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AAIB CORRESPONDENCE INVESTIGATIONS (Cont)

SPORT AVIATION / BALLOONS

MISCELLANEOUS

ADDENDA and CORRECTIONS

(ALL TIMES IN THIS BULLETIN ARE UTC)

AAIB Special Bulletins / Interim Reports

AAIB Special Bulletins and Interim Reports

This section contains Special Bulletins and Interim Reports that have been published since the last AAIB monthly bulletin.

ACCIDENT

Aircraft Type and Registration:	Agusta A109E G-CRST
No & Type of Engines:	2 x Pratt & Whitney Canada PW206C
Year of Manufacture:	1998
Location:	St George Wharf, Vauxhall, London
Date & Time (UTC):	16 January 2013 at 0759 hrs
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew -1 Passengers - None
Injuries:	Crew - 1 (Fatal) Passengers - N/A
Nature of Damage:	Helicopter destroyed
Commander's Licence:	Air Transport Pilot's Licence
Commander's Age:	50 years
Commander's Flying Experience:	To be confirmed
Information Source:	AAIB Field Investigation

Notification

At 0820 hrs on 16 January 2013 the Air Accidents Investigation Branch (AAIB) was notified that a helicopter, flying over central London, had collided with a crane and crashed into the street near Vauxhall Bridge. A team of AAIB inspectors and support staff were deployed immediately and arrived on the scene at 1130 hrs.

Synopsis

The helicopter was flying to the east of Battersea Heliport when it struck the jib of a crane, attached to a building development at St George Wharf, at a height of approximately 700 ft in conditions of reduced meteorological visibility. The pilot, who was the sole occupant of the helicopter, and a pedestrian were fatally injured when the damaged helicopter impacted

a building and adjacent roadway. This Special Bulletin presents facts determined up to the time of issue and offers no analysis.

History of the flight

The pilot of G-CRST arrived at Redhill Aerodrome at approximately 0630 hrs in preparation for a flight to Elstree Aerodrome. He intended to collect a client to take him and another passenger to the north of England.

The helicopter, callsign Rocket 2, lifted at 0735 hrs and departed to the north climbing to 1,300 ft amsl[1] (see Figures 1 - 3). The pilot called Thames Radar on frequency 125.625 MHz and stated that he was en route from Redhill Aerodrome to Elstree Aerodrome and wished to route overhead London Heliport (near Battersea) with a Special VFR (SVFR) clearance. He was cleared to transit the London Control Zone (CTR) via Battersea, under SVFR, not above 1,000 ft. The helicopter descended to 1,000 ft before entering the London CTR.

At 0742 hrs, G-CRST was abeam London Heliport at 1,100 ft heading approximately north. It crossed the River Thames 15 seconds later and altered track left towards Holland Park, towards a point immediately east of Brent Reservoir. At 0745 hrs, when 2 nm southeast of the reservoir, ATC amended the helicopter's clearance to "NOT ABOVE 2,000 FT".

G-CRST climbed to 1,500 ft on track to Elstree and cleared the northern boundary of the London CTR at 0746 hrs, when it began a descent. It passed Elstree Aerodrome at 0748 hrs in a descent through 1,200 ft before reaching a minimum altitude of 1,000 ft. At 0749 hrs, G-CRST was 2 nm north-west of Elstree Aerodrome when it climbed and turned right onto a south-easterly track towards central London.

At 0751 hrs, Thames Radar broadcast London City Airport ATIS[2] information 'J' which reported a visibility of 700 m, a Runway Visual Range (RVR) of 900 m, freezing fog and broken cloud with a base 100 ft above the airport. Thirty seconds later, the pilot of G-CRST asked to route back to Redhill Aerodrome via the London Eye and received the reply:

> "ROCKET 2 APPROVED VIA THE LONDON EYE NOT ABOVE ALTITUDE 1,500 FEET VFR IF YOU CAN OR SPECIAL VFR, QNH 1012".

The pilot replied:

> "YEAH, WE CAN, 1012 AND NOT ABOVE 1500, VFR OR SPECIAL VFR ROCKET 2".

G-CRST climbed to 1,500 ft for the transit. At 0753 hrs, the controller asked:

> "ROCKET 2 DO YOU HAVE VMC OR WOULD YOU LIKE AN IFR TRANSIT?"

The pilot replied:

> "I HAVE GOOD VMC ON TOP HERE, THAT'S FINE, ROCKET 2".

At 0755 hrs, G-CRST was put under radar control as it entered the London CTR. One minute later, the pilot asked:

> "ROCKET 2, IS BATTERSEA OPEN DO YOU KNOW?"

Footnote

[1] Helicopter altitudes above mean sea level (amsl) were derived from the Mode S downlink of transponder Mode C altitude, and have an accuracy of approximately ± 50 ft.

Footnote

[2] Automatic Terminal Information Service.

After being told that London Heliport was open, the pilot said:

"IF I COULD HEAD TO BATTERSEA THAT WOULD BE VERY USEFUL".

The controller replied:

"I'LL JUST HAVE A CHAT WITH THEM, SEE WHAT THEIR CLOUD IS LOOKING LIKE"

At 0757 hrs, G-CRST was abeam the London Eye at 1,500 ft and the pilot said:

"ROCKET 2, I CAN ACTUALLY SEE VAUXHALL, IF I COULD MAYBE HEAD DOWN TO H3… H4[3] SORRY"

The ATC controller replied:

"ROCKET 2, YOU CAN HOLD ON THE RIVER FOR THE MINUTE BETWEEN VAUXHALL AND WESTMINSTER BRIDGES AND I'LL CALL YOU BACK".

G-CRST was flying south parallel to the River Thames and, as it passed Westminster Bridge, began to descend. At 0758 hrs, G-CRST was approaching the north side of the river, 0.5 nm west of Vauxhall Bridge. The controller said:

"ROCKET 2 BATTERSEA ARE JUST TRYING TO FIND OUT IF THEY CAN ACCEPT THE DIVERSION"

The pilot acknowledged, after which the controller continued:

"AND YOU CAN MAKE IT QUITE A WIDE HOLD, YOU CAN GO AS FAR AS LONDON BRIDGE"

Footnote

[3] H4 is a helicopter route that runs along the River Thames.

The helicopter crossed the north bank of the Thames at 1,000 ft heading south-west and began a right turn through north onto a south-easterly heading which took it back over the middle of the river. It was by now level at approximately 800 ft and altered course to follow the line of the river east towards Vauxhall Bridge.

At 0759:10 hrs, the ATC controller said:

"ROCKET 2 YEAH BATTERSEA DIVERSION APPROVED YOU'RE CLEARED TO BATTERSEA".

The pilot replied:

"LOVELY THANKS ROCKET 2".

The ATC controller continued:

"ROCKET 2 CONTACT BATTERSEA ONE TWO TWO DECIMAL NINER".

The pilot replied:

"TWO TWO NINE, THANKS A LOT".

This exchange ended at 0759:18 hrs when G-CRST was approximately 150 m south-west of Vauxhall Bridge. Immediately afterwards the helicopter began to turn right. At 0759:25 hrs it struck a crane on the south side of the river 275 m from the south-west end of Vauxhall Bridge.

Telephone calls and text messages

Another pilot (Witness A) was aware of the flights planned by the pilot of G-CRST. He reported that the pilot phoned him at 0706 hrs to tell him that the weather at Redhill was clear and that he was going to collect a passenger from Elstree. The pilot said there was fog at Elstree but he was going to fly overhead to see for himself.

At 0718 hrs, the client called the pilot to discuss the weather. The pilot said he thought the weather might clear earlier than forecast. The client said he would drive to Elstree and call the pilot to keep him advised.

At 0731 hrs, having noticed how poor the weather was during his journey, the client called the pilot to suggest that he did not take off until he (the client) had reached Elstree and observed the weather. The pilot replied that he was already starting the engines. The client stated that he repeated his suggestion that the pilot should not take off.

At approximately 0750 hrs the client phoned London Heliport and was told that it was open.

Table 1 shows text messages that were sent during the morning.

Witness and CCTV information

Witness and CCTV evidence collected to date indicate that the top of the crane and the top of the building to which it was attached were obscured by cloud at the time of impact.

Time	From	To	Text
0630	Pilot	Client	Weather ok up north but freezing fog at Elstree and Luton not clearing between 8 - 10am I've got same at Redhill keep you posted
0640	Pilot	Operator	Freezing fog all london airports ok up north have text [client] clearing between 8 - 10
0705	Witness A	Pilot	Give me a call as I have checked weather and freezing fog around at the moment
0729	Pilot	Client	I'm coming anyway will land in a field if I have to
0743	Pilot	Witness A	Can't see batts
0744	Witness A	Pilot	Ok
0747	Pilot	Witness A	VFR on top at 1500 feet
0748	Witness A	Pilot	But can you land?
0751	Pilot	Witness A	No hole hdg back to red
0753	Witness A	Pilot	Ok
0753	Pilot	Client	Over Elstree no holes I'm afraid hdg back to Redhill least we tried chat in 10
0755	Client	Pilot	Battersea is open
0755	Pilot	Operator	Can't get in Elstree hdg back assume clear still
0755	Operator	Pilot	Yes it's fine still here. *NB. This text was not read*

Table 1

Text messages

Meteorological information

Redhill Aerodrome Common Automatic Weather Station ATIS

The information below was taken from the Redhill Aerodrome Common Automatic Weather Station ATIS on 16 January, 2013.

At 0720 hrs, the wind was variable in direction at 1 kt, visibility was 3,100 m, the temperature was -5° C, the dew point was -5° C and QNH was 1010 hPa.

At 0738 hrs, the wind was variable in direction at 1 kt, visibility was 1,300 m, the temperature was -6° C, the dew point was -6° C and QNH was 1010 hPa.

At 0804 hrs, the wind was variable in direction at 1 kt, visibility was 5,000 m, the temperature was -5° C, the dew point was -5° C and QNH was 1011 hPa.

Throughout this period, the system was reporting "NO CLOUD DETECTED" (NCD).

Met Office Report

The Met Office produced a general report of the meteorological conditions prior to and at the time of the accident.

A large ridge of high pressure, centred over Finland, extended a slack, mainly east to south-easterly flow across southern England which had stagnated overnight. The air mass was particularly cold, with air temperatures well below freezing across the area. Much of the area was prone to widespread low cloud, poor visibility and patches of freezing fog. Cloud bases were in the range of 100 ft to 400 ft agl at 0800 hrs. Visibility was generally below 4,000 m, with several areas of London, including London City Airport, reporting freezing fog with visibility of approximately 700 m.

Visibility at nearby airports (London Heathrow, London City and Royal Air Force Northolt) was generally less than 4,000 m at 0800 hrs, and as low as 700 m at London City Airport. Freezing fog was forecast for Redhill and Elstree Aerodromes, and at London Heliport until 1000 hrs.

Crane description

The crane was in place to facilitate the construction of a new high-rise building at One St George Wharf. The main tower of the crane was positioned next to the building and was braced to its structure at regular points. The height of the crane tower was increased by introducing new sections as the building increased in height. At the time of the accident the building had reached its full height; the crane tower had reached a height of 572 ft agl. On top of the crane tower was a cab unit, a counterjib 'A' frame and counter weight platform attached to the crane tower by a bearing ring, which allowed the jib to rotate (slew) in the horizontal plane. The crane had a 'luffing' jib, which meant the full length of the jib pivoted in the vertical plane from a point a further 11.5 ft above the height of the tower section.

During out-of-service periods, such as overnight, the jib was parked in the 'minimum jib' position, at a 65° angle above the horizontal. At the time of the accident this gave a total height from the ground to the tip of the jib of 719 ft.

The crane was lit at night with red lights, both on its tower and jib. The tower lighting consisted of mains powered steady red lights at approximately 50 m intervals. The jib lighting was provided by solar powered lights. The *Air Navigation Order* requires the lighting to be of medium intensity (2,000 candela) and that the obstacle be lit at night only.

Notice to Airmen (NOTAM)

The following NOTAM relating to the crane was valid at the time of the accident:

Q) EGTT/QOBCE/IV/M/
AE/000/008/5129N00007W001

B) FROM: 13/01/07 17:00C) TO: 13/03/15 23:59

E) HIGH RISE JIB CRANE (LIT AT NIGHT)
OPR WI 1NM 5129N 00007W, HGT

770FT AMSL (VAUXHALL, CENTRAL LONDON), OPS CTC 020 7820 3151

12-10-0429/AS 2.

The following is a plain language translation:

> *'In the London Flight Information Region an obstacle has been erected affecting both instrument and visual traffic. Aerodrome and en route traffic is affected. The obstacle is from the surface to 800 ft amsl and is positioned within a 1 nm radius of 51°29'N 000° 07'W. The obstacle will be in place from 1700 hrs on 7 Jan 2013 to 2359 hrs on 15 March 2013. It is a high rise jib crane (lit at night).'*

Recorded information

The helicopter's radar position and Mode S altitude were provided to the AAIB by NATS[4]. The position of the helicopter was captured by several radar heads and was first recorded at 07:35:48 hrs just north of Redhill Aerodrome at 400 ft amsl. The helicopter then climbed and tracked north towards Elstree arriving 1,100 ft overhead at 07:48:19 hrs, before turning back towards central London.

Footnote

[4] The national air traffic control services provider.

The helicopter arrived over the River Thames adjacent to Battersea Power Station at 07:58:35 hrs at a recorded altitude of 900 ft before performing a right turn to track along the river towards Vauxhall Bridge. The final two recorded positions show a turn to the right abeam St George Wharf at 800 ft, with the final position recorded at 07:59:24 hrs.

Injuries to persons

The pilot and a pedestrian on Wandsworth Road suffered fatal injuries in the accident. Several people on the ground suffered serious injuries[5], but the exact numbers have yet to be confirmed.

Aircraft description

The Augusta A109E is a high performance, multi-purpose helicopter. The cockpit seats up to two pilots and the rear cabin can accommodate six passengers. It is powered by two Pratt and Whitney PW206C turboshaft engines and has a fully articulated main rotor head with four main rotor blades. To the rear of the passenger cabin are the fuel tanks, baggage compartment and electrical equipment bay. Above the cabin located on the engine deck are the two engines and the main gearbox. This gearbox drives the main rotor head and blades and the tail rotor drive shaft. The tail boom of the helicopter is bolted to the main fuselage and locates the twin-bladed tail rotor and gearbox, the vertical fin and the horizontal stabilizer. The helicopter has a retractable, tricycle landing gear.

Damage to the helicopter

The collision with the crane's jib resulted in separation of the main rotor blades from the rotor head, and the rotor head and main gearbox from the fuselage of the

Footnote

[5] As defined by ICAO Annex 13 and the Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 1996, which are accessible from the AAIB website.

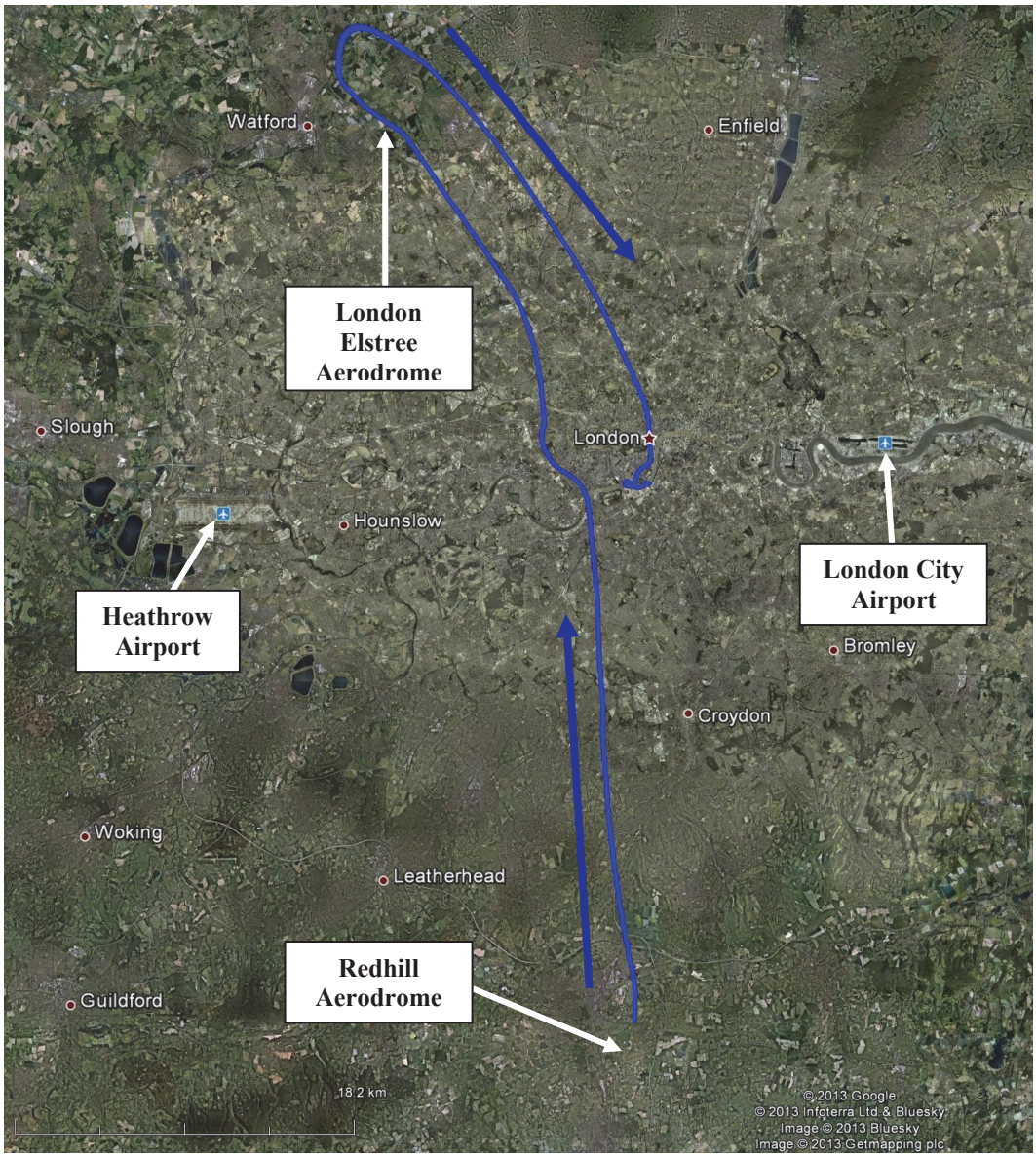

Figure 1

G-CRST radar track

helicopter. The cockpit airframe structure was also damaged. The main rotor head and gearbox landed separately from the fuselage and were further damaged by the impact with the ground. The tail section of the helicopter detached from the tail boom as the helicopter made contact with a building, before the fuselage struck the ground. The ground impact caused further extensive damage and the majority of the fuselage wreckage was consumed by a post-impact fire.

Other damage

The helicopter's collision with the crane resulted in detachment of the outboard section of jib structure from near the point of impact to the tip of the jib. The released section landed in the road on Nine Elms Lane, adjacent to the base of the crane, causing extensive damage to the road surface. The inboard section of the jib remained attached to the crane at its pivot point, but hanging vertically. A residential building below

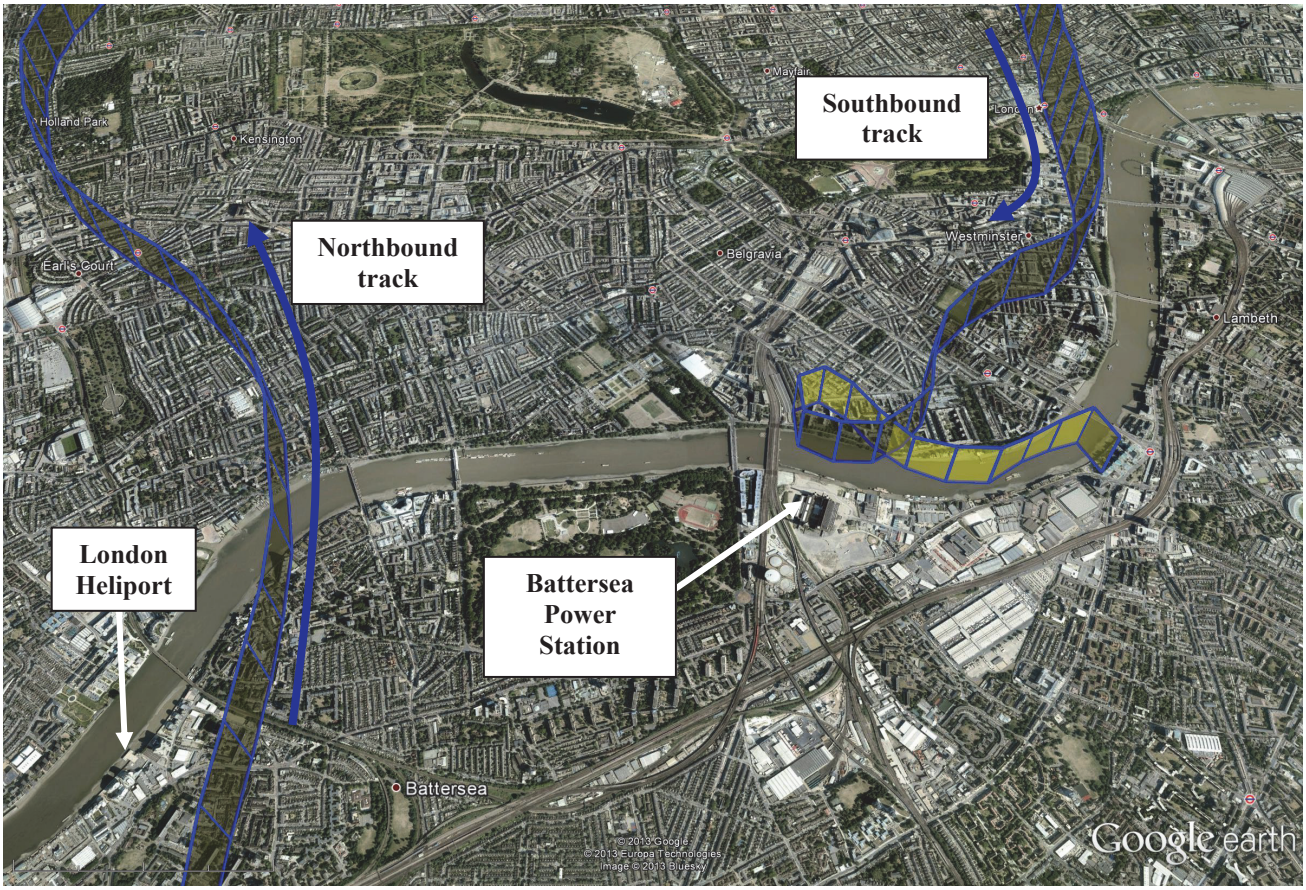

Figure 2

G-CRST radar track showing London Heliport

the crane suffered minor structural damage, including broken glass panels, from impact by released sections of the helicopter's main rotor blades.

The detached rotor head and gearbox from the helicopter landed in the loading bay of the nearby flower market, striking and damaging a delivery van. The tail of the helicopter struck a low-rise building immediately prior to its impact with the ground, resulting in structural damage to the building. The subsequent impact of the forward fuselage with the pavement adjacent to the building created a shallow crater and ruptured the water main below. The final impact sequence disrupted the helicopter's fuel tanks allowing a significant amount of fuel to be released and ignited. The fuselage continued to travel forward onto the road, resulting in an area of fire damage which encompassed the two adjacent building fronts and the road surface from the initial ground impact to the final resting position of the fuselage. The surface of the road there suffered considerable heat damage as the stationary fuselage was consumed by fire.

A number of vehicles on Wandsworth Road, close to the impact of the fuselage, suffered heat damage or were damaged by liberated wreckage debris. Two cars suffered severe fire damage, with the one closest to the final location of the fuselage wreckage being completely consumed. A third vehicle was damaged by a piece of wreckage falling through the panoramic sunroof.

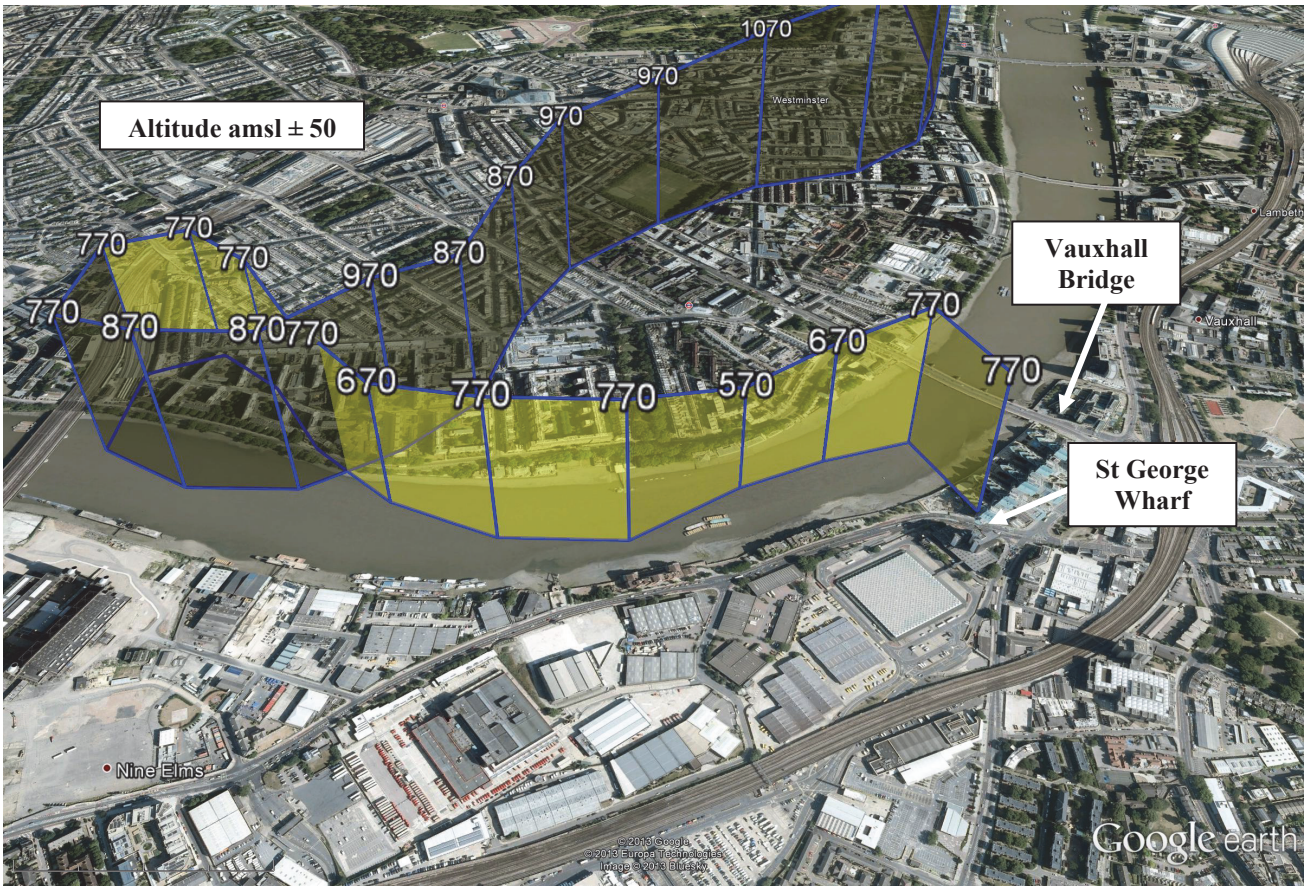

Figure 3

G-CRST radar track final positions showing altitude amsl

Wreckage and impact information

Initial assessment of the location and condition of the various sections of wreckage from the helicopter indicated that the first points of contact with the jib of the crane were the helicopter's main rotors followed by the main rotor head and top section of the fuselage at the level of the main rotor gearbox. These sections were released from the rest of the fuselage and fell separately from the main wreckage. Loose items from the cockpit and sections of airframe structure from the roof of the cockpit were found in the wreckage trail close to the tower to which the crane was attached. This indicated that the top of the forward fuselage above the pilot had also been damaged during the initial impact.

Provisional calculations based on damage to the crane indicate the point of collision was at a height of around 682 ft agl. The helicopter's fuselage then travelled a horizontal distance of approximately 240 m to the south of the crane on an approximate track of 170°, rotating in yaw and descending, until the tail section struck the top of the external wall of a low rise building on Wandsworth Road. This resulted in the tail rotor, fin and horizontal stabiliser detaching, such that these items remained on the roof of the building. Paint transfer marks from the tail boom were visible on the wall of the building, indicating the track of the main fuselage as it reached the primary ground impact site. The remains of the main fuselage indicated that it had been upright at the time of the ground impact. The fuselage continued to slide approximately 20 m before coming to rest on the road.

Based on initial evidence the helicopter had approximately 500 kg of Jet A1 fuel onboard at the time of the accident. At the point of impact with the ground, disruption of the fuel tanks resulted in the fuel being released, allowing the fuel/air mix to ignite. This caused extensive heat damage to the adjacent buildings and caused vehicles in the immediate vicinity to catch fire, but there was no evidence of significant blast damage. The main wreckage of the fuselage and a car adjacent to it were consumed by sustained fires, the remaining vehicles and buildings were extinguished by London Fire Brigade having suffered limited fire damage.

The main rotor head and gearbox, together with a section of one of the four rotor blades landed in a loading bay of the New Covent Garden Flower Market, to the northwest of the main impact site. Several items which would have been loose in the cockpit were also found in the vicinity of the market and on the roofs of adjoining buildings. Further small items of wreckage, mostly from the damaged rotor blades were found in the area around the base of the crane, the residential building adjacent to the crane and on the exposed bank of the river.

Civil Aviation Publication (CAP) 393, Air Navigation: The Order and the Regulations

Section 2 of the Air Navigation Order (ANO) details the Rules of the Air Regulations. Section 1, *Interpretation* states at paragraph 1 (k) that a Special VFR flight means a flight:

> *'in the course of which the aircraft ...remains clear of cloud and with the surface in sight.'*

Section 3, *Low Flying Rule,* details in Rule 5 the low-flying prohibitions with which aircraft must comply unless exempted by Rule 6. The prohibitions include:

> *'Except with the written permission of the CAA, an aircraft shall not be flown closer than 500 feet to any person, vessel, vehicle or structure';* and:
>
> *'Except with the permission of the CAA, an aircraft flying over a congested area of a city town or settlement shall not fly below a height of 1,000 feet above the highest fixed obstacle within a horizontal radius of 600 meters of the aircraft.'*

Exemptions in Rule 6 states that:

> *'Any aircraft shall be exempt from the 500 feet rule when landing and taking off in accordance with normal aviation practice';* and:
>
> *'Any aircraft shall be exempt from the 1,000 feet rule if it is flying on a special VFR flight.'*

UK Air Information Publication (AIP)

The UK AIP entry for London Heathrow Airport contains in section AD 2.22 rules for non-IFR helicopter flights in the London CTR. It states that:

> *'Non-IFR helicopter flying in the London CTR is normally restricted to flight at or below specified altitudes along defined routes. These routes have been selected to provide maximum safety by avoiding built up areas as much as possible.'*

For flights along the helicopter routes:

> *'Non-IFR flights in the London Control Zone are not to be operated unless helicopters can remain in a flight visibility of at least 1 km. Non-IFR helicopters must remain clear of cloud and in sight of the surface';* and:

> *'Non-IFR helicopters may be required to hold…. except on that portion of [route] H4 that lies between Vauxhall and Westminster Bridge.'*

Multi-engined helicopters are not required to use the helicopter routes.

CAP 493 *Manual of Air Traffic Services (MATS) Part 1*

Chapter 2 of MATS Part 1 considers Flight Rules. Section 8.5 details the responsibilities of a pilot on a Special VFR flight and states:

> *'The pilot of an aircraft on a Special VFR flight is responsible for ensuring that his flight conditions enable him to remain clear of cloud, determine his flight path with reference to the surface and keep clear of obstructions.'*

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Further work

The AAIB will conduct a detailed inspection of recovered wreckage and helicopter maintenance documents, and an analysis of weather conditions. The investigation will also examine the conduct of this flight, regulation of flights over London, planning guidance and regulations relevant to development around aerodromes, and the lighting of obstacles.

AAIB Field Investigation reports

ACCIDENT

Aircraft Type and Registration:	Jetstream 4100, G-MAJJ
No & Type of Engines:	2 Garrett Airesearch TPE331-14GR-807H turboprop engines
Year of Manufacture:	1993 (Serial no: 41024)
Date & Time (UTC):	28 May 2012 at 1456 hrs
Location:	Brussels National Airport, Belgium
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 3 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Rear pressure bulkhead of nose landing gear bay, lower fuselage skin and keel plate aft of nose landing gear bay
Commander's Licence:	Air Transport Pilot's Licence
Commander's Age:	40 years
Commander's Flying Experience:	5,638 hours (of which 1,700 were on type) Last 90 days - 70 hours Last 28 days - 15 hours
Information Source:	AAIB Field Investigation

Synopsis

During pushback, the aircraft came to an abrupt halt and the shear pin on the towbar broke. Subsequently damage to the keel area of the aircraft and to the pressure bulkhead at the rear of the nose landing gear bay was discovered. The aircraft had operated for eight sectors since the pushback.

History of the flights

At approximately 1455 hrs on 28 May 2012 G-MAJJ was pushed back from Stand 209 on Apron 2 South at Brussels National Airport. The pushback proceeded normally until the aircraft came to an abrupt halt and the shear pin on the towbar broke. The captain asked the ground agent to look to see if there were any signs of damage and, when the agent said that he could see none, the captain decided to continue with the flight.

The aircraft flew uneventfully to Southampton Airport and later operated to Aberdeen Airport, its last sector of the day. During the climb out of Southampton Airport, the crew experienced a "low, steady thumping" below the cockpit after the landing gear was raised, which continued until the aircraft climbed through approximately FL70. After landing at Aberdeen Airport, the captain reported to the engineer "a clunking sound from the nosewheel after take off." The engineer

recorded this defect in the aircraft's Technical Log and on investigation found the nosewheel misaligned, which he corrected in accordance with the maintenance manual[1]. A 5-Day Service Check was completed during the evening of 28 May 2012.

On 29 May 2012, G-MAJJ operated five sectors. On the second and third sectors, the crew noticed a "clunk" in the climb between FL50 and FL100 that sounded like "metal stretching" beneath their feet or "crushing a beer can". On the fourth sector of the day, a new crew felt a clunk through their feet as the aircraft climbed between FL50 and FL60 although they did not hear anything. On landing at Aberdeen Airport, the captain carried out a visual inspection to look for obvious signs of damage but saw none. On the return leg to Southampton Airport, the crew heard a clunking sound as the nose landing gear lowered. The captain reported this to Line Maintenance Control (LMC) after landing. No defects were reported in the Technical Log following any of the flights on 29 May 2012.

The aircraft's next flight was from Southampton Airport to Aberdeen Airport on 30 May 2012. At approximately 5,000 feet during the climb, a clunking noise was heard by the crew. As with all the preceding sectors flown since the pushback at Brussels, there were no other indications or handling difficulties and the aircraft continued and landed normally at Aberdeen. After landing it was discovered that the aircraft had suffered damage to its forward keel and to the pressure bulkhead at the rear of the nose landing gear bay.

Footnote

[1] The nosewheels rotate together with the axle and any misalignment of the wheels can cause a strong vibration when the wheels lift off the ground during takeoff.

Information from witnesses

Pilot of the aircraft during the pushback

The captain of the aircraft during the pushback at Brussels reported that he and his co-pilot were running through the after-start checks during the pushback. The pushback was normal until the aircraft came to a halt "almost as if we had pushed back onto chocks." He spoke to the ground agent on the headset and asked him to look for any signs of damage but the ground agent said he could not see any. The pilot decided to continue with the flight because the event did not feel serious at the time. He reported that there were no steering problems during the taxi out to the runway and no other symptoms during the flight to Southampton Airport. He believed that neither he nor his co-pilot had applied the brakes. A video of the event, obtained from a CCTV camera at the airport, showed no evidence of an external cause for the abrupt stop.

The driver of the tug

The driver of the tug was a qualified pushback operator but was working on this type of aircraft for the first time. He did not notice any defects with the towbar while coupling it to the aircraft nose gear. He stated that he kept the aircraft in a substantially straight line, with only minor corrections, while pushing it backwards at slow speed. After about 100 m, he saw the nosewheel of the aircraft lift up and almost immediately drop back downwards with the nose towards the right. The shear pin on the towbar head had broken leaving the towbar head to pivot freely horizontally. The nosewheel was turned completely to one side as were the towbar and the towbar head. There were no obstacles in the path of the aircraft and the driver had no idea why it had come to such an abrupt halt.

The ground agent on the headset

During the pushback, the ground agent was in contact with the pilot through his headset. One engine was started with the aircraft on the stand and the other was started during the pushback. He reported that he was watching the engine start when suddenly the nose of the aircraft moved to his right, the nosewheel turned and the towbar was no longer aligned with the aircraft. The shear pin on the towbar had broken and the towbar head had pivoted.

The ground agent told the pilot what had happened and had a look at the nose gear himself but did not notice any damage. The pilot decided that it would not be necessary to return to stand for further investigation.

Pushback equipment

The pushback tractor was a Schopf Maschinenbau GmbH F100 Tug, which has an empty weight of 14,000 kg. The towbar was of a type approved for this aircraft and was fitted with the appropriate connecting head. The towbar incorporated a shear pin to protect the aircraft from excessive loads. The shear pin is designed to transmit normal loads but will break if a pre-determined load value is exceeded (Figure 1). If the shear pin breaks due to an excessive load in line with the towbar, the load will initially be removed but it will be reapplied as soon as the pivot bolt reaches the end of its slot in the towbar head.

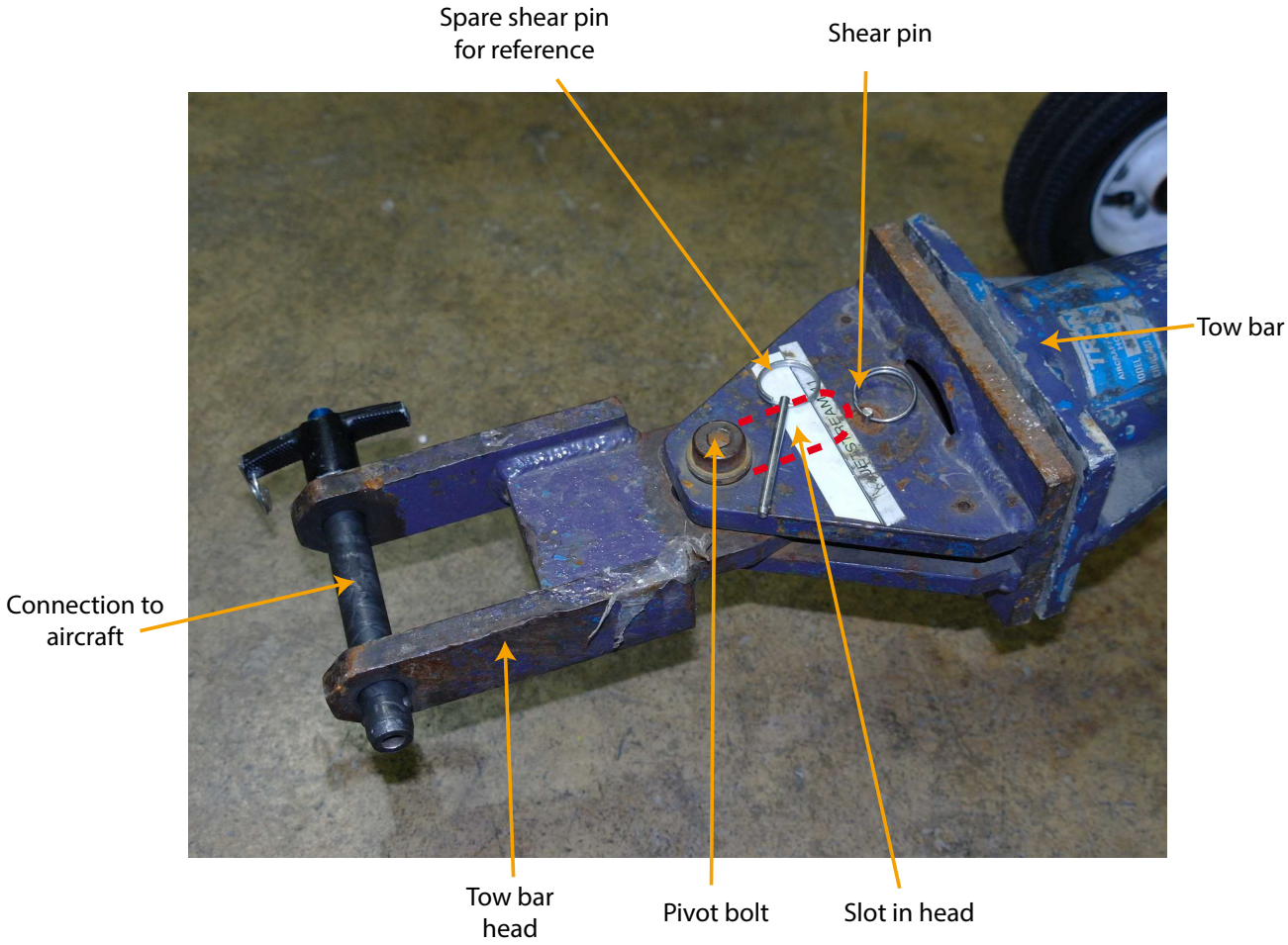

Figure 1

Detail of towbar head, shear pin and head attachment to towbar

The aircraft manufacturer's Aircraft Maintenance Manual (AMM), Towing and Taxiing, 09-10-00 page 209 states: *'The tractor used should weigh between 5000 lb and 10000 lb'* (approximately 2,300 kg and 4,500 kg). The ground handling agent did not have access to the AMM but followed the instructions laid down in the operator's Ground Operations Manual (GOM) and Ground Handling Instructions which, at the time of this event, did not refer to the type of tractor to be used.

Pushback procedures

The operator's GOM contains pushback procedures for ground handlers. It states:

> *'If a shear pin breaks on pushback and the towbar remains attached, the tug should be slowed and stopped, and the flight deck informed.'*

Damage

When the damage was found, the aircraft was removed from service and moved to a hangar for a full inspection and evaluation. The aircraft was jacked and the nose gear and some of the cockpit equipment removed to allow access. The rear pressure bulkhead of the nose gear bay, the lower fuselage skin and keel plate immediately behind the nose gear bay and its supporting frames were found to be damaged (Figure 2).

Inspection schedule

Prior to each flight the commander is responsible for ensuring that a walk-around inspection is carried out, the requirements for which are detailed in the Operations Manual Part B1-BA41-2, 2.3 External Checks. Inspection requirements in the area of the nose gear and front fuselage are to check that the skin and antennas are undamaged.

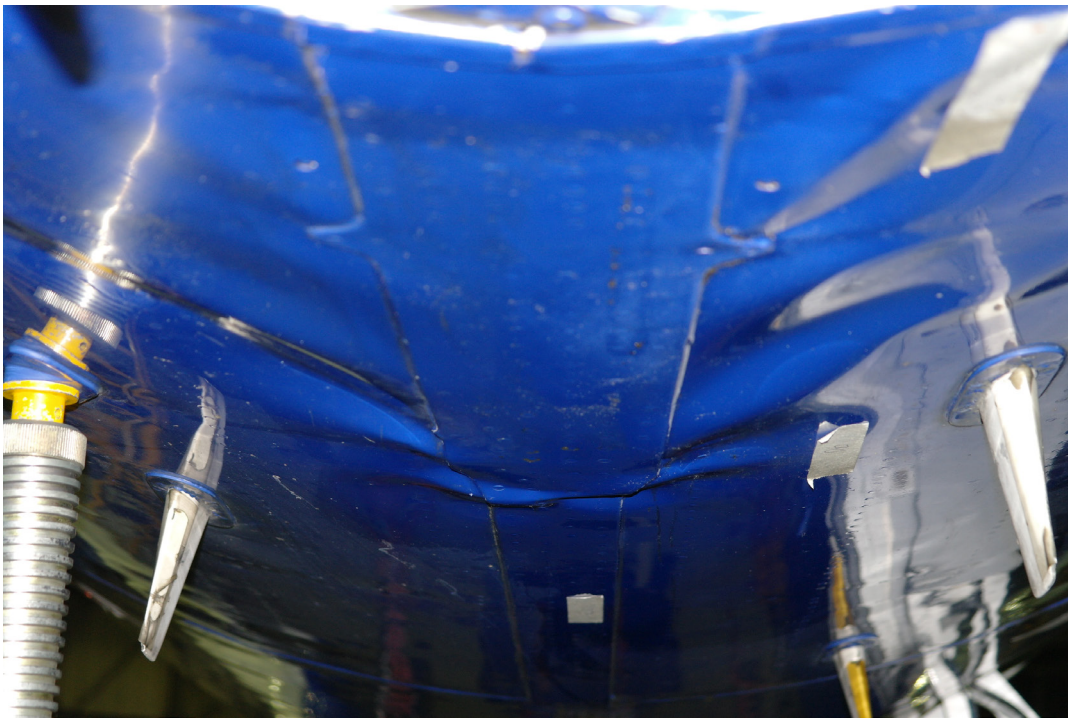

Figure 2

View, looking aft following removal of the nose leg, of damage to lower fuselage skin and keel plate aft of nose gear bay

Every five calendar days a 5-Day Service Check is completed by maintenance engineers in accordance with the aircraft maintenance programme, reference EA-41-01. This check includes a general visual inspection of all external fuselage areas including antennas.

Defect reporting

The operator has procedures contained in the Operations manual that require defects to be entered into the Technical Log.

Flight recorders

The aircraft was equipped with a 30-minute CVR and a Flight Data Recorder (FDR), which contained data from 44 flights. Because the aircraft flew eight sectors after the pushback event before any damage was discovered, the CVR record of the event itself was overwritten. The FDR did not record the position of the brake pedals or hydraulic brake pressure.

All the flights recorded on the FDR were analysed for evidence of the forward fuselage having been damaged during a heavy landing on the nose gear, or as a result of a rapid de-rotation of the nose gear onto the runway during a landing. No such evidence was found. During one landing on the 29 May 2012 at Brussels Airport, the normal acceleration at touchdown was 0.06g above the aircraft manufacturer's hard landing limit of 1.5g. However, the vertical descent rate at touchdown was below the landing gear load limit of 10 ft/sec and the aircraft had not touched down on the nose gear first.

Because the towbar shear pin had broken during pushback at Brussels Airport on the 28 May 2012, the relevant FDR data was analysed. The FDR started to record when the number one engine was started while the aircraft was stationary on the stand. About 40 seconds later, the pushback began (refer to Figure 3 - Point A), followed several seconds later by the number two engine being started. During the initial 43 seconds of the pushback, the aircraft heading remained constant at 334° before turning slightly onto a heading of 330°. Over the following 19 seconds, the aircraft heading remained constant to within 1°, after which the aircraft was turned onto a heading of 338° over a period of 34 seconds (refer to Figure 3 - Point B). Three seconds later, the aircraft came to a stop with its nose briefly pitching up by just less than 2°, but sufficient to cause the weight-on-wheels switch to change state briefly (refer to Figure 3 - Point C). During this short period, aircraft heading changed by 3° to a heading of 335°.

Safety action taken by the operator

Shortly after this incident, the operator issued a Flight Crew Instruction (FCI) to try and reduce the likelihood of a similar event happening again. The FCI stated that crews were not to action the after-start checklist until the pushback was complete and the ground agent was clear of the aircraft. In the event of a shear pin breaking, inadvertent application of the brakes, or an unexplained jolt during the pushback, the FCI instructed crews to return to the stand so that the aircraft can be inspected.

The operator decided that this incident highlighted a need to improve its defect reporting systems. Subsequently a number of initiatives were introduced for pilots, engineers and staff within LMC to ensure that the passage of information improved with regard to technical issues on the aircraft:

An FCI was issued to remind crews of the requirement to record defects in the Technical Log.

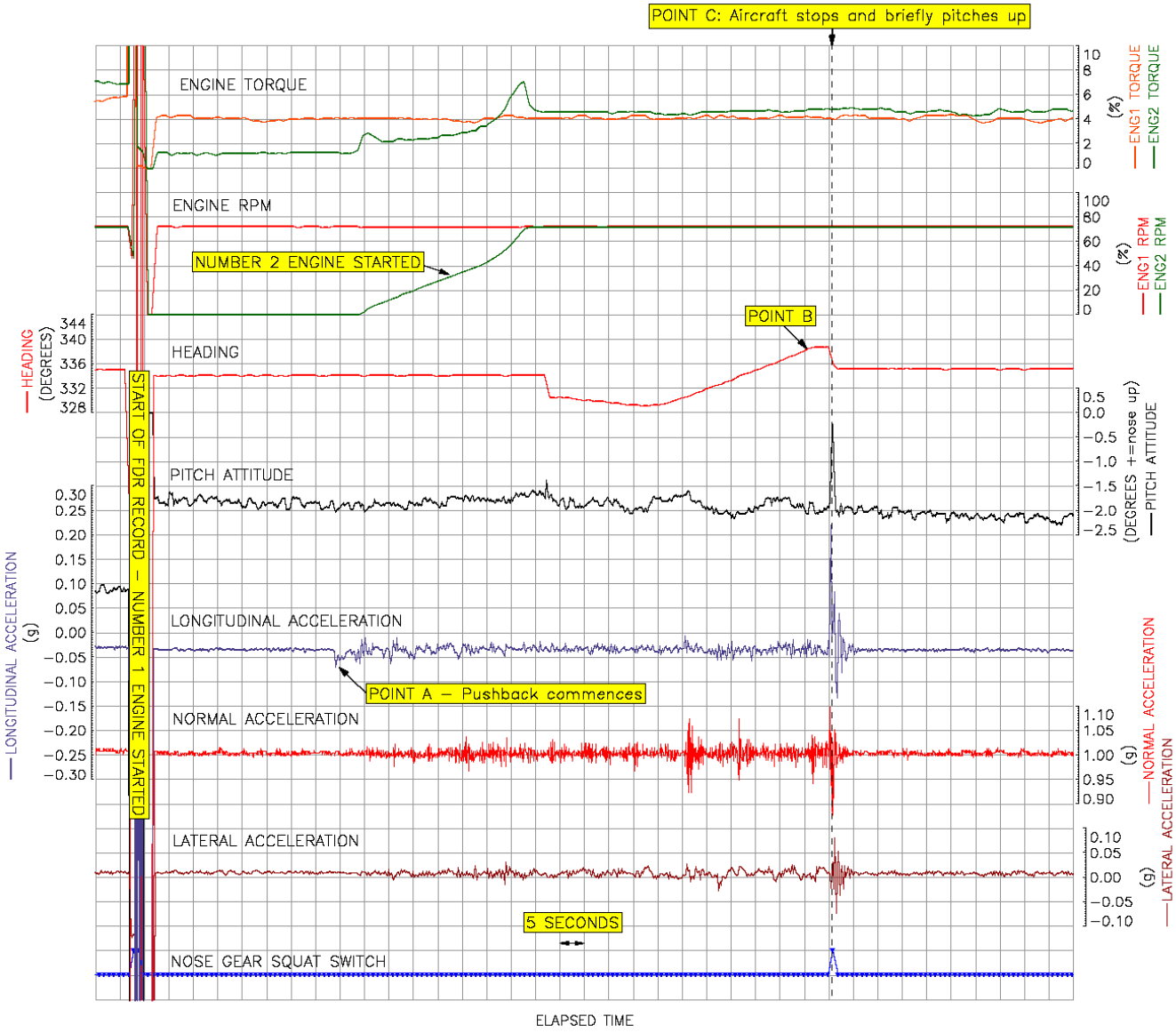

Figure 3

Pushback at Brussels Airport 28 May 2012

The operator discussed this event with its certifying staff during a regular 'tool-box talk' and reminded them of the need to be vigilant during service checks. In addition, the completion and certification of service checks was discussed at a Station Engineers meeting and all the attendees inspected the damaged aircraft. A notice to all certifying staff reminding them of their responsibilities was issued and displayed on notice boards.

The operator initiated a review of the entire Technical Log process but, following the review, decided that no changes were necessary.

A Ground Handling Instruction was issued to all Ground Handling Agents associated with this airline's operation to ensure that suitable towing vehicles are used.

Analysis

It is highly likely that damage occurred during the pushback in Brussels on 28 May 2012. Witness evidence, recorded flight data and a video recording from a camera at the airport showed that the aircraft experienced a significant jolt that caused the towbar shear pin to fail. Further damage may have occurred as a consequence of operation with a weakened structure during subsequent flights.

The tug used for the pushback weighed 14,000 kg, which was much heavier than the 4,500 kg recommended in the AMM, and this would have given it much more momentum than a lighter tug when the towbar pin sheared. Consequently, the tug was capable of applying a large longitudinal force to the aircraft as the pivot bolt reached the end of its slot. The investigation did not determine whether or not the use of a lighter tug would have caused similar damage.

The aircraft was subject to a number of routine inspections by both flight crew and maintenance staff between the pushback incident and the time at which damage was identified. Damage was not discovered during these inspections even though the relevant check lists required the damaged skin area to be inspected. There were a number of factors that made identification more difficult. The damaged area was located at the bottom of the fuselage, which is approximately waist high above the ground. It is not visible from a standing position and to inspect the area effectively a person would have to crouch down and look up. The lower fuselage is painted blue and in poor lighting conditions, such as a floodlit ramp at night (similar to when the service check was completed), identification of damage would be difficult, even when using a torch.

The FCI was issued by the airline to prevent an aircraft being flown following a similar pushback incident. However, the wider issue was that the resulting damage was not identified, and no action was taken, despite symptoms being experienced by a number of crews. The symptoms were entered into the Technical Log after the last flight on 28 May 2012. An engineer identified a fault with the nose landing gear that could give similar symptoms and this was rectified but damage to the pressure bulkhead and forward keel was not identified. Similar symptoms were experienced during four flights on 29 May 12 but no entries were made in the Technical Log. LMC was informed but this did not result in an inspection of the aircraft.

The Technical Log is the formal document relating to the airworthiness of the aircraft and there are procedures for clearing entries or deferring them in accordance with the Minimum Equipment List (MEL). Reporting problems in the Technical Log, perhaps after consultation with an engineer, facilitates good decision-making in relation to faults. Actions are being taken by the airline to improve the Technical Log and its use by pilots, engineers and staff within LMC. This is to ensure that problems identified by crews or line engineers will be reported promptly so that appropriate corrective action can be taken.

ACCIDENT

Aircraft Type and Registration:	De Havilland DH53 Humming Bird, G-EBHX
No & Type of Engines:	1 ABC Scorpion II piston engine
Year of Manufacture:	1923 (Serial no: 98)
Date & Time (UTC):	1 July 2012 at 0842 hrs
Location:	Old Warden Aerodrome, Bedfordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Fatal) Passengers - N/A
Nature of Damage:	Substantial
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	52
Commander's Flying Experience:	14,780 hours (of which 55 minutes were on type) Last 90 days - 151 hours Last 28 days - 56 hours
Information Source:	AAIB Field Investigation

Synopsis

The pilot lost control of the aircraft in gusty wind conditions during a re-familiarisation flight. There was insufficient height in which to recover and the aircraft impacted the ground, causing the pilot to receive fatal injuries.

History of the flight

The pilot planned to conduct a re-familiarisation flight and display practice ahead of an air display scheduled for that afternoon. The aircraft was positioned onto Runway 21 by the operator's ground crew. After signing the authorisation sheet for the flight, the pilot went to the control tower to discuss his requirements with the AFISO. He informed the AFISO that he would operate within gliding range of the aerodrome, initially over the southern end of the field for a few minutes, to re-familiarise himself with the aircraft, before positioning to the north to commence a practice display. The total planned flight time was about 10 minutes.

The pilot then walked towards the aircraft and on the way met the Chief Pilot. The two pilots had a brief discussion on a range of topics, including the current weather conditions. The Chief Pilot had considered that the conditions were unsuitable for some of the flying planned for the day and he had cancelled some aircraft and less experienced pilot combinations. However, he saw no reason to disagree with the accident pilot's own assessment that the weather was acceptable for the planned flight.

The aircraft's start, taxi and takeoff were without incident. The pilot flew to the southern end of the airfield where, at a height of between 600 ft and 800 ft, he performed a series of level turns. The Chief Pilot had watched the aircraft take off and conduct the initial turns; satisfied that all was well, he returned to his other duties. Another DH53-qualified pilot had also watched the takeoff and first minutes of the flight and, seeing nothing amiss, he too continued with other tasks. Several witnesses continued to watch the aircraft which, after a few minutes, flew downwind to the northern end of the airfield before descending to between 150 ft and 200 ft aal as it turned towards the airfield. The aircraft then established approximately along the Runway 21 centreline (Figure 1).

Witnesses commented that the effect of the wind made the aircraft appear unusually fast downwind and that as it turned upwind it appeared, from their perspective, to be almost stationary.

The aircraft continued to fly along the runway to position 'A' (Figure 1) before making a level turn to the left. This turn took the aircraft close to, and downwind of, a copse of tall trees. It is possible that the aircraft completed this turn before commencing a second turn; eyewitnesses were divided as to whether the aircraft had performed one or two turns away from the crowd-line prior to the accident. During the left turn preceding the accident, witnesses saw the left wing drop sharply; the aircraft then recovered to level flight after which the left

Figure 1

Approximate position of the turn away from the crowd-line

wing dropped again, with the aircraft rolling to a steep angle. The nose of the aircraft then dropped and the aircraft entered a very steeply descending left turn. It did not recover and struck the ground, near the intersection of Runway 25 and Runway 30, with a nose-down pitch attitude beyond the vertical. Witnesses estimated the total time from initial wing drop to the aircraft striking the ground as being two to three seconds.

A unit of the AFRS had been watching the practice display and witnessed the accident. They arrived at the aircraft within one minute but the pilot had already been fatally injured.

Pilot information

The pilot had joined the operator as a volunteer pilot in 1997 and had been the Chief Pilot between 2009 and 2010. He was qualified to fly almost all the aircraft in the operator's fleet and for a large number of types, only he and the current Chief Pilot were qualified on them. In addition to flying the operator's fleet he was employed by a major airline as a commander on passenger jets. He had previously been a military test pilot and was a graduate of the Empire Test Pilots' School. He also flew modern single engine piston light aircraft.

Organisational information

The operator was part of a charitable trust, the purpose of which was depicting the history of flight from the early 1900s to the 1950s. Its pilots, including the accident pilot, the majority of the ground staff and those with management positions, were volunteers. The organisation also employed qualified engineers.

The aircraft were of a vintage where available flying hours were severely limited. The operator commented that it operated a number of aircraft (of which the DH53 was one) that do not lend themselves from an organisational or financial perspective to regular use for display purposes, but which do need to be displayed from time to time in fulfilment of its charitable objective of public education. The accident pilot's limited total time on type was therefore not unusual among the operator's pilots. Where aircraft were flown infrequently, the operator's mitigating measures were: restricting flights to the area of the Old Warden circuit; limiting the number of pilots qualified on infrequently flown aircraft; selection of the most widely experienced pilots such as the accident pilot to fly such aircraft; and the undertaking of pre-display currency flights, as was the case on the accident flight.

The operator divided the aircraft into groups of similar vintage, performance and handling characteristics. The DH53 was one of a group of very light aircraft with low power margin and no systems such as brakes or hydraulics. The accident pilot was qualified on all the aircraft within this group and was one of four pilots qualified on the accident aircraft. However, he had not flown the accident aircraft since 2010, when he completed a 10-minute air test. Prior to that, his last flight in the DH53 had been in 2004. On the day of the accident he was intending to conduct a short refresher flight, including a practice display, before flying in the public display in the afternoon.

Meteorological information

The Luton Airport TAF issued at 0500 hrs on the day of the accident gave a forecast wind from 230° at 12 kt, with a 30% probability, between 0900 hrs and 1500 hrs, of wind temporarily from 240° at 17 kt, gusting 27 kt.

The airfield was not, nor was it, required to be equipped with approved and calibrated aviation weather observation equipment. However, the observation equipment that was installed was audited by The Met Office in 2011 and found to be fit for purpose.

Immediately after the accident the AFISO recorded an unofficial local weather observation, noting the wind as being from 240° at 15 kt. Other pilots reported that the wind appeared to be varying in direction by about 30° and included some "hard-edged gusts."

The Met Office provided an aftercast of the weather for the accident area. Wind data came from surrounding airfields and a wind profile at the Cardington meteorological balloon launch site 3.8 nm to the north-west of the accident site. The Met Office summarised:

> *'The weather…was generally fine, with good visibility and cloud bases mainly between 2000-3000FT. The surface wind was in the process of increasing because the temperature to trigger convection had been reached within the previous hour. This meant that there was mixing occurring within the boundary layer, allowing the 2000FT wind to be brought down to the surface as gusts. The wind increase is reflected in the local METARs and in the TAFs for the local airports as well. The 2000FT winds in the area appear to have been around 250 20-25KT and the 1000FT winds around 240 20KT....would suggest the surface wind given in the post crash observation of 240 15KT is likely to be correct, with gusts reaching values of 22-25KT. The winds at around 200FT are likely to have been about 15KT.'*

Aircraft information

The DH53 is an open-cockpit, single-seat light aircraft of wooden construction with a fabric covered wing and empennage. G-EBHX was powered by a single-ignition 34 hp ABC Scorpion II engine driving a two-bladed fixed pitch wooden propeller. A fuel tank mounted in the fuselage between the cockpit and engine firewall provided gravity fuel flow to the engine.

The aircraft was equipped with conventional flight controls operated by a non-adjustable control column and rudder bar, with the rudder and elevator control cables running externally. There were no trimming devices fitted to the control surfaces and the aircraft was not equipped with a radio.

The airspeed indicator fitted to G-EHBX was of similar vintage to the aircraft and had a speed scale ranging from 40 to 160 mph. The scale was compacted at lower speeds, with a 10 mph range represented by a 13° arc, and expanded at the higher speed ranges, where a 10 mph range occupied a 38° arc.

G-EBHX was the only remaining airworthy example of its type, having been rebuilt and re-engined in 1960 and donated to the operator's fleet. Since then the aircraft had accumulated a total flight time of 23 hrs and 55 minutes. Valid records prior to 1960 were not available.

Maintenance history

The aircraft possessed a valid LAA Permit to Fly and had been maintained in accordance with a CAA approved maintenance programme.

The aircraft's engine was not considered by the operator's engineers to be particularly reliable and in the past the aircraft had suffered a number of engine power losses during engine ground runs and also in flight, resulting in significant damage to the aircraft. As a result, the operator's policy was to only operate the aircraft within gliding range of the aerodrome. The engine was last overhauled in 1992. The problems experienced were predominantly associated with

engine ignition and carburetion. The carburetion issues were attributed to possible fuel foaming in the carburettor associated with the high levels of vibration to which the engine was prone, and the engine mount rubbers were replaced in an attempt to address this. The carburettor was also re-worked, re-jetted and the float levels reset.

The magneto was overhauled in 2003 after failing during an engine ground run. Following reinstallation, engine start performance and subsequent ground runs were noticeably improved. G-EBHX did not fly during the period August 2004 to April 2010, but during part of this time the magneto was installed on another aircraft, on which it operated normally. The magneto was refitted to G-EBHX in February 2010 and the subsequent engine ground runs were carried out satisfactorily.

A test flight was carried out in April 2010 for the purposes of revalidating the Permit to Fly and there were no engine-related findings. The aircraft completed a further four flights in 2010 and one flight in 2012, with no engine issues recorded in the aircraft technical log.

The most recent maintenance performed on the aircraft was an annual inspection for the purposes of the LAA permit renewal on 2 April 2012, at 23 hrs 45 mins flight time. An engine ground run was carried out successfully and the magneto contact breakers were checked for cleanliness.

There were no relevant defects in the technical log prior to the accident flight.

Accident site

From examination of the wreckage and ground marks, it was determined that the aircraft had impacted the ground with a pitch attitude that was slightly beyond vertically nose-down and with the wings approximately level; the aircraft's trajectory prior to impact was predominantly vertical, with no appreciable lateral speed.

The engine compartment had separated from the fuselage at impact and the engine was partially buried in the impact crater. Both propeller blades had fractured chordwise close to the hub at impact; a single, shallow horizontal propeller strike on the ground was made by the leading edge of one of the propeller blades.

The cockpit structure was severely disrupted during the impact. The remainder of the aircraft, largely intact, was situated approximately 5 m from the initial impact point.

Detailed wreckage examination

General

Examination of the wreckage revealed that all damage to the airframe and flight controls had resulted from the impact with the ground and there was no evidence to suggest that the aircraft had not been structurally intact prior to the accident.

The engine was stripped and inspected and no evidence was found of pre-impact mechanical failure. The body of the carburettor was significantly damaged in the impact and there was no fuel remaining in the float chamber. The carburettor was dissembled and no anomalies were evident.

Magneto

The magneto was removed for testing. The cover on the contact breaker points had been damaged in the impact, allowing debris to become lodged in and around the breaker points. However, the unit itself was largely undamaged and, after removal of debris, the magneto was placed on a test rig. Excessive sparking was noted at the contact breaker points. Sparking at the breaker points results in a weaker spark being generated at the high tension leads and can result in rough running and reduced engine performance. It was noted that one of the breaker points was platinum and the other tungsten. The tungsten point was observed to have small amounts of oxidation on the surface. Oxidation is a known issue on tungsten contact breakers; it can be common on magnetos which are not used often and can lead to excessive sparking at the contact breakers. Residue on the breaker points from the debris may also have contributed to the sparking. After cleaning the points and retesting the magneto it performed satisfactorily.

The magneto was originally fitted with two platinum breaker points but at some point in the component's history they had been replaced by tungsten points. This was noted during the overhaul in 2003 and one of the tungsten points was replaced with a platinum one in an attempt to reduce excessive sparking at the points. The operator's engineers were aware that tungsten points were susceptible to oxidation and reported that all such breaker points were cleaned at the commencement of the flying season and after long periods of disuse.

Weight and balance

Although a weight and balance schedule was not completed for the accident flight, the April 2010 test flight was conducted by the accident pilot. The weight and CG annotated on the flight test schedule were within limits. As the only variable weight for this aircraft was the pilot weight (the aircraft was always operated with full fuel), it can be assumed that the weight and CG on the accident flight were also within the permissible limits.

Photographic evidence

Photographs taken from or near the crowd-line were provided to the investigation. However, there was a 14-second gap in the provided imagery during which the aircraft departed from controlled flight. Imagery then resumed one second before the aircraft struck the ground and the photographs from this point showed no signs of damage to the aircraft. The externally mounted portions of the rudder and elevator control runs were visible and intact, the pilot's head and hands were clearly visible and he appeared to be conscious. It did not appear that any control inputs were being made.

Pilot's notes for the DH53

In the aircraft were a set of laminated flight reference cards for the DH53 which had been issued by the operator. The operator had also produced a set of pilot's notes for the aircraft.

The pilot had on his person a set of typed notes which included the following points: the need to be prepared for an engine failure at any time; that vibration made the instruments hard to see; and that the pilot should firmly hold the ailerons central as the aircraft had a tendency for *'aileron tramping[1] near the stall giving symptoms of catastrophic wing drop.'*

Footnote

[1] Aileron tramping is movement back and forth of the ailerons (and thus the control column) caused by varying aerodynamic effects at the control surface.

The flight reference cards noted the relevant operating speeds for the aircraft as:

> *'Takeoff: 45 mph*
> *Cruise / Climb / Approach: 55 mph*
> *Stall: 42 mph'*

During the April 2010 flight test the accident pilot's report on stalling noted a wing drop of 10° in calm conditions using a 1 mph/sec deceleration. He also noted: *'Altimeter u/s….altimeter is of small scale type which is of little practical use to the pilot at low levels.'*

Medical and pathological information

The pilot held a current JAA Class 1 medical certificate. A post-mortem, conducted by a specialist aviation pathologist, found no evidence of pre-existing disease. Toxicology did not detect any drugs, drug metabolites or alcohol. The pathologist commented that the pilot had sustained a very severe head injury which would probably have been instantaneously fatal. Although the pilot's cloth flying helmet afforded little protection from impact, due to the specific nature of the head injury it was considered unlikely that a more protective helmet would have altered the outcome of this accident.

Discussion

Engineering aspects

All damage to the airframe and flight controls was consistent with the impact with the ground. There was no evidence to suggest that the aircraft was not structurally intact prior to the accident.

Although low levels of oxidation were observed on the tungsten contact breaker point of the magneto, had this level of oxidation existed prior to the accident flight, engine performance would have been noticeably degraded during the engine start up and ground running. There were no indications that this was the case. Whilst the engine had been somewhat unreliable in the past, its performance was noticeably improved following the rework of the carburettor and magneto. The aircraft flew five times in 2010 and once in 2012 with no reported engine problems, suggesting that the previous engine reliability issues had been resolved.

It was not possible to determine conclusively if the engine was operating normally at the point of impact, but neither was there sufficient evidence to suggest that it was not. The engine note was distinctive and noisy; none of the witnesses reported being aware of a change in engine note during the flight. The shallow propeller strike on the ground is indicative of the fact that the propeller was rotating at the time of impact but no assessment could be made of the engine power being delivered.

Given the low power rating of the engine, the wooden construction of the propeller, the hardness of the ground and the predominantly vertical trajectory of the aircraft at impact, it is uncertain whether the propeller would have made a more substantial propeller strike even if the engine was operating at full power.

Aircraft handling

The weather at the time of the flight was changing from a moderate constant wind to conditions including significant gusts of 22 to 25 kt.

The aircraft's normal operating speed was 55 mph and its stalling speed was 42 mph. Therefore in normal conditions there would have been a 13 mph margin above stalling speed. With a steady wind of 15 kt (17 mph) and gusts of 22 kt (25 mph) to 25 kt (28.7 mph), the

gust would comprise between 62% and 88% of the available speed margin.

The margin of 13 mph occupied a very small portion on the available speed scale on the airspeed indicator, represented by an arc of approximately 15°. With the known vibration of the aircraft the small display range of the airspeed indicator would have made accurate reading of the airspeed difficult. A lack of clear, usable airspeed indications in gusty conditions would have made the aircraft more challenging to operate. The turn at point 'A' took the aircraft downwind of the treeline at a height at which it was possible to encounter turbulent airflow in the strong winds, particularly given the developing gusts.

The aircraft had, by modern standards, low stability and power margins and poor flight instrumentation. The aircraft was known to be prone to aileron tramping close to the stall and the eyewitness accounts describe a departure from controlled flight consistent with a stall followed by a significant wing drop. It seems likely that the loss of control was the result of a combination of the challenging operating/handling characteristics of the DH53, the turbulent effect of the trees and the gusty wind conditions.

Safety actions

The operator conducted a comprehensive internal safety review following the accident. Although many aspects covered did not relate directly to this accident, the operator highlighted actions they intend to consider further or take action on. These included:

- analysing the effect of wind over the trees on the east side of the airfield and whether those trees could be reduced in height;
- provision of on-site AFRS and medical services during all flying activity, not just during displays;
- a review of the safety equipment worn by the organisation's pilots;
- a review of the current provision of meteorological information and consideration of installing a certificated anemometer;
- consideration of the imposition of total wind and gust limits for individual aircraft;
- addition of modern flight instruments, particularly airspeed indicators and slip balls to all aircraft capable of mounting them;
- fitting and use of radios in the operator's aircraft**.**

Conclusion

The aircraft departed from controlled flight for reasons that could not be fully determined. Technical failure of the aircraft and pilot incapacitation were considered, but ruled out as causal factors. Given the prevailing weather conditions and the challenging operating/handling characteristics of the aircraft, it is considered that the most probable cause of the accident was handling related.

AAIB correspondence reports

These are reports on accidents and incidents which were not subject to a Field Investigation.

They are wholly, or largely, based on information provided by the aircraft commander in an Aircraft Accident Report Form (AARF) and in some cases additional information from other sources.

The accuracy of the information provided cannot be assured.

SERIOUS INCIDENT

Aircraft Type and Registration:	Beech C90GTI Kingair, G-MOSJ
No & Type of Engines:	2 Pratt & Whitney Canada PT6A-135 turboprop engines
Year of Manufacture:	2010 (Serial no: LJ-1984)
Date & Time (UTC):	12 December 2012 at 1318 hrs
Location:	Approach to Runway 25, Belfast Aldergrove Airport
Type of Flight:	Private
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:	52 years
Commander's Flying Experience:	3,852 hours (of which 997 were on type) Last 90 days - 130 hours Last 28 days - 29 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and ATC occurrence report

Synopsis

The aircraft inadvertently descended below the ILS glidepath during an approach in fine weather conditions. The crew rectified the situation and continued the approach visually to landing. High crew workload, interaction with automation, distraction and communications issues contributed to the incident.

History of the flight

Aircraft commander's report

The aircraft was being vectored by ATC for an ILS approach to Runway 25 at Belfast Aldergrove Airport. The weather conditions were good and the co-pilot was handling the aircraft. As it neared the localiser centreline from the south at a range of about 10 nm and 4,000 ft altitude, the commander was aware that ATC had not yet issued a clearance for the approach. He alerted the co-pilot to the fact, and reminded him that the aircraft was now above the ideal vertical profile.

ATC warned the crew that the aircraft was flying through the localiser centreline, and issued a descent clearance to 3,000 ft with a left turn to a heading of 210° (localiser QDM was 249°M). The commander asked ATC to confirm that the aircraft was cleared for the ILS approach, which they did.

The co-pilot selected the autopilot altitude target to 3,000 ft and a vertical speed of 2,000 ft/min down. The commander warned him that this would lead to

the flap limit speed being exceeded. ATC then cleared the aircraft to descend to 1,700 ft and further with the ILS glideