of 10 ft. He realised that the runway length remaining was insufficient to land and so applied takeoff power to go around. The aircraft configuration was left unchanged with landing gear selected DOWN and flaps selected to TAKEOFF/APPROACH. The commander positioned for a visual inspection by the controller in the ATC tower and then flew another circuit and landed without further incident.

Witness information

A witness was in a room in an airport building with a clear view of the touchdown point. He saw the aircraft flare and noticed that the landing gear was still retracted. The aircraft tail appeared to contact the runway and he saw a "puff of white smoke" and heard the airport crash alarm. He saw the aircraft get airborne again and the landing gear extend.

Engineering inspection

Following the incident, an inspection of the aircraft was carried out to determine the serviceability of the landing gear warning system. The landing gear was found to be serviceable but the flaps were stuck in the TAKEOFF/APPROACH position. The landing gear warning system operated correctly in the achievable configurations.

Landing gear warning system

The landing gear aural warning is triggered when the IAS falls below 130 kt if one or more of the landing gear are not locked down and one or both thrust levers are retarded below approximately 85% N_2. Pressing the HORN SILENCE - PUSH button on the landing gear control panel silences the warning but does not reset the system. The system resets when the thrust levers are advanced above approximately 70% N_2.

Assessment of cause

The landing gear was not selected down while the aircraft was on the downwind leg. The landing checklist was not completed in the usual 'challenge and response' manner which meant opportunities were lost to highlight the omission.

The commander stated later that he had expected to hear the landing gear warning horn and had cancelled it immediately when it was triggered on the downwind leg. He could not say why the checklists were not completed properly. The landing gear warning system would have reset had the power increased above approximately 70% N_2. With the landing gear UP and the flaps selected to TAKEOFF/APPROACH, however, the drag and power required during the approach were lower than normal.

The commander believed the landing gear warning system had not reset which meant that there was no final warning prior to touchdown that the landing gear was not locked down.

The co-pilot remembered the landing gear warning horn sounding on final approach and, if his recollection was correct, the warning system reset at some point during the circuit. If this was the case, the warning horn was triggered and cancelled at a critical point in the approach and its meaning was not appreciated by the crew.

It was not possible to determine with any certainty whether or not the system had reset prior to the final approach.

INCIDENT

Aircraft Type and Registration:	Embraer 190-200, G-FBEH
No & Type of Engines:	2 General Electric CF34-10E7 turbofan engines
Year of Manufacture:	2007
Date & Time (UTC):	15 January 2009 at about 0740 hrs
Location:	Overhead Edinburgh
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 5 Passengers - 40
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:	6,250 hours (of which approximately 100 were on type) Last 90 days - 137 hours Last 28 days - 33 hours
Information Source:	AAIB Field Investigation

Synopsis

During fight, "smoke" was seen to emanate from a galley sink and the fight deck and cabin crews took appropriate emergency action. In the course of the *'Electrical System Fire or Smoke'* procedure the fight crew established the aircraft on emergency power, after which communications between the fight deck and cabin became difficult. The aircraft landed safely. Deficiencies in the interphone system were identified, and four Safety Recommendations were made in AAIB Special Bulletin S1/2009 (February 2009).

History of the fight

The aircraft was on a scheduled passenger service from Aberdeen to London Gatwick. As it cruised overhead Edinburgh at FL370, the Senior Cabin Crew Member (SCCM) poured half a jug of water down the forward galley sink. He saw that "smoke", apparently "ice-blue" in colour, immediately began to emanate from the sink. He assumed that this was not steam, as the jug of water had been drawn from the boiler some minutes previously, and he checked the galley area for signs of fre. He called another cabin crew member to the forward galley, and they both assessed that the "smoke" was not steam. There were no signs of combustion, and neither crew member detected an odour.

The fight deck and cabin crews took appropriate emergency action. In the course of the '*Electrical System Fire or Smoke*' procedure, the fight crew disarmed the emergency lighting, deployed the Ram Air Turbine

(RAT) and then selected off the Integral Drive Generators (IDGs), which are the engine-driven sources of main electrical power. This caused all the cabin lighting to extinguish; it was early morning and there was little ambient light. In the fight deck, only one Primary Flight Display (PFD) and one Multi-Function Display (MFD) remained operating.

The RAT is positioned on the right side of the aircraft nose, forward and below the forward service door; ram air drives a two-bladed 'propeller' connected to a generator, supplying emergency electrical power to the aircraft's systems. The cabin crew heard the noise caused by the RAT's operation, for which they were unprepared, and which they described as "horrendous". The cabin lights extinguished soon afterwards.

The SCCM attempted to call the fight crew on the cabin interphone system, by pressing the PILOT call button. The green light above the button (Figure 1) illuminated, but the fight crew did not answer. Despite repeated attempts, using handsets in both the forward and rear galleys, the SCCM could not establish communication with the pilots in this way.

The "smoke" diminished and eventually ceased. Nonetheless, the cabin crew became concerned at the darkness in the cabin, the unexplained noise from the forward part of the aircraft, and the lack of communication with the fight crew. They became concerned either that the fight crew might have become incapacitated or that a serious emergency had developed in the fight deck. After some minutes they decided to attempt to access the fight deck using the emergency fight deck access system[1], but this, too, did not function and the cabin crew were unable to gain access to the fight deck.

Concern amongst the cabin crew continued until the commander made a public address announcement explaining that the aircraft was diverting to Newcastle; the cabin crew then recognised that their concerns were unfounded.

The aircraft landed without further incident and was inspected by the Airport Fire and Rescue Service, who used a thermal imaging camera to search for evidence of heat or fre; none was found.

Figure 1

Cabin interphone handset at front galley

Footnote

[1] A system which enables the cabin crew to gain access to the fight deck if both fight crew members become simultaneously incapacitated; safeguards prevent its use to gain unauthorised access to the fight deck.

illuminate, and no voice contact was possible. The cabin crew did not attempt to use the EMER PILOT function, as this would involve an emergency call, which differed (in the cabin crewmembers' perception) from the normal call only in the number of chimes.

The 'false positive' indication of the PILOT call was crucial to the incident; had the PILOT call not appeared to function correctly, it is probable that the cabin crew, instead of contemplating incapacitation of the flight crew or serious emergency on the flight deck, would have attempted to establish communication using the EMER PILOT call.

The operator's operations manual did not detail the functioning of the interphone and flight deck access systems when the aircraft was on emergency power, and training had not made the crew aware of this functioning.

Safety Recommendations and action

The following Safety Recommendations were made in AAIB Special Bulletin S1/2009:

Safety Recommendation 2009-017

It is recommended that Embraer (Empresa Brasiliera de Aeronautica SA) immediately notify all operators, of the Embraer 190 family of aircraft, to inform flight crew of the importance of advising cabin crew when an aircraft is on emergency electrical power.

Safety Recommendation 2009-018

It is recommended that Embraer (Empresa Brasiliera de Aeronautica SA) immediately notify all operators, of the Embraer 190 family of aircraft, to inform their flight and cabin crew of the functioning of the interphone system when the aircraft is supplied only with emergency electrical power.

Safety Recommendation 2009-019

It is recommended that Embraer (Empresa Brasiliera de Aeronautica SA) modify the functioning of the interphone systems of Embraer 190 family aircraft to provide crew with the facility to make both normal and emergency calls when the aircraft is supplied only with emergency electrical power.

Safety Recommendation 2009-020

It is recommended that Embraer (Empresa Brasiliera de Aeronautica SA) immediately notify all operators, of the Embraer 190 family of aircraft, to inform flight and cabin crew of the functioning of the flight deck access system when the aircraft is supplied only with emergency electrical power.

Manufacturer's response

In response, Embraer has agreed with Safety Recommendations 2009-018 and 2009-020 and pertinent information is included in recent revisions of the Airplane Operations Manual (AOM) and Flight Attendant Manual (FAM) for affected Embraer 170 and 190 operators.

For Safety Recommendations 2009-017, it is Embraer's opinion that it would not be advisable to increase the flight crew workload in an electrical emergency situation and that this issue is more properly addressed through the FAM and training.

Safety Recommendation 2009-019 is under analysis by Embraer engineering.

INCIDENT

Aircraft Type and Registration:	Agusta A109A II, G-ELTE
No & Type of Engines:	2 Allison 250-C20B turboshaft engines
Year of Manufacture:	1984
Date & Time (UTC):	2 May 2008 at 1431 hrs
Location:	Redhill Aerodrome, Surrey
Type of Flight:	Private
Persons on Board:	Crew - 2 Passengers - 4
Injuries:	Crew - None Passengers - None
Nature of Damage:	Minor damage
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	54 years
Commander's Flying Experience:	8,740 hours (of which 2,240 were on type) Last 90 days - 43 hours Last 28 days - 20 hours
Information Source:	AAIB Field Investigation

Synopsis

Whilst in flight, the landing gear operating handle detached from the selector mechanism, preventing the landing gear from being lowered. The pilot disembarked the passengers in the hover and successfully landed the helicopter on pre-positioned car tyres.

History of the flight

The helicopter was planned to operate a passenger flight between Manchester (Barton) and Battersea Heliport, London. The commander, seated on the right, was accompanied by the helicopter owner, a PPL/CPL(H) holder, who acted as co-pilot. When the commander selected the landing gear lever up on departure, he noted that the lever operation felt unusual, in that the handle rotated in his hand. After entering the cruise, he decided to confirm that the landing gear could be lowered again and asked the co-pilot to investigate.

When the co-pilot pulled on the handle prior to selecting the landing gear lever down, the handle and spindle became detached from the lever. Noting that the end of the spindle was threaded, he attempted to screw it back into the lever, but was unsuccessful. Several attempts were made to lower the gear by pushing down on the visible stub of the lever, but it failed to move.

The co-pilot then contacted the maintenance organisation by mobile telephone. They consulted the available technical documentation before contacting the helicopter manufacturer, who confirmed that selecting the lever

down was necessary for both normal and alternate methods of landing gear operation. The co-pilot subsequently managed to insert the threaded portion of the spindle back into the lever, but the lever still could not be moved. A small panel to the left of the lever was removed to gain better access, but this was of no benefit. In accordance with the commander's instructions, the co-pilot pulled the landing gear warning circuit breaker and then removed his collective lever to make it easier for him to exit the helicopter.

In the area of Bovingdon, the commander informed the passengers that he would be diverting to the helicopter's base at Redhill, where maintenance and operating personnel familiar with the helicopter type were available. Staff from the helicopter operator's operations department informed the emergency services and ATC at Redhill of the problem, advising them that, if necessary, the commander would disembark the passengers with the helicopter in the hover. When the commander contacted Redhill ATC, he was advised that the Aerodrome General Manager was not in favour of his proposed actions. It was suggested that the commander should divert to Biggin Hill, but he elected to continue to Redhill.

He approached the apron normally used at Redhill, where engineers were waiting, and entered a low hover. He continued to hover for some 15 minutes whilst discussions continued with ground personnel on a practical and safe course of action. ATC again informed the commander that the Aerodrome General Manager did not approve of his intended actions.

Aware that his fuel level was becoming low, the commander requested that the helicopter be refuelled in the hover. ATC informed him that no refuellers were available, as they were in the fire truck in readiness to respond to the emergency. With the helicopter still in a low hover, he instructed the co-pilot to disembark and to liaise with the engineers.

The engineers realised that they would not be able to lower the landing gear as the uplocks could not be released without depressurizing the hydraulic system. By now, both low fuel indication lights had illuminated. The commander estimated that he had about 15 minutes of fuel remaining. It was decided that the safest course of action would be for the helicopter to land on pre-positioned car tyres. These were obtained from a local garage, once it was clear that no other practical solution was available. The commander's major concern with landing gear-up, was that the tail rotor could contact the ground, control would be lost, and the helicopter might roll over. He therefore decided to disembark the passengers in a low hover; this was completed successfully with the assistance of company personnel.

In order to minimise the risk to others, the commander then selected a remote area of the airfield in which to land. The car tyres were placed in two parallel lines and the helicopter was landed on the tyres, with the aid of an engineer giving hand signals. The helicopter remained upright and the commander shut it down in the usual manner, except that he waited for the rotor blades to stop before turning off the electrics, as the rotor brake is inoperative without a weight-on-wheels signal from the landing gear squat switch.

Landing gear selector

The landing gear on the Agusta 109 helicopter is operated via a selector lever located on the left side of the instrument panel. The lever assembly comprises a circular (wheel-shaped) handle attached to a spring-loaded telescopic spindle. The spindle locates inside a tubular lever. The lever passes through a slot in the

instrument panel and is pivoted in a housing containing the landing gear hydraulic selector valves. The lever is locked in the upper position in flight. The landing gear is operated by pulling the handle outwards axially against spring pressure to disengage a latch, then moving the lever down to the mid-position to lower the landing gear. It can be moved further down to a third position for emergency lowering. A secondary system retains the lever in the selected position. The handle and spindle spring back in when released.

The spindle is threaded into the latch of the lever. It is prevented from unscrewing by a locking collar positioned near its outer end. The collar incorporates two anti-rotation lugs which engage in recesses in the end of the lever and internal slots in the handle. A spring circlip positioned in an internal groove inside the tubular section of the lever retains the locking collar in position against spring pressure. The wheel-shaped handle is retained on the end of the spindle by a roll pin.

A cross-section of the assembly is presented in Figure 1.

Selector mechanism examination

The landing gear selector assembly was removed and examined by the component manufacturer in the presence of representatives from the aircraft manufacturer and the AAIB. On disassembly, it was found that the spring circlip had come out of its locating groove, permitting the locking collar to move longitudinally and disengage, freeing the handle and spindle to rotate. The circlip

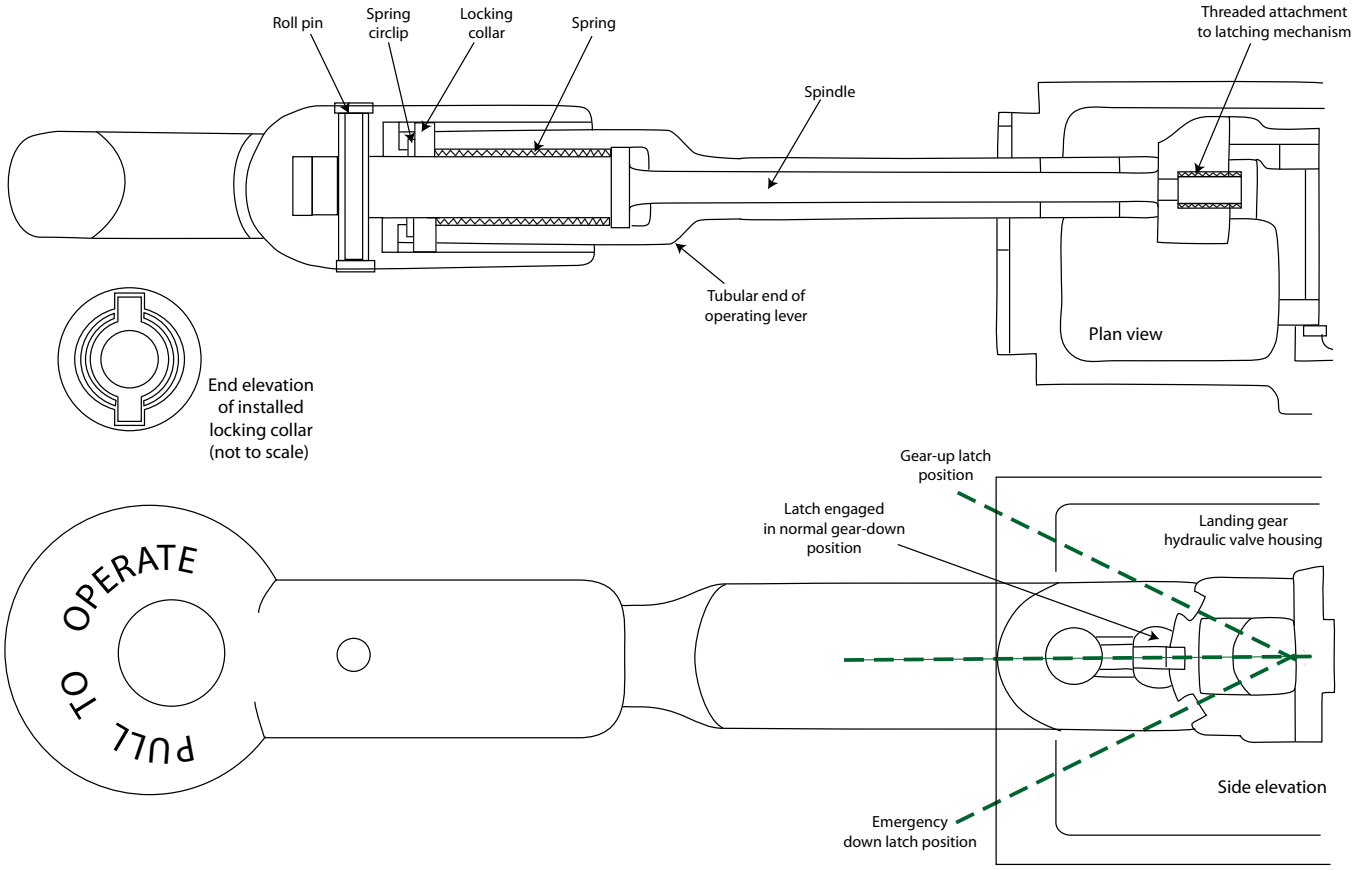


Figure 1

Landing gear selector assembly

and groove were undamaged and it was surmised that the circlip may have been incorrectly located during assembly of the mechanism. Records showed that the selector assembly had been overhauled by the component manufacturer approximately two years before the incident. There was no record of any difficulties having been experienced when assembling the unit. According to the aircraft maintenance records the unit had been recently fitted to G-ELTE.

Assembly demonstration

The component manufacturer demonstrated the normal method of installing a circlip, spindle and handle into a selector valve. The circlip was driven into its locating groove using dedicated tooling consisting of two components. The first was an aluminium alloy block with an internally tapering bore and a short end section counter bored to a larger diameter to fit over the exposed end of the cylindrical operating lever. The second comprised a thin-walled tubular drift. During this demonstration, problems were encountered in installing the circlip and a large hammer was applied to the drift to drive the circlip into the correct position. The correct positioning of the circlip in its retaining groove could not be determined easily by inspection once assembly was complete. Examination of the main part of the tool revealed that it had sustained considerable damage to its tapered internal bore over a long period of time, leaving it extensively scored and grooved. The thin gauge tubular drift was also extensively damaged on its end face. These defects, coupled with the short length of counter-bore, hindered the easy inward movement and retention of the correct alignment of the circlip as it was driven into the locating groove.

At the request of the helicopter manufacturer, the component manufacturer subsequently introduced a visual check for correct installation of the circlip in the retaining groove during assembly of the landing gear selector. The correct positioning of the circlip is now verified by measurement. The component manufacturer has also introduced improved tooling for installing the circlip.

Failure mode

Given the difficulties experienced during the assembly demonstration, it would appear likely that the circlip was not correctly located in its groove when the unit was last assembled.

With the circlip out of its locating groove, there may have been sufficient frictional resistance between the circlip and the operating lever to enable a number of landing gear operating cycles to take place before the circlip became displaced outwards sufficiently for the locking collar to disengage. The spindle would then have been free to rotate and, over an indeterminate period of time, unthread itself from the lever. (Approximately 17 rotations of the handle are required for the spindle to detach from the lever). When the circlip becomes dislodged from its retaining groove, the spring action of the handle is lost. For reasons which were not apparent, the crew did not report experiencing this.

Both handle rotation and the loss of spring-back action of the handle should be immediately evident to the pilot. According to the helicopter manufacturer, landing gear operation is not compromised until the handle and spindle become detached from the lever.

Operational considerations

The commander elected to divert to the helicopter's home base at Redhill as expertise and assistance were readily available there. Although the Aerodrome General Manager wasnot in favour of the commander's actions, the passengers were safely disembarked in the

hover. (CAA safety advice contained in booklet '*CAP 745 Aircraft Emergencies, Considerations for Air Traffic Controllers*' states, on page 25: '*Passengers can be disembarked in the hover following a landing gear problem*'). Engineers at Redhill were able to assist the commander in effecting a safe landing on pre-positioned car tyres. Had the helicopter diverted elsewhere, these facilities would not have been available and the landing may not have been so successful.

SERIOUS INCIDENT

Aircraft Type and Registration:	EC135 T1, G-CCAU
No & Type of Engines:	2 Turbomeca Arrius 2B1A-1 turboshaft engines
Year of Manufacture:	1997
Date & Time (UTC):	4 December 2008 at 1330 hrs
Location:	Hindlip Hall, Hindlip, Worcestershire
Type of Flight:	Aerial Work
Persons on Board:	Crew - 3 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to engine/gearbox cowlings
Commander's Licence:	Airline Transport Pilot's Licence (Helicopters)
Commander's Age:	Not applicable
Commander's Flying Experience:	Not applicable Last 90 days - Not applicable Last 28 days - Not applicable
Information Source:	AAIB Field Investigation

Synopsis

Shortly before the aircraft landed, one of the two rotating scissor link assemblies, which connect the rotating swash plate to the main rotor mast, became detached from the swash plate. The helicopter landed immediately without further incident. The investigation revealed that, during recent maintenance, the scissor link had not been correctly re-attached to the rotating swash plate. Since the incident, the maintenance organisation involved has introduced a number of changes to minimise the possibility of a similar event occurring again.

History of the flight

The helicopter had been returned to the operator on 3 December 2008 following maintenance to rectify a vibration defect. The next day, it was tasked to carry out a routine photographic flight. Approximately 50 minutes into the task, whilst flying towards the West Mercia Police Headquarters at Hindlip Hall, there was a noticeable increase in vibration throughout the speed range. The helicopter made a normal approach to the landing site at Hindlip Hall until it was approximately three feet above the ground. There was then a loud bang, followed by further repetitive banging and heavy vibration at the same frequency as the main rotor rpm. The commander landed immediately and completed an emergency shutdown, during which the vibration increased significantly. After confirming that there was no further danger, the flight crew examined the rotor system and found that one of the rotating swash plate

scissor link assemblies had become detached from the swash plate. There were no injuries to the fight crew or personnel on the ground.

Initial examination

The EC135 is ftted with two identical scissor link assemblies, mounted on the main rotor mast (see Figure 1), which connect the rotating swash plate to the mast. Initial examination confrmed that one of the two scissor links (the one located between the yellow and green main rotor blades) had become detached from its mounting stud on the rotating swash plate. Damage was also found on the engine/gearbox cowlings, where the scissor link had struck them whilst rotating. No other damage was identifed.

The scissor assemblies are made up of two sections, the helical tube and the helical lever (see Figure 1), which are secured to the rotor mast and rotating swash plate respectively.

The helical lever is secured to a mounting stud on the rotating swash plate by the use of a cup washer, castellated 'nyloc'-type nut and a split pin. The mounting stud was intact and the threads undamaged. The castellated nut and cup washer were recovered from the engine/ transmission deck; the split pin was not recovered.

Maintenance history

On 20 November 2008 the maintenance organisation received a report from the operator of in fight vibration on the helicopter. The engineers dispatched to investigate the problem found several defects, amongst which was damage to one of the scissor link assembly/rotor mast attachment bolts and bushes. The helicopter was then recovered by road for rectifcation. During this rectifcation the damaged scissor link attachment bolt and bushes were replaced and a series of 'track and balance' fight tests were conducted prior to the helicopter being declared serviceable on 2 December 2008. The helicopter then few for a further 4 hours before the incident occurred.

Investigation

In view of the rectifcation work completed on the helicopter immediately before the incident, the investigation focused on this maintenance input. Examination of the castellated nut showed no evidence of damage to the castellations or threads. However, the nylon insert did appear to show signifcant signs of wear, possibly indicative of the nut being reused. A number of split pins from the same production batch as those installed on the scissor links were obtained; tests identifed no material abnormalities and confrmed that these items met their production specifcation.

In order to remove the main rotor blades, for example, when transporting the helicopter by road, all the blade pitch control rods must be removed. This requires the disconnection of both the rotating swash plate scissor links from the rotating swash plate. Removal and reinstallation of the scissor link is classifed by the manufacturer as a 'vital system' task. This requires an independent duplicate inspection upon completion. During the initial phase of the investigation it became apparent that the scissor link which had become detached in fight was not the same as the assembly which had the damaged mounting bolt and bushes. For clarity, the scissor link assembly involved in the incident is referred to as scissor link A in the report, and the assembly which had the damaged mounting bolt and bushes, scissor link B.

Maintenance activity

The Master Signature Sheet within the work pack indicated that 10 members of staff had been involved

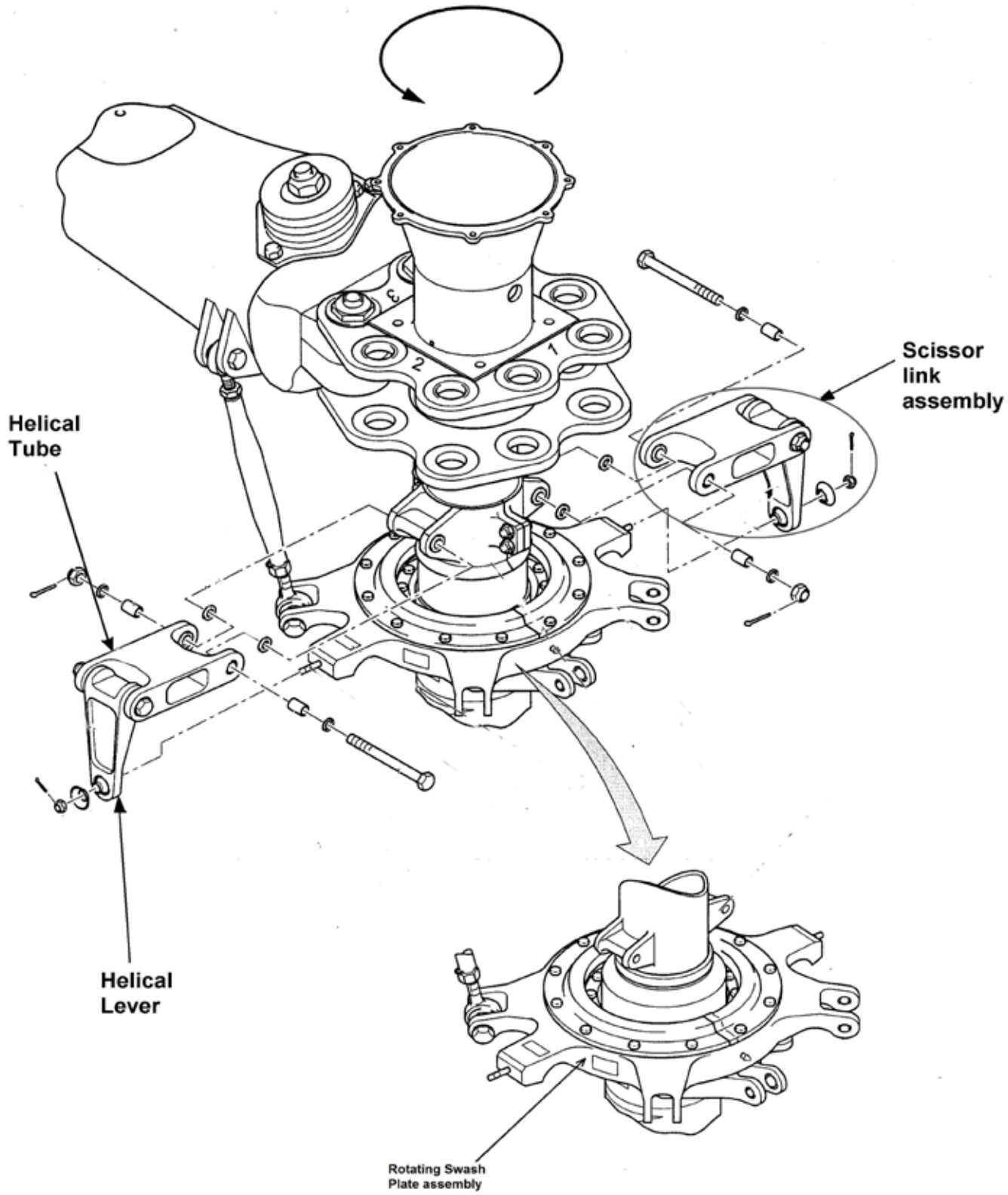


Figure 1

Rotor mast and scissor link assemblies

in the maintenance input. In addition the company identified three other people who had been involved in the input but did not appear on the signature sheet. It was determined that seven of these people, two fitters and five Licensed Aircraft Engineers (LAE's) had been involved in work carried out in the area of the swash plate scissor links. Interviews were carried with all of these personnel; these are referred to as Fitter 1 and 2, and LAE's 1 to 5 in the description of events which follows. In discussion with both managers and maintenance personnel it became apparent the removal of the main rotor blades and hence the disconnection of the scissor links was a very frequent occurrence, and was considered by all to be a routine task.

From the helicopter's arrival on 20 November until the late afternoon of 28 November, LAE1 had been responsible for the maintenance input. Fitters 1 & 2 had also been allocated to the aircraft and had completed various tasks during the input, as well as working on the scissor links. A routine work card, Task 5, had been raised in the work pack detailing the damage to scissor link B. This task card did not provide any additional information to identify which scissor link required rectification. Two additional work cards, Task 19 and 21, were raised for the removal and reinstallation of the blade pitch links and both scissor link assemblies, respectively. The description of the work requirement written in Task 21 stated:

> *'1) MAIN ROTOR SCISSOR ASSY'S TO BE REMOVED TO FACILITATE INSPECTION*
>
> *2) TO BE REFITTED POST WORK'*

Early in the input, Scissor link B was removed from the rotor mast, the damaged bushes were removed from the helical tube and a replacement set of bushings was obtained from the aircraft manufacturer. These were installed in accordance with the manufacturer's Repair Design Approval Sheet (RDAS) 1756. After completion of this task an attempt to refit scissor link B to the rotor mast was made but it was found that the replacement bushes appeared to be too large to allow the helical tube to fit around its locating lug on the rotor mast. At this point scissor link A was completely removed for comparison purposes. This confirmed that the replacement bushings were oversized. Subsequent communication with the manufacturer revealed that the bushes required honing before installation, which was not detailed in the RDAS. It was not possible to remove the newly installed bushings without damaging them so a second, replacement set of bushings were ordered from the manufacturer and scissor link B remained uninstalled. Scissor link A was reattached to the rotor mast by Fitter 2, who fitted the castellated nut on the bolt and installed, but did not 'bend over' the split pin; this was subsequently done by LAE1. The helical lever of scissor link A was not attached to the rotating swash plate.

In order to ensure that as much of the required work was completed prior to the arrival of the second set of bushes, all the main rotor blades and pitch control rods were refitted by LAE1 and Fitter 2. This task was certified within the work pack and the task closed. During this process Fitter 2 had placed the helical lever of scissor link A over the stud on the rotating swash plate and reinstalled the castellated nut. The nut was 'finger tightened' but not torqued up or split pinned, as Fitter 1 believed that there may have been a need to remove scissor link A again for comparison purposes. No documentation was raised to record the status of scissor link A in the work pack and the components were not 'tagged' in any way to identify that the installation was incomplete. Due to the approaching weekend and the fact that LAE1 was required to attend

a two-week training course on the following Monday, the helicopter was handed over to LAE2. LAE1 stated that, on the afternoon of 28 November, he carried out a verbal handover of the helicopter and its outstanding tasks to LAE2, who had been assigned to complete the input in the absence of LAE1. LAE1 also stated that, as the work pack still contained an open task card to refit the scissor link assemblies, he had no doubt that scissor link A would be checked for its correct installation prior to certification of the open work card, Task 21. Company records show that LAE2 was then reassigned to support a customer's helicopter 'off base', approximately 2 hours after being assigned to G-CCAU, and no handover was given to either the hangar supervisors or any other LAE.

After the arrival of the replacement bushes on 1 December they were honed and installed by Fitter 1, Fitter 2 having been assigned to another helicopter. This task was overseen by LAE3 and LAE4, both hangar supervisors, who appeared to be sharing the responsibility for G-CCAU. As far as they were aware, the only outstanding item on the helicopter was the replacement of the bushes on scissor link B and its re-installation. On completion of the task, scissor link B was reinstalled by Fitter 1.

The position of G-CCAU within the hangar meant that, with the rotor blades installed, the rotor head could not be turned. Maintenance platforms were in place on the right side of the fuselage allowing access to install scissor link B, but access to scissor link A could only be achieved by climbing up the left side of the helicopter. After installation, LAE3 inspected scissor link B and then climbed up the left side of the fuselage to inspect scissor link A. He recalled that the transmission cover had been refitted on the left side but noticed no abnormalities with the installation of scissor link A and certified the work card. In order to complete the duplicate inspection, Fitter 1 requested assistance from LAE4 who was engaged in supervisor duties elsewhere within the hangar. LAE4 conducted the inspection from the maintenance platforms on the right side of the fuselage, leaning across the transmission system to confirm the presence of the nuts and the split pins on scissor link A by touch. The second part of the duplicate inspection was carried out by LAE5 who climbed up the left side of the fuselage to view the installation of scissor link A. Neither LAE4 nor LAE5 noticed any abnormalities with the installation of scissor link A. All the remaining cowlings were refitted and a Check 'A' inspection was carried out and certified by LAE5. The Check 'A' included a specific task to check the condition of the swash plate drive (scissor) link assemblies.

On completion, the helicopter carried out a total of eight track and balance flights, amounting to 1.3 hours of flight time. After removal of the rotor track and balance equipment, LAE5 handed the helicopter over to LAE2 to rectify a separate outstanding defect, after which he completed a further Check A before the helicopter was declared serviceable on 2 December. The helicopter was flown from the maintenance facility by the operator on 3 December and accumulated a further four flying hours prior to the incident.

Maintenance facility organisation

The maintenance facilities consisted of two hangars. The day-to-day running of the hangar was controlled primarily by two supervisors who were LAE's. In addition to the day-to-day running of the hangars, the supervisors were heavily involved in liaison with customers and manufacturers on technical issues. It was also common practice for supervisors to be requested to carry out duplicate inspections of tasks and, in times

of high workload, to fll in for shortfalls in available manpower on the hangar foor.

In order to support its customers, the maintenance organisation had committed to provide engineering support 'in the feld'. To support this activity it had a number of 'feld' engineers. In the event that one of these engineers became unavailable, LAE's from the hangar work force were dispatched, sometimes at very short notice, to support customer's aircraft away from base, as was the case with LAE2 on 28 November.

For planning purposes, the normal workload within the maintenance facility was planned at 80% of the total available man hours, not including the use of supervisory staff or overtime. Examination of the workload for the period when G-CCAU was undergoing maintenance showed that, for the majority of this time, the actual workload within the facility exceeded this fgure, and on several occasions exceeded the normal available capacity of the facility. Information obtained during the investigation indicated that personnel were routinely moved onto different tasks in order to meet production targets.

Maintenance facility paperwork

The revision standard of the maintenance manual used during the maintenance input was found to be correct for the period of the inspection. As previously mentioned, two work cards were raised involving the swash plate scissor links, Task No 5 (detailing the original defect, including replacement of the bushes and bolt in accordance with RDAS 1756) and Task No 21 which covered the removal and reinstallation of both scissor link assemblies. The certifcation information for Task No 21 indicated that both scissor assemblies had been removed on 25 November and reinstalled on 1 December. There were no additional work cards raised to cover the earlier installation of scissor link A, its subsequent removal (for comparison with scissor link B, after ftting the oversized bushes) or its partial reinstallation whilst awaiting the arrival of replacement bushes. After the fnal installation of scissor link B, Fitter 2 signed for action on the appropriate work card, Task No 21, and, as no additional task cards had been raised, he also signed for the installation of scissor link A, which he played no part in ftting.

Company procedures required a documented handover during changes of certifying engineers. No evidence could be found of a documented handover having been completed during the maintenance input on G-CCAU between 20 November and 2 December. During the interviews it became apparent that the handover process was only considered to be necessary when changing from a day shift to a night shift. It was also apparent that the use of verbal handovers between LAE's was considered to be normal.

Analysis

The tests carried out on the batch of split pins showed no evidence of an abnormality which may have led to the failure of a correctly installed pin. There was no evidence of unusual wear or distress on the castellations of the nut used to secure scissor link A to the rotating swash plate, or the corresponding stud on the swash plate. These facts, together with the information provided during interviews indicated that a split pin had not been inserted through the nut and stud securing scissor link A to the rotating swash plate. The condition of the nylon insert in the castellated nut indicated that this nut had been installed previously. Had the nut been new, it may not have been possible to hand-wind the nut fully onto the stud thread, thereby providing an additional visual cue to the incomplete installation.

The work cards raised for the original defect did not identify which of the two scissor link assemblies required rectification. This could have been achieved by making reference to its position in relation to the main rotor blades, for example as in between the yellow and green blades. The repair scheme provided by the manufacturer (RDAS 1756) did not identify the need to hone the bushes before installation this has since been rectified with the result that scissor link B could not be refitted as planned. As a result, scissor link A was removed for comparison and then partially installed. The absence of any paper work being added to the work pack to reflect this situation meant that the true condition of the scissor link assembly was only known to Fitter 1 and LAE1.

The delay in obtaining a replacement set of bushes for scissor link B, coupled with the need to attend a training course, meant that LAE1 was unable to oversee the completion of the maintenance input. The use of a verbal handover, which appeared to be the established norm, from LAE1 to LAE2 could have led to a possible misunderstanding of the outstanding tasks on the helicopter. No evidence was found of the use of a written handover during the input. The organisation's policy of providing field support for customers meant that LAE2 was taken off G-CCAU two hours after receiving the handover from LAE1 and any information that had been passed to him was lost.

All the remaining personnel involved in the final installation of scissor link B believed, incorrectly, that the only outstanding task was the refitting of scissor link B. The fact that the main rotor blades and blade pitch rods had been refitted, tasks normally associated with the refitting of the scissor links to the rotating swash plate, and the lack of maintenance platforms on the left side of the fuselage would only have served to reinforced this opinion.

The workload within the facility during the maintenance input on G-CCAU's resulted in the hangar supervisory staff who had no direct involvement with G-CCAU being required to act as certifying engineers, in addition to their normal supervisory duties. This may have introduced an element of distraction and additional pressure whilst they performed their roles as certifying engineers. Without a documented handover they did not have a full understanding of the outstanding tasks on the input. After the installation of scissor link B, the duplicate inspection process, designed to identify such errors, failed to identify the incomplete installation of scissor link A. It was clear from the interviews, that all the personnel involved felt that they had carried out the inspection, yet the error went unidentified. Both the subsequent Check A's also failed to identify this situation.

Conclusions

The scissor link assembly requiring rectification work was not clearly identified in the input work pack. Also, the incomplete repair scheme, provided by the aircraft manufacturer for the replacement of the bushes on scissor link B, resulted in a delay to the maintenance input which, due to other commitments, prevented LAE1 from completing the rectification work.

The removal and subsequent incomplete refitting of scissor link A for comparison with scissor link B was not recorded in the work pack. Nor was there evidence to suggest that the nut securing the helical lever of scissor link A to the rotating swash plate had been torque-loaded or secured with a split pin after being refitted. The nut used appeared to have been previously installed; had a new nut been used, its incomplete installation may have been more apparent.

The use of a verbal handover between LAE1 and

LAE2 could have resulted in a misunderstanding of the status of the helicopter. The organisation's policy for providing 'in feld' support resulted in a further discontinuity in the management of the input and the lack of a documented handover then prevented subsequent certifying staff from fully understanding the status of the helicopter. All the personnel involved with the helicopter from 1 December onwards were under the impression that the only outstanding task was the refitting of scissor link B. The reinstallation of the main rotor blades and pitch control rods seems to have reinforced that belief.

The use of hangar supervisors to carry out certification tasks in addition to their normal duties may have introduced additional distractions during these tasks. After the reinstallation of scissor link B, five further inspections of the scissor link assembly failed to identify the situation.

Safety actions taken

In addition to the investigation conducted by the AAIB, the maintenance organisation conducted an internal investigation using the Boeing Maintenance Error Decision Aid (MEDA) tool. As a result, the maintenance organisation introduced the following changes to minimise the possibility of a similar event occurring again:

1. All engineering staff received additional training on the importance of identifying the status of all tasks within a work pack. This included the need to record accurately the partial assembly/disassembly of components and systems, the use of high visibility labelling to be attached to partially assembled items and the need to identify identical and interchangeable components clearly.

2. An internal engineering notice (EN323) was circulated reminding all staff of the standard practices involved in the use of self-locking nuts.

3. A redesign of the work card layout and procedures was carried out to improve the method of assessing, recording and certifying a task.

4. A redesign of the duplicate inspection process was carried out. This included additional training and guidance for all certifying staff in how to assess, scope and certify a task, how to identify possible areas of ambiguity and the consideration of external factors, such as lighting and use of maintenance platforms.

5. Hangar supervisors were no longer required to supervise inspections in a certifying role.

6. Certifying engineers acting in the role of 'crew chief' would be assigned to a single airframe and not distracted or expected to certify additional airframes.

7. Certifying staff completing critical inspections were required to wear a red waistcoat to signify that they were completing such a task and should not be distracted.

8. An amended handover procedure was introduced. This required that a documented handover be produced for every crew/shift change. These handovers would form part of the aircraft work pack.

9. A review and amendment of the content and scope of the current Human Factors training undertaken by the company was carried out, to ensure that the areas of concern identified in the investigations were addressed.

ACCIDENT

Aircraft Type and Registration:	Beech A36 Bonanza, G-CDJV
No & Type of Engines:	1 Continental Motors Corp I0-520-BA piston engine
Year of Manufacture:	1976
Date & Time (UTC):	25 June 2008 at 1640 hrs
Location:	Lydd Airport, Kent
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of the Damage:	Damage to left wing and landing gear door
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	53 years
Commander's Flying Experience:	12,000 hours (of which 600 were on type) Last 90 days - 150 hours Last 28 days - 50 hours
Information Source:	AAIB Field Investigation

Synopsis

When the landing gear was selected DOWN a loud mechanical noise was heard and no green landing gear 'down and locked' lights illuminated. The pilot recycled the landing gear twice and the nose and right landing gear 'down and locked' lights illuminated, but not the light for the left landing gear. After two low fights past ATC the pilot was told that all three landing gear legs looked correctly extended but towards the end of the landing roll the left landing gear collapsed. Components in the left landing gear system were found to be seized and restricted in movement. A similar accident, to a Beech 58 Baron, G-OSDI, is also published in this Bulletin.

History of the fight

After takeoff from Lydd Airport the pilot retracted the landing gear normally. When the landing gear was selected DOWN during the approach phase to the destination airfeld a loud mechanical noise was heard and no green landing gear 'down and locked' lights illuminated. The pilot recycled the landing gear. The retraction phase appeared normal and the extension phase produced illuminated nose and right landing gear 'down and locked' lights. The pilot recycled the landing gear once more and this time the extension phase was accompanied by a loud and unusual noise, and again only the nose and right landing gear 'down and locked' lights illuminated.

The pilot then conducted a low fight past the control

tower and the controller informed him that all three landing gears were extended and appeared normal. The pilot suspected that he had a problem with the landing gear and decided to return to his departure airfeld, Lydd, where the wind direction was more favourable and he could burn off fuel. During the return fight, with the landing gear extended, he attempted to extend the landing gear manually but only managed half a turn with the emergency landing gear extension handle before coming up against what he felt was a mechanical limit. The pilot also checked the Emergency Procedures in the Airplane Flight Manual (AFM) but found that there was not a procedure for this situation.

On contact with ATC at Lydd the pilot advised the controller of the situation and requested him to alert the rescue and frefghting service (RFFS). Following his arrival at the airfeld the pilot carried out a low fight past the control tower and the RFFS confrmed that all three landing gears appeared to be in their down and locked positions. After a stable approach, with full fap, the aircraft touched down gently on the right landing gear and, with the use of aileron, the pilot kept the weight off the left gear for as long as possible. As the airspeed decreased and the weight went onto the left gear, it slowly collapsed and, at about 10 kt, the left fap contacted the ground and the aircraft slewed to the left, off the runway. The pilot switched off all the electrical systems and, when the aircraft had come to rest, he left via the right door.

Previous landing gear problem

On the previous fight of G CDJV, some 10 weeks prior to the accident, the same pilot had heard a loud mechanical noise as he lowered the landing gear. This was followed by only the nose and right landing gear 'down and locked' lights illuminating. After an uneventful landing he had taxied the aircraft to the apron and reported the problem to the resident maintenance organisation who, upon examination, found that the left landing gear extension/retraction rod (Figure 1) was bent in two places and the landing gear downlock was not engaged. The engineers were surprised that the left landing gear had not collapsed during the landing. The extension/retraction rod was replaced, the landing gear system inspected, retraction/extension cycles performed and no further fault was found.

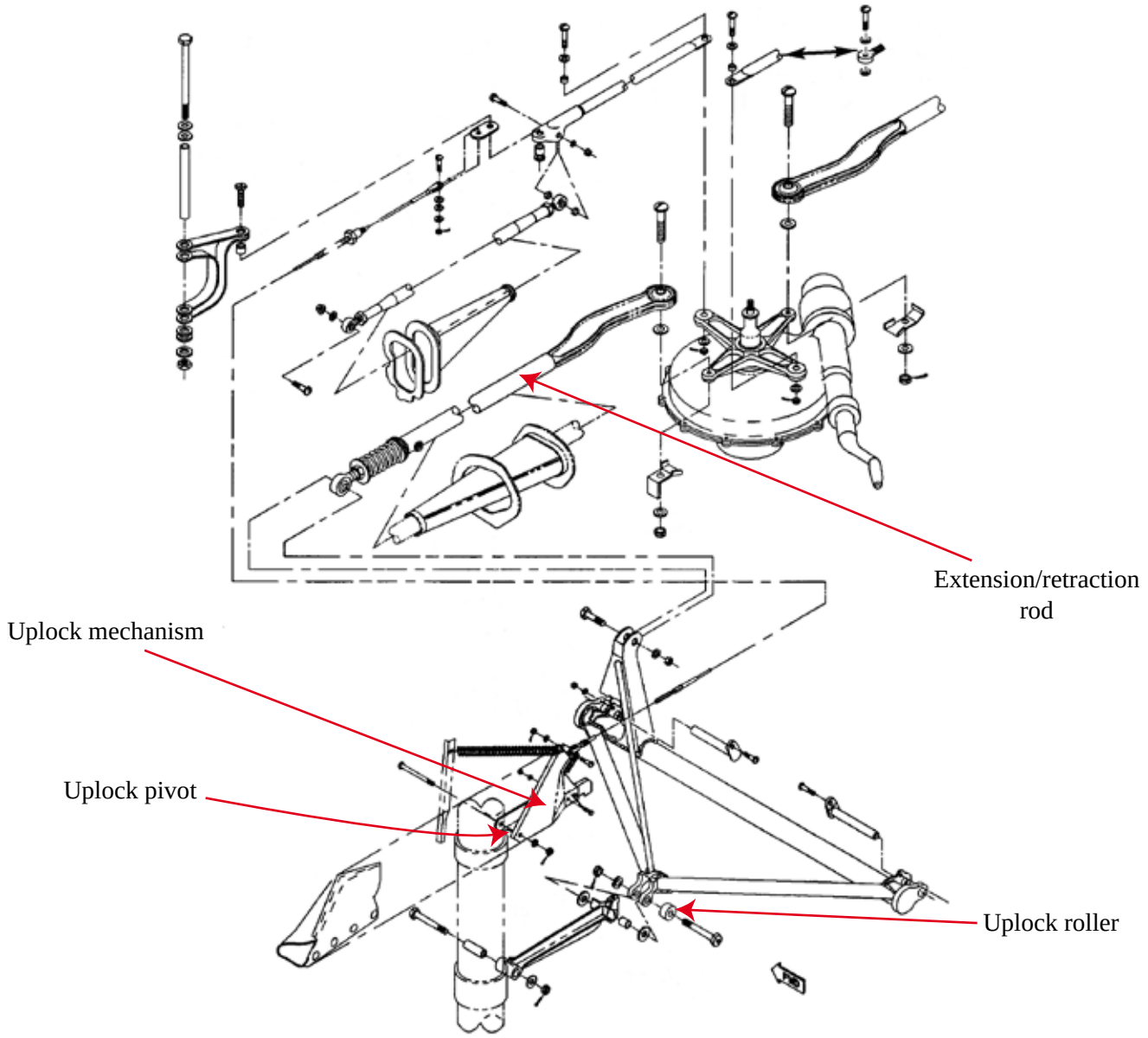
Engineering examination

A description of the landing gear system in the Beech Baron, which is similar to the system in this aircraft, is given in the account of G-OSDI, also published in this Bulletin.

Initial examination of the aircraft was carried out by the same maintenance organisation that had repaired the aircraft following the previous landing gear problem and they found that the replacement left landing gear extension/retraction rod had bent in an almost identical way to the previous rod. Further examination revealed that the landing gear lock mechanism (Figure 1) was not free to move around its pivot, due to corrosion and lack of lubrication and that the uplock roller was seized. Examination of the right landing gear revealed that the lock mechanism had restricted movement around its pivot and the uplock roller was very stiff to rotate. Both uplock rollers were of the latest standard, which incorporate grease points in the form of grease nipples.

Maintenance

The aircraft had been maintained in accordance with CAP 411, the Light Aircraft Maintenance Schedule – Aeroplanes (LAMS) issue 2 and a 50-hour check was carried out on 21 January 2008 and an Annual check on 19 June 2007. When this accident occurred the aircraft had fown 7 and 45 hours respectively since these



Adapted from a manufacturer's drawing

Figure 1

Main Landing Gear Mechanism

maintenance checks. The aircraft manufacturer requires the re greasing of the uplock rollers every 100 flight hours, or 12 months, and this was accomplished during the annual check carried out in June 2007. There were no specific inspection/maintenance requirements for the main landing gear lock mechanism pivot.

Similar occurrence

In April 2008 a Beech B58 Baron aircraft, G-OSDI, (see page 34 of the Bulletin) had a right landing gear collapse following a failure to obtain a right landing gear 'down and locked' indication. Examination of the landing gear system revealed that the right landing gear

extension/retraction rod, which is almost identical to the rod fitted to the Beech A36 Bonanza aircraft, had bent in a way that was very similar to the extension/retraction rods from G-CDJV. The right landing gear uplock roller fitted to G OSDI was found to be seized. The operation and components of the landing gear systems fitted to the Beech B58 Baron and A36 Bonanza aircraft are similar.

Airplane Flight Manual (AFM)

The Airplane Flight Manual for the Beech B58 Baron has a requirement in the Pre flight Inspection part of Section IV to '*Check the landing gear uplock rollers'*. There is no similar requirement in the Airframe Flight Manual for the Beech A36 Bonanza. There is no specific requirement in the LAMS Check A to 'check' or 'inspect' retractable landing gear lock mechanisms.

Safety action

The aircraft manufacturer, Hawker Beechcraft, has reviewed this accident and intends to include the uplock roller mechanism in the Pre flight Inspection section of the A36 AFM.

Other information

The aircraft was parked in the open mainly at airfields which were located very near to the coast. The manufacturer's Maintenance Manual states:

> *'Airplanes operated in extremely humid tropics, or in exceptionally cold, damp climates, etc., may need more frequent inspections for wear, corrosion, lubrication, and/or lack of maintenance. Under these adverse conditions, perform periodic inspections in compliance with this guide at more frequent intervals until the operator can set his own inspection periods based on the contingencies of field experience.'*

There is no similar statement in LAMS.

ACCIDENT

Aircraft Type and Registration:	Beech B58 Baron, G-OSDI
No & Type of Engines:	2 Continental Motors Corp IO-520-CB piston engines
Year of Manufacture:	1980
Date & Time (UTC):	5 April 2008 at 1220 hrs
Location:	Leicester Airport, Runway 28
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - None
Nature of Damage:	Right propeller blades bent, engine shock-loaded, scraping on right wing tip, passenger step displaced
Commander's Licence:	Private Pilot's Licence
Commander's Age:	54 years
Commander's Flying Experience:	682 hours (of which 64 were on type) Last 90 days - 1 hour Last 28 days - 0 hours
Information Source:	AAIB Field Investigation

Synopsis

Whilst landing at Leicester Airport, the pilot was unable to obtain a green 'down and locked' indication for the right main gear, despite several reselections. During the landing roll the gear collapsed at relatively slow speed and with minimal damage. Examination of the aircraft showed that both main gear uplock rollers had seized and this has previously been recognised as a cause of main gear 'hang ups'. A similar accident in this Bulletin (Beech A36 Bonanza, G-CDJV) contains a diagram of the main landing gear system.

History of the flight

The aircraft was returning to Leicester, with just the pilot on board, after a period in Guernsey. The pilot had elected to load full fuel, giving a departure weight of 5,255 lbs. The flight was uneventful but, some 26 miles from Leicester, the pilot encountered deteriorating weather with a lowering cloudbase. Leicester Airport was reporting a cloudbase of 800 feet but he sighted the airfield at about 900 feet. He elected to use Runway 28 since the active runway, 04, was too short for his aircraft.

Normal landing checks were carried out, including selection of first stage of flap and landing gear DOWN. However, the indicator showed green lights for the left main and nose landing gears only, with the right gear not indicating and with the GEAR UNSAFE warning horn

sounding. Having requested a visual inspection by the control tower, the pilot made a reselection whilst positioning the aircraft for a fly by. This resulted in the same indications.

The tower initially reported that the gear appeared to be down but requested a closer fly by. Whilst positioning for this the pilot made a third selection – again with the same indications and with the same response from the tower. A fourth reselection was also unsuccessful and the pilot positioned the aircraft north west of the airfield, whilst he considered his options. His thought processes included:

Using the manual gear extension crank. He was aware that the Pilot's Operating Handbook gave a procedure for using manual extension in the event of failure of the landing gear to extend. He was uncertain whether its use might be inappropriate for cases where only one gear was indicating unsafe. Also, because of the distraction caused by the 50 turns needed to crank the gear all the way down, he would need to be well above the 800 feet cloudbase for safety, and he was not current in IMC procedures.

Performing high-energy manoeuvres to try and force the gear down. He discounted this option for the same reason: he did not want to perform such manoeuvres at low level.

The pilot now accepted that he was going to have to land with the right gear possibly unsafe and requested the presence of a fire crew. He made his approach to Runway 28, having tried a fifth, unsuccessful, reselection. Touching down at 85 kt on the left side of the runway and on the left landing gear first, the ground roll was initially normal and he commenced gentle braking. The aircraft had slowed and completed roughly 75% of the ground roll when the right gear collapsed: the aircraft slewed about 80° and, after a very short slide, came to rest. The right engine had stopped and the left was running at higher rpm than idle (the pilot thinks he may have inadvertently moved the throttle as the right gear collapsed). He shut the aircraft down and tried to evacuate through the pilot's door on the right, but it was jammed, apparently from structural distortion due to the aircraft's unusual attitude. The fire crew wrenched it open and the pilot exited the aircraft "shaken but unhurt". He recalls that he had considered opening the pilot's door prior to landing, but discounted this for the same reasons of distraction at low level which had precluded cranking the manual gear extension mechanism or forcing the gear down with manoeuvres.

After the aircraft was jacked, the right gear actuating rod was disconnected from the actuator, and the gear dropped into full downlock position.

Description of the landing gear mechanism

The B58 Baron (and several other Hawker Beechcraft models) uses a single electric actuator for landing gear extension and retraction. In case of failure of the actuator motor, the gear can be manually cranked down. Three rods are moved by the actuator to extend and retract the left, right and nose gears and two further rods actuate the inboard main doors. Also attached to each of the latter rods is a cable which is tensioned and relaxed by rod movement. These cables move an uplock mechanism into place when the gear is fully UP and a secondary lock into place when the gear is fully DOWN.

The primary method of downlock is provided by the overcentre geometry of the two-piece folding sidestay. The extension/retraction rod rotates the upper, V shaped, element of the sidebrace and moves the whole gear assembly. As the gear approaches the down-and-locked

condition, the rod overtravels and compresses a spring, which forms part of the rod: the downlock is thus held overcentre by this spring pressure (see Figure 1). As this occurs, cable 'B' tensions and pulls the secondary downlock into place underneath a roller on the sidebrace; this is to prevent the gear from being forced out of lock by cornering forces or yawed landings. The green indication in the cockpit is not an indication that the gear is fully locked DOWN with the secondary lock in place, but, because it is activated by a striker plate on the sidebrace, it is an indication that the leg is in a position where the sidebrace is overcentre.

Upon selecting gear UP, the rod reverses its travel, cable 'B' relaxes and the secondary lock drops clear under spring tension, allowing the sidebrace to fold and the leg to retract. As the gear reaches the fully UP position, cable 'A', which is attached to cable 'B', tensions and pulls the uplock block underneath the same roller, preventing movement towards the extended position. The actuator rod is also keeping the gear UP, so the uplock is intended to prevent the gear from sagging against the spring tension.

It will be appreciated that, if the gear is not fully

Figure 1

Gear down and locked

downlocked upon landing, the gear will start to fold and buckle the actuator rod, as it cannot backdrive the actuator. It will also damage the inboard door, which is only open during extension/retraction cycles.

Examination of the aircraft

During the accident the right main landing gear, which had clearly not been locked down, had retracted. The actuator rod had buckled the fitting connecting it to the actuator motor and there was a second, minor, kink in the tubular part of the rod. The inboard door had also been damaged.

When inspected by the AAIB, the bent actuator rod had been replaced with a new, serviceable rod and the system was tested using the manual winding handle on the actuator. All three landing gear legs were found to retract and extend into downlock normally.

Figure 2 shows the right main landing gear of G-OSDI in the up-and-locked condition (doors removed for access): cable 'A' is tensioned and pulling the uplock against its spring under the roller. Although not apparent in the photograph, there was a clearance of about 0.25 inches between the uplock and the roller. The

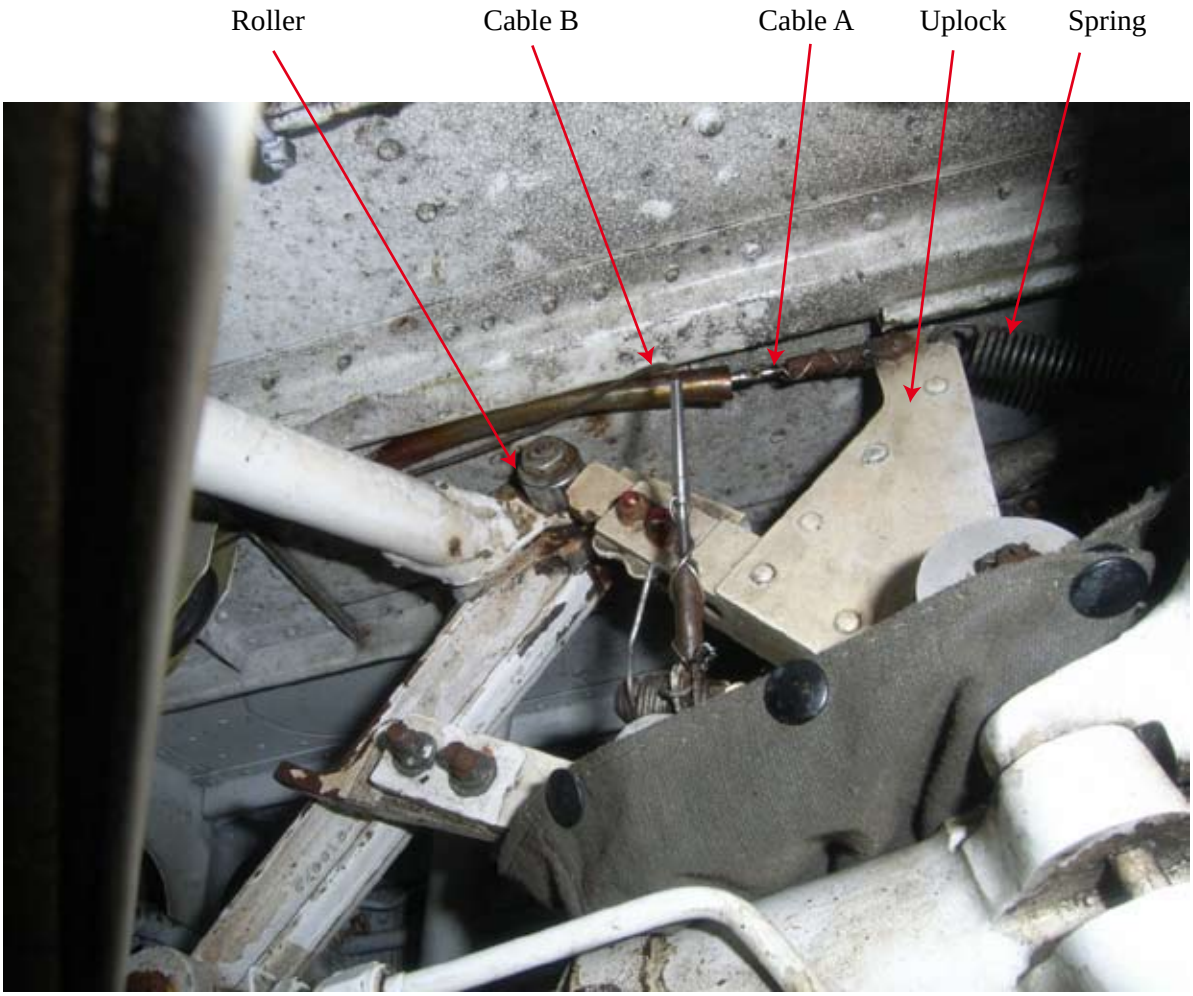


Figure 2

Gear up and locked

Maintenance Manual (MM) requires this gap to be only 0.010 – 0.020 inches. In Figure 1 it can be seen that the secondary lock is hard up against the roller, whereas the MM specifes the same clearance. Both left and right gear rollers were found to have seized solid and could not be freed. A third roller of the same type in the nose landing gear mechanism was also seized.

A test was devised in which the uplock was temporarily prevented from moving during a hand cranked extension cycle. As the gear started to move, the roller contacted the uplock and the whole mechanism jammed; further cranking would have caused the extension/retraction rod to bend. This situation could occur if the extension cycle was initiated during an encounter with turbulence or, possibly, freezing of the uplock. When a 'free' roller was used, and the test repeated, the roller was able to nudge the uplock upwards out of the way and gear extension was unimpeded.

G OSDI had fown only 13 hours since its lastAnnual/ Certifcate of Airworthiness inspection, which had taken place 5 months previously. The records showed that the left roller had been lubricated but there was no entry for the right. Total airframe hours at the time of the accident were 2,188. Considerable corrosion was found on components of both main landing gears, such that replacement would be required before the aircraft few again.

Roller maintenance requirements

In May 2007, the FAA issued Airworthiness Directive (AD) 2007-08-08, which was effectively a re-issue of AD 72-22-01 to add a new model to the list of aircraft to which the earlier AD applied. Essentially the AD required replacement of the uplock rollers with a type which could be regularly greased and thereafter to lubricate at 100 hour intervals. The reason for the AD was:

> *'….to decrease the possibility of gear-up landings caused by seizure of the uplock rollers.'*

The AD is not directly applicable to G-OSDI because the modifed rollers were ftted at build, but it is an indication that the importance of maintaining free rotation of the rollers had been recognised in 1972.

The '*Pilot's Operating Handbook and FAA approved Flight Manual*' requires lubrication of the rollers at 100 hour intervals. The same document requires a check of the rollers as part of the pre fight inspection.

Discussion

The accident to G-OSDI bears many similarities to an accident to a Beech A36 Bonanza, G-CDJV, also in this Bulletin. The aircraft share a similar mechanism for the main landing gears and can suffer the same problems from seized rollers. It appears that some pilots and maintainers are unaware of the potential for seized rollers to cause hang-ups of the main gear. The probable cause is that contact between a seized roller and the uplock results in a transient jam, which distorts the extension/retraction rod so that it can no longer fully move the gear into downlock, despite reselections. The gross bending of the rod occurs as the gear folds on landing. It is possible that, when observing a properly rigged system during extension and retraction, there appears to be no contact between the roller and the up/ downlocks and the necessity of maintaining free rotation is not apparent.

The Pilot's Operating Handbook requirement to check the rollers prior to fight is not specifc, but the intent is that the pilot should check them for free rotation. In the case of G-OSDI, this would not have been possible because the system was misrigged such that

the roller was hard against the secondary downlock. Equally, there is little point in pumping grease into a roller which has seized and free rotation should be checked as well – this requires jacking the aircraft when, as was the case with G-OSDI, the system is improperly rigged.

In the scenario described, hand-cranking the gear down would not have been successful had the pilot attempted it, nor would any attempts to force the gear into lock using 'high g' manoeuvres.

ACCIDENT

Aircraft Type and Registration:	Cessna 152, G-TALA
No & Type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1981
Date & Time (UTC):	12 November 2009 at 1110 hrs
Location:	Runway 26, Tatenhill Airfeld, Staffordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Propeller, noseleg, engine frame and engine shock-loaded
Commander's Licence:	Private Pilot's Licence
Commander's Age:	19 years
Commander's Flying Experience:	106 hours (of which 106 were on type, and 17 as PIC) Last 90 days - 13 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot had decided to practise circuit flying in order to build up her hours. After a touch-and-go on Runway 26, the weather conditions deteriorated to a point where she felt uncomfortable to continue, so she decided to land. On touchdown, after the aircraft had bounced several times, the nose landing gear collapsed. The wind at the time was reported as southerly, 8 kt to 9 kt.

ACCIDENT

Aircraft Type and Registration:	Cessna F177RG Cardinal RG, G-LNYS
No & Type of Engines:	1 Lycoming IO-360-A1B6D piston engine
Year of Manufacture:	1974
Date & Time (UTC):	23 August 2009 at 1520 hrs
Location:	Etchingwood Lane, Framfeld, East Sussex
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Minor) Passengers - None
Nature of Damage:	Damaged beyond economic repair
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	35 years
Commander's Flying Experience:	8,887 hours (of which 350 were on type) Last 90 days - 173 hours Last 28 days - 96 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft suffered a loss of power in flight. During the subsequent forced landing the pilot decided that his initial choice of field was unsuitable, so he landed in an adjacent small field. The aircraft was unable to stop within the distance available and entered some trees at the far end. It was extensively damaged and the pilot received a minor injury. His passenger was uninjured and there was no fire.

History of the flight

The aircraft departed from Popham at 1100 hrs, with the pilot and a photographer, the owner of the aircraft, on board. The purpose of the flight was to carry out aerial photography in the local area. The aircraft had been refuelled to full tanks, which gave it an endurance of approximately six hours. The weather conditions were good, with scattered clouds at 3,000 ft and a westerly wind.

The pilot reported that the aircraft had been flying for about four hours and twenty minutes, with normal engine indications, and was in the cruise at 1,500 ft, returning to Popham, when the engine began to "shudder" and lose power. He attempted to trouble-shoot the problem but was unable to restore power. Although the engine continued to run roughly, the pilot could not maintain level flight, so he initiated a descent, selected a field for a forced landing and declared a PAN on the radio. As the aircraft approached the pilot's initial choice of field, it became apparent to him that it contained livestock and

was, therefore, unsuitable. The surrounding fields were all small and the pilot selected the one that appeared to be the most acceptable. The aircraft landed in the field but was unable to stop in the distance available and entered some bushes and small trees at the far end. The aircraft was extensively damaged but the pilot, who received a minor injury, and the photographer, who was uninjured, were able to vacate the aircraft normally. There was a smell of fuel around the aircraft after the accident but there was no fire.

The owner of the aircraft commented that he had not experienced any previous problems with the aircraft or its engine. It was reported that an initial examination of the engine could find no obvious reason for the loss of power. The aircraft was scrapped.

ACCIDENT

Aircraft Type and Registration:	Europa XS, G-FELL
No & Type of Engines:	1 Rotax 912 UL piston engine
Year of Manufacture:	1998
Date & Time (UTC):	3 June 2009 at 1625 hrs
Location:	1 mile west of Ashcroft Airfeld, near Manchester.
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to fbreglass fairings, bent nose leg and one damaged main gear leg
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	68 years
Commander's Flying Experience:	7,633 hours (of which 68 were on type) Last 90 days - 34 hours Last 28 days - 17 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft was damaged during a forced landing due to loss of engine power, resulting from a blocked fuel filter. The previous day the pilot had experienced a similar reduction in engine power but had attributed it to vapour lock in the MOGAS fuel.

History of the flight

The pilot reported that, on a flight from Oban to Glenforsa, the engine spluttered and coughed twice before he was able to switch on the electric fuel pump. The engine then ran well and the pilot suspected vapour lock as the aircraft had sat in warm sunshine that afternoon and the fuel (MOGAS) temperature would probably have been over 20°C.

The following day the pilot discussed the issue with ground engineers at his home base and they suggested the same likely cause: vapour lock. The fuel filters were not suspected, partly because they had recently been changed. The pilot therefore refuelled with 40 litres of AVGAS at Oban before taking off for Strathaven, where he refuelled with a further 20 litres of MOGAS.

Flying back into England, the engine ran well for almost another two hours. However, close to the MAN low level corridor the engine began to lose power. The pilot turned on the electric fuel pump and this solved the problem for a few minutes. He transmitted that he had a rough-running engine and would be landing

at Ashcroft and, after some radio confusion, started a slipping turn to try to reach Ashcroft's Runway 27. However, realising that, due to a tailwind, he would be touching down too far down the runway, he decided to fy a "dumbell" approach onto Runway 09. During this manoeuvre the engine "surged" and the pilot made a forced landing into a feld, with about 100 metres rollout into a barbed wire fence.

The pilot believes the cause of the loss of power was the partially blocked main fuel flter. However, he considers that his lack of system knowledge contributed to the accident, as selection of the reserve tank would probably have cleared the problem. He also considers that he should have ignored the radio when transmission became confused, and concentrated on the forced landing.

ACCIDENT

Aircraft Type and Registration:	Europa XS, G-PHXS
No & Type of Engines:	1 Rotax 912 ULS piston engine
Year of Manufacture:	2002
Date & Time (UTC):	4 July 2009 at 0830 hrs
Location:	Weldon Farm strip, near Corby, Northamptonshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Tail broken off forward of tail fin, damage to nosewheel and main landing gear legs
Commander's Licence:	Private Pilot's Licence
Commander's Age:	62 years
Commander's Flying Experience:	118 hours (of which 14 were on type) Last 90 days - 7 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft was landing at Weldon Farm on a grass strip 480 metres long by 15 metres wide, cut into a crop. The pilot later recalled that it appeared to him that he was too close to the crop and he attempted a correction. The next thing he remembered was the aircraft stationary on the ground at the edge of the runway, having turned through about 50° to the right. The rear fuselage had broken just forward of the tail but the pilot was uninjured. He is unsure whether he drifted into the crop due to a gust of wind or whether he had been simply too close to one side of the strip during the fare to land.

ACCIDENT

Aircraft Type and Registration:	Extra EA 230, G CBUA
No & Type of Engines:	1 Lycoming AEIO-360-A1E piston engine
Year of Manufacture:	1986
Date & Time (UTC):	10 October 2008 at 1330 hrs
Location:	White Waltham Airfield, Berkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Right landing gear, wheel spat, aileron spade and propeller
Commander's Licence:	Private Pilot's Licence
Commander's Age:	44 years
Commander's Flying Experience:	698 hours (of which 128 were on type) Last 90 days - 26 hours Last 28 days - 4 hours
Information Source:	AAIB Field Investigation

Synopsis

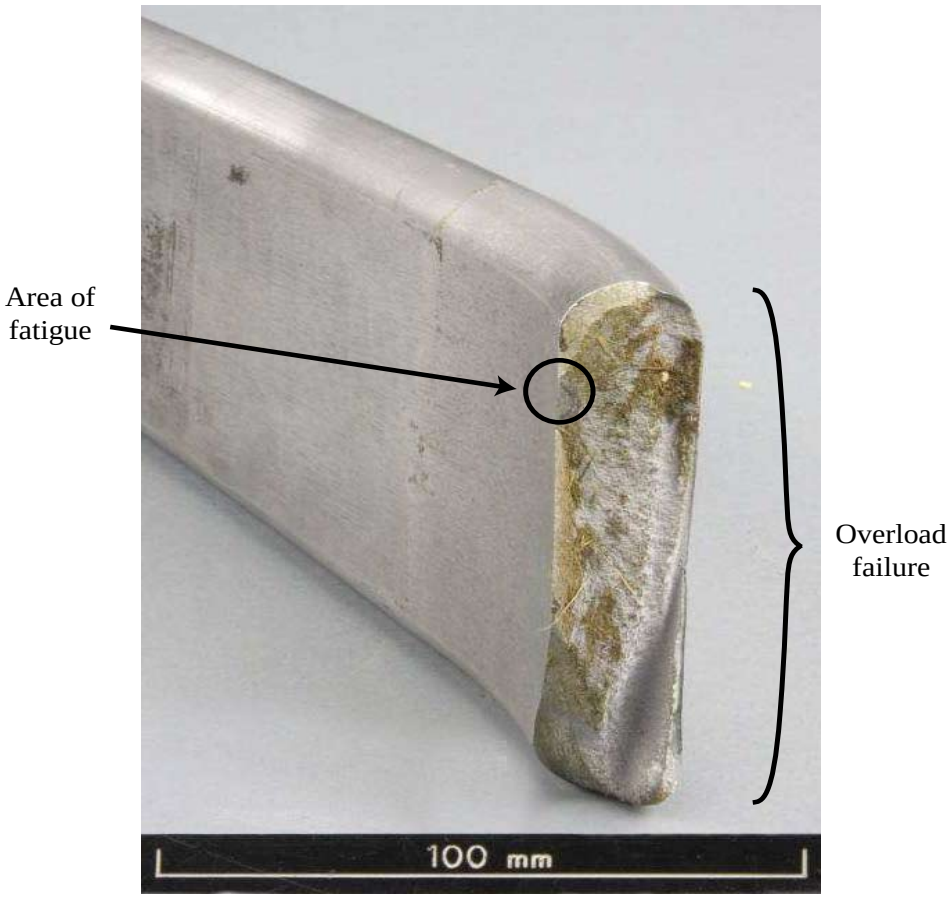
While taxiing to the holding point the right landing gear leg fractured, which resulted in the right wing tip contacting the ground and the aircraft pivoting to the right. Metallurgical examination of the failure of the right landing gear showed that the fracture was as the result of a fatigue crack that had initiated from a small corrosion pit.

History of the flight

The pilot carried out a daily inspection of the aircraft and found it to be fit for flight. After starting the engine he taxied the aircraft towards the holding point for Runway 21. The airfield, which was where the aircraft was based, has a grass surface and is, in areas, very undulating. The pilot taxied very slowly to minimise the bouncing and vertical loading on the aircraft. While passing the holding point for Runway 25 the upper right landing gear leg fractured, the right wing tip contacted the grass surface and the aircraft pivoted to the right by approximately 90°. During the pivot to the right the propeller contacted the ground, shattering the wooden blades.

Engineering examination

Initial examination of the failure surface of the aluminium landing gear indicated an area of fatigue (Figure 1).



Courtesy of QinetiQ

Figure 1

Landing gear leg, G-CBUA

Both halves of the landing gear were taken to the Materials and Failure Analysis Department at Qinetiq for detailed examination.

In summary, the QinetiQ examination revealed that the landing gear was manufactured from a single length of 2024 aluminium alloy 22.5 mm thick, which was then formed to the desired profile. It was found that the gear had fractured at the bend at the top of the right leg. It was concluded that the failure of the right main landing gear was caused by the growth of a fatigue crack which originated at a small corrosion pit on the inner surface of the bend radius at the top of the leg. There was evidence of a second similar crack originating from a small corrosion pit on the matching (unbroken) left leg of the landing gear. There was no evidence of protective measures having been taken to prevent corrosion pitting other than surface polishing, which had been carried out only to the lower part of the landing gears. There was no associated mechanical damage that would have influenced the failure.

Examination of the fracture surface in a scanning electron microscope (SEM) revealed coarse growth bands across the crack length and attempts to count them showed there to be between 45 and 50 visible. Contained within the major visible growth bands there appeared to be a number of less distinct bands and

individual fatigue striations. It is possible that each of the major growth bands visible on the fracture surface indicated a landing, whilst the minor bands found within these could be associated with bumps during taxiing over rough ground. Therefore it is possible that the crack may have been progressing for up to 50 landings before final fracture occurred.

The metallurgist further commented that there was no evidence to suggest that the material's mechanical properties contributed to this failure, but that the high copper content of 2024 alloy makes it susceptible to corrosion and the material commonly requires additional protection from environmental degradation. In this case there was no evidence found of an effective protection scheme applied to the undercarriage leg, which would have increased the likelihood of the formation of the corrosion pit which initiated the fatigue cracking. The metallurgist considered that the adoption of additional corrosion protection measures, such as inhibited paint coatings over anodising or conversion treatments on the landing gear, would reduce the occurrence of the fatigue-initiating corrosion pits. There is evidence[1] to suggest that there can be in-service fatigue failures originating from corrosion damage in components under sustained stresses acting in the longitudinal or short-transverse directions relative to the grain structure of the material.

Other information

At the time of the accident the aircraft had flown approximately 1,743 hours since manufacturer and 28 hours since an annual maintenance check.

The area where the failure occurred is covered by a composite fairing. There are no specific maintenance requirements to examine for cracking of the landing gear in that area and nor is there a manufacturer's requirement to apply corrosion protection measures to the main landing gear. As this aircraft design is not type certificated, the following Safety Recommendation is made to the aircraft manufacturer:

Safety Recommendation 2009-104

It is recommended that EXTRA GmbH review the continued airworthiness of the main landing gear fitted to the Extra EA 230 aircraft, to ensure adequate protection measures to reduce the occurrence of corrosion pitting.

Footnote

[1] ASM Speciality Handbook, Aluminium and Aluminium Alloys 1996. Properties of Wrought Aluminium and Aluminium Alloys – corrosion behaviour.

ACCIDENT

Aircraft Type and Registration:	Glasair, EI-CTG
No & Type of Engines:	1 Lycoming IO-360 piston engine
Year of Manufacture:	2007
Date & Time (UTC):	12 July 2009 at 1315 hrs
Location:	3 miles northeast of Enniskillen Airfeld, Co Fermanagh
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:	61 years
Commander's Flying Experience:	1,017 hours (of which 717 were on type) Last 90 days - 11 hours Last 28 days - 7 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and subsequent AAIB enquiries

Synopsis

The aircraft was cruising at about 3,000 ft when the engine cut out, requiring the pilot to make a forced landing. The pilot considers the engine stopped due to water in the fuel which had not been apparent during the pre fight fuel checks. He believes the water entered the fuel system because the aircraft had been parked in the rain prior to the fight.

History of the fight

The aircraft had fown to Prestwick in Scotland without incident three days prior to the accident and had been left parked outside. On the day of the accident the pilot intended to fy back to the aircraft's home base at Abbeyshrule in Ireland, via a refuelling stop at Enniskillen. The pilot stated that he had visually checked the fuel quantity prior to departure and that the header tank was full and the main tanks about a quarter full, giving an endurance of about two hours. This was suffcient for the intended fight. He also stated that he had completed a drain check on all the tanks and found no evidence of water in the fuel.

After departure the pilot had switched fuel selection from the main tank to the header tank and climbed to a cruising altitude of 3,000 ft. He reported the fight proceeded without incident until the aircraft was approximately 12 miles from Enniskillen when the engine cut out. Believing it to be a fuel problem the pilot selected the

main tank and turned the booster pump on. The engine did not respond and the pilot then re-selected the header tank and then the main tank again, but to no effect. He notified Enniskillen of the engine failure and selected a field in which to make a forced landing. The field he chose was not particularly long and so he elected to land with the wheels up in an attempt to reduce the landing distance. The aircraft touched down and came to a halt within the field but the landing badly damaged the aircraft. The pilot was able to vacate the aircraft unaided through his door but the passenger had to be cut free from the aircraft by the emergency services.

Subsequent examination

As the aircraft was destroyed in the accident it has not been possible to ascertain whether the engine failure was due to a mechanical problem.

The pilot reported that after the accident he tested a sample of fuel from the header tank and that this contained significant amounts of water. He believes this was sufficient for the pre departure test sample to have only contained water and therefore he had not been able to detect a water/fuel interface when doing the test. The aircraft was normally stored in a hangar and had operated without problem on the flight to Prestwick. During the time the aircraft was parked at Prestwick it had rained moderately at various times and the pilot considers it possible that water had entered the fuel tanks as a result.

Comment

The investigation was unable to establish a definite cause of this accident. Although the engine may have cut out due to contamination of the fuel by water, it might be expected that the significant levels of water described by the pilot, would have become apparent earlier in the flight. The accident reinforces the importance of ensuring fuel cap seals are kept in good condition and that a sufficient amount of fuel is checked for water on each occasion prior to flight.

ACCIDENT

Aircraft Type and Registration:	Luscombe 8A (Modified) Silvaire, G BRSW
No & Type of Engines:	1 Continental Motors Corp A75-8J piston engine
Year of Manufacture:	1946
Date & Time (UTC):	31 August 2009 at 1200 hrs
Location:	Cromer Airfeld, Norfolk
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Left landing gear and tailwheel assembly damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	57 years
Commander's Flying Experience:	518 hours (of which 326 were on type) Last 90 days - 12 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot reported that during the approach he concentrated on clearing the power cables at the threshold end of Runway 26 at Cromer, which has an uphill slope and a displaced threshold. He stated that he reduced the engine power too soon, with the result that the aircraft landed heavily, damaging the left landing gear leg. The wind at the time was from 210° at approximately 15 kt.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28-161 Cherokee Warrior II, G-BSLK
No & Type of Engines:	1 Lycoming O-320-D3G piston engine
Year of Manufacture:	1979
Date & Time (UTC):	29 August 2009 at 1013 hrs
Location:	Sandown Airport, Isle of Wight
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Nose leg and engine mounting bracket bent, scuff marks to the propeller tips
Commander's Licence:	Private Pilot's Licence
Commander's Age:	55 years
Commander's Flying Experience:	143 hours (of which 63 were on type) Last 90 days - 11 hours Last 28 days - 6 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Following an uneventful flight from Wellesbourne Mountford the pilot made an overhead join for a right-hand circuit to Runway 23 at Sandown Airport. The reported wind was 200º at 10 kt. On late final the pilot considered that he was too high and so decided to go around. He considered that his second approach appeared to have been normal. However, the aircraft touched down heavily and sooner than the pilot was expecting, before it bounced back into the air. The pilot decided to go around again. He flew a low level circuit and landed without further incident, after which damage to the nose leg, engine mounting brackets and scuff marks on the propeller tips were found. The pilot considered that the heavy landing and subsequent bounce may have been due either to a misjudgement in height resulting in a late flare or that he had allowed the airspeed to reduce too much.

ACCIDENT

Aircraft Type and Registration:	Escapade 912(1), G-CDLE
No & Type of Engines:	1 Rotax 912 UL piston engine
Year of Manufacture:	2005
Date & Time (UTC):	4 April 2009 at 1435 hrs
Location:	Shobdon Airfeld, Herefordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Fatal) Passengers - 1 (Fatal)
Nature of Damage:	Destroyed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	56 years
Commander's Flying Experience:	86 hours (of which 77 were on type) Last 90 days - 2 hours Last 28 days - 1 hour
Information Source:	AAIB Field Investigation

Synopsis

While positioning to join the visual circuit, G CDLE took avoiding action on a departing aircraft. G-CDLE subsequently entered a spin from about 500 ft aal and crashed onto land adjacent to the airfeld. Both occupants were fatally injured on impact.

History of the fight

The aircraft took off from its base at Eastbach Farm Airfeld, near Lydbrook, Gloucestershire, at about 1045 hrs with the pilot and a passenger on board. It few to Over Farm Airstrip, near Gloucester, before landing at Rodley Airstrip, 5 nm south-east of Gloucester, at about 1140 hrs. People who spoke to both occupants at Rodley stated that they "were both their normal selves and were both in good spirits".

The aircraft departed Rodley at 1340 hrs destined for Shobdon Airfeld, Herefordshire, where it is believed the occupants planned to take lunch. Shobdon were using Runway 27 where the weather was CAVOK with a surface wind of 270º/15-20 kt.

The pilot made contact with Shobdon radio at approximately 1400 hrs and told the Flight Information Service Offcer (FISO) that he was 3 nm south of the airfeld at 1,400 ft aal. When asked by the FISO if he was familiar with the circuit at Shobdon the pilot replied "AFFIRMATIVE" and said he would join the microlight circuit at 1,500 ft. At 1425 hrs the pilot reported "DESCENDING DEAD SIDE", to which the FISO advised "NOT BELOW 1,500 FT DUE TO GLIDING"; this was

acknowledged by the pilot. A visitor to the air traffic control tower brought the FISO's attention to an aircraft in a spiral descent at about 500 ft aal. The FISO saw the spiral descent develop into a nose-low vertical descent before it impacted a field about 150 m north of the runway. There was a post impact fire.

The AFRS were quickly on scene and extinguished the fire with foam. Paramedics from a visiting Air Ambulance declared both occupants dead at the scene.

Witness accounts

Several witnesses on the ground saw the final moments of the aircraft's flight. They all described seeing the aircraft in a vertical spiral dive/spin. One pilot witness on the ground described seeing the aircraft at "no more than 500 ft and quite slow." Having taken his eyes off the aircraft for a few moments this witness next observed the aircraft's left wing drop, followed by the nose as it entered a vertical dive and went into a spin.

An airborne pilot in another microlight passed adjacent to G-CDLE soon after he had taken off from Shobdon whilst still on the runway centreline, heading west. He stated that he first saw G CDLE after his passenger brought it to his attention as his aircraft climbed through 400 ft aal. G-CDLE was about 400 m away at his two o'clock position, approximately 50 ft above him and on a conflicting track. He closed the throttle and pushed the control column forward to pass underneath G-CDLE. As he did so, G-CDLE turned sharply to the left and appeared to stall almost immediately. The left wing "dropped sharply" and the aircraft rotated anti-clockwise through about 180° in a near vertical attitude before he lost sight of it. His passenger subsequently reported that the aircraft had crashed adjacent to the airfield near the upwind end of the active runway.

Aircraft details

The Escapade is a three axis microlight aircraft. Certification flight testing of the Escapade reported that 400-600 ft was required to recover from a one-turn spin or a spiral dive.

An aircraft checklist recovered from the accident site stated that the clean stall speed was 30 mph.

Occupants' details

The pilot's logbook showed that he had previously visited Shobdon on six occasions, the last time being in August 2008. The passenger was an experienced qualified flex wing microlight pilot.

Medical information

Post mortem reports on both occupants stated that they received severe injuries as a result of a relatively high speed impact. Toxicology revealed no evidence of alcohol or drugs in either occupant.

Airfield details

The following information on Shobdon Airfield is published in the UK Aeronautical Information Publication and pilots' flight guides.

> *'Circuit directions: Runway 27 – LH [Left Hand]; Runway 09 – RH [Right Hand].*
>
> *Overhead joins: Descend not below 1,500 ft aal dead side, further descent to circuit height when south of runway.*
>
> *Circuit heights:*
>
> *Powered fixed-wing circuits at 1,000 ft QFE to the south of the villages;*

Microlight circuits at 500 ft QFE;

Helicopter circuits at 700 ft QFE inside the normal circuit pattern.'

A copy of a flight guide for Shobdon Airfield was found on the pilot's knee board.

Engineering

The aircraft wreckage came to rest approximately 150 m north of the Runway 09 threshold.

A substantial post impact fire had destroyed the fabric covering, the fuel system and most of the combustible components. The tubular aluminium alloy wing spars were partly melted. The firm dry crop surface, coupled with the low mass of most of the aircraft components, resulted in no ground markings of the extremities of the aircraft being identifiable at the impact site.

The left landing gear leg and nose leg had both been displaced substantially to the right by the impact, being positioned beneath the centre fuselage, whilst the right main gear was almost undamaged. The left tail-plane was deflected upwards from a station just outboard of the bracing tube, although it was not in contact with the ground after the aircraft came to rest. The complete wing structure had migrated forward, rotated to the left relative to the fuselage and rotated in a leading-edge, nose-down sense. The leading edge had been crushed, in the plane of the structure, over its entire span, as a result of its ground impact. The displacement of the complete wing structure had resulted in the right Glass Reinforced Plastic (GRP) fuel tank, positioned within the wing structure, coming into forceful contact with the top of the engine cowling. This appeared to have punctured the lower surface of the tank, allowing fuel to spill onto the engine. The fuselage structure below the seats and engine was considerably crushed. On removal of the aircraft from the site, a slight ground impression was observed below the area previously occupied by the engine and centre fuselage structure.

No evidence was observed of damage or failure within the flying control system which could not be attributed to the effects of impact or fire.

The aircraft was fitted with a three bladed propeller, each blade having carbon composite skins with a foam core. Two of the blades had failed, but had not separated, close to the roots as a result of backward bending, whilst the third blade had shattered. Areas of carbon composite and fragments of foam were distributed in approximately a straight line at right angles to the propeller shaft axis.

None of the aircraft's flight instruments were identifiable from the wreckage.

Analysis

Engineering

The general condition of the aircraft was consistent with it having suffered an impact at a high vertical speed whilst banked to the left with low forward speed. The bent state of the left tail-plane, which did not remain in contact with the ground, further indicates a high descent rate. Such an impact results from an aircraft striking the ground whilst in a spin to the left. Past accidents with high wing aircraft having small span and relatively tall landing gears, known to have spun into the ground, have produced a broadly similar impact effect. The relatively low mass of the components of the Escapade aircraft, the limited strength of components such as wing ribs and the firm nature of the ground probably contributed to the almost total absence of ground markings of wing structure. Nonetheless the general condition of the aircraft and crushing of the occupied section indicate a rate of descent which would not be survivable.

The shattered condition of one propeller blade and the linear distribution of blade debris in the plane of the propeller disc can only be explained by the propeller rotating at significant speed as impact occurred. Since this type of geared engine will not continue rotating if power is lost (ie loss of fuel supply or ignition function will cause the unit to cease rotating whilst the aircraft is at any normal flight speed), there is little doubt that some engine power was available at impact.

Conduct of the flight

The pilot transmitted that he was familiar with the circuit at Shobdon and a copy of the airfield information was found in the wreckage. However, dialogue with the AFISO indicates that he was planning to descend below the minimum required 1,500 ft on the dead side. Although he was reminded of the height restriction, the aircraft was subsequently observed by airborne witnesses at 500 ft aal whilst still on the dead side of the circuit ie north of the runway.

The aircraft subsequently took avoiding action on a departing aircraft which probably led to the loss of control. If G-CDLE had been at or above 1,500 ft aal, there would have been less chance of confliction with departing traffic and also more height available to recover from any loss of control.

The aircraft was described as flying "slowly" by one witness. Although the aircraft's speed was not recorded, had it been flying close to the stall speed of 30 mph it would have been more susceptible to depart controlled flight through any aggressive manoeuvring.

ACCIDENT

Aircraft Type and Registration:	Ikarus C42 FB100, G-HIJN
No & Type of Engines:	1 Rotax 912 ULS piston engine
Year of Manufacture:	2004
Date & Time (UTC):	15 September 2009 at 1732 hrs
Location:	Hoylake Beach, Merseyside
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Noseleg, front forks, engine mount, and front spat
Commander's Licence:	Student
Commander's Age:	48 years
Commander's Flying Experience:	62 hours (of which 35 were on type) Last 90 days - 11 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and subsequent AAIB enquiries

Synopsis

During a solo navigation exercise the pilot, on suggestion of his instructor, attempted a landing on the intertidal zone of a beach. The fare was misjudged leading to a bounced landing and collapse of the nose landing gear.

History of the fight

The student pilot few some dual circuits at Ince Airfeld and then received a brie fng from his instructor to fy a solo navigation exercise to Llandudno and back. The instructor suggested he land on Hoylake beach on the return leg (the student and instructor had previously landed on another beach together). The weather was benign with good visibility, high cloud base, and a light easterly wind.

On the return leg of the fight, the student few over the beach to check that it was clear, before fying a normal approach into wind. He fared the aircraft, and it touched down very promptly on the main wheels before bouncing; he was surprised at the height of the bounce. He pitched the nose down and fared again but the aircraft bounced a second time. Touching down from the second bounce, the student lowered the nose, and the nose landing gear collapsed. He was not injured and evacuated the aircraft without diffculty. There was no fre.

Assessment of cause

The student reported that the expanse of sand with no points of reference may have led him to fare too high. He considered that he should have gone around.

The importance of ground texture to pilots judging their landing is understood and surfaces with poor texture (such as sand or, in the case of amphibious aircraft, smooth water) are known to cause pilots diffculty in judging their height. It is probable that the student fared too high, because of the poor texture and lack of reference points.

At the time of the accident, the student had fown fve hours solo.

ACCIDENT

Aircraft Type and Registration:	Pegasus Quik, G-EEWZ
No & Type of Engines:	1 Rotax 912ULS piston engine
Year of Manufacture:	2005
Date & Time (UTC):	9 August 2009 at 0930 hrs
Location:	Willingale Airfeld, Essex
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Aircraft severely damaged
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	40 years
Commander's Flying Experience:	276 hours (of which 24 were on type) Last 90 days - 6 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot reported that he intended to take off from Runway 03 of the 400 m long grass strip. The air temperature was approximately 20°C, there was a light wind from the south-east and the aircraft had approximately 25 litres of fuel on board.

The aircraft accelerated normally and at approximately 55 mph the pilot applied forward pressure on the basebar to lift off from the strip but the aircraft did not respond immediately. After a few seconds it rose about two feet into the air, before veering to the right and impacting the ground with the right wing leading edge. It then skidded along the ground for approximately 15 m. Although the aircraft was severely damaged, neither the pilot nor passenger were injured.

ACCIDENT

Aircraft Type and Registration:	Pegasus XL-Q, G-MVRU
No & Type of Engines:	1 Rotax 462 piston engine
Year of Manufacture:	1988
Date & Time (UTC):	8 August 2009 at 1144 hrs
Location:	Brookfeld Farm Strip, 14 nm north east of Lincoln
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to keel, pod, forks and monopole
Commander's Licence:	Private Pilot's Licence
Commander's Age:	61 years
Commander's Flying Experience:	360 hours (of which 90 were on type) Last 90 days - 5 hours Last 28 days - 0 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

After landing to the left of the centreline, the aircraft drifted further left, off the side of the strip, onto rough ground and rolled onto its side. The aircraft was damaged but the pilot was uninjured.

History of the fight

The aircraft was landing at a private grass airstrip which was 350 m in length, 15 m wide and orientated east-west. The pilot assessed the wind as south-westerly at 5 to 6 kt. Approaching from the east, the aircraft drifted to the right during the fare and the pilot few a go around. For the second approach, the pilot elected to land to the left of the centreline but, as the aircraft slowed after touchdown, it drifted further to the left. At about 10 to 12 kt groundspeed, the left main wheel ran off the runway surface onto the rough ground of the adjacent feld, causing the aircraft to yaw to the left and tip over. The pilot later thought that landing offset from the strip centreline was not the best course of action. He also thought that the wind had changed to a more northerly one, contributing to the accident. The pilot, who was wearing a lap strap and protective helmet, was uninjured.

The CAA's General Aviation Safety Sense Leafet No 12, entitled *Strip Flying*, points to the advice given in Civil Aviation Publication (CAP) 428, entitled *Safety Standards at Unlicensed Aerodromes*, which states:

> *'Short' (ie those under 800 metres in length) runways should be at least 18 metres wide.*

ACCIDENT

Aircraft Type and Registration:	Rotorsport UK MTOSport, G-DWDW
No & Type of Engines:	1 Rotax 914 UL piston engine
Year of Manufacture:	2009
Date & Time (UTC):	4 July 2009 at 1255 hrs
Location:	Holyrood, near Prestwich, Lancashire
Type of Flight:	Unknown
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Rotor blades, propeller and tail fn damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	53 years
Commander's Flying Experience:	338 hours (of which 12 were on type) Last 90 days - 21 hours Last 28 days - 12 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft was operating from a private feld and, with the pilot, one passenger and 40 kg of fuel on board, was probably lighter than its maximum 500 kg takeoff weight. Having assessed the wind direction and speed as 120° and 7 kt, the pilot attempted to take off in an easterly direction. After a longer-than-anticipated takeoff run the pilot judged that the aircraft would not climb sufficiently to avoid trees near the eastern edge of the feld. To avoid these he turned the aircraft left but in doing so it descended. He was also aware of electricity cables to the south of the feld that would constrain his fight path if he attempted to turn right. Nevertheless, judging that the aircraft would not climb above a fence at the eastern end of the feld he aborted the takeoff and attempted to turn right through 180°. The aircraft landed heavily and rolled onto its side. The pilot and passenger vacated the aircraft without injury and righted the aircraft to avoid fuel spillage. The pilot stated that the wind direction changed after his initial assessment such that the takeoff was downwind.

ACCIDENT

Aircraft Type and Registration:	Thunder AX7-77 hot air balloon, G-BSZH
No & Type of Burner:	Double Cameron CB 579-1
Year of Manufacture:	1990
Date & Time (UTC):	2 September 2009 at 0700 hrs
Location:	Bilsdale, North Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 3
Injuries:	Crew - None Passengers - 2 (Minor)
Nature of Damage:	Connecting wires severed, envelope and burner damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	57 years
Commander's Flying Experience:	40 hours (of which 40 were on type) Last 90 days - 20 hours Last 28 days - 10 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The balloon was approaching to land at the bottom of a valley in a sheltered field which was free of livestock but crossed by power lines. The surface wind was approximately 3 kt. The pilot reported that the balloon approached clear of the power lines until, approximately 20 ft above the field, it reversed direction briefly before continuing towards them. The pilot used the burner in an attempt to arrest the descent but the balloon suspension cables touched the power lines before this took effect. The balloon slid along the power lines until continued contact caused the suspension cables to break, releasing the basket which fell approximately 15 ft to the ground. Two passengers received minor injuries during the impact. The pilot commented that backing of the balloon was probably caused by local reversal of airflow in the lee of a ridge over which it had flown on approach to the field. He noted that the balloon had had sufficient fuel aboard to continue the flight into an area of more open ground beyond the selected field.

BULLETIN CORRECTION

AAIB File:	EW/C2008/04/01
Aircraft Type and Registration:	Piper PA-32R-300 Cherokee Lance, G-BSYC
Date & Time (UTC):	5 April 2008 at 0948 hrs
Location:	Cairn Gorm, Cairngorms, Scotland
Information Source:	AAIB Field Investigation

AAIB Bulletin No 11/2009, page 105 refers

In the second sentence of the **History of the fight** section of this report it was incorrectly stated that the pilot began his journey at Gamston Airfeld, Nottinghamshire on 4 April 2009.

The sentence should have read:

He began the journey at Gamston Airfeld, Nottinghamshire on Friday 4 April **2008**, departing from there at 1025 hrs.

FORMAL AIRCRAFT ACCIDENT REPORTS ISSUED BY THE AIR ACCIDENTS INVESTIGATION BRANCH

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.

5/2008 Boeing 737-300, OO-TND
at Nottingham East Midlands Airport
on 15 June 2006.
Published April 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.

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http://www.aaib.gov.uk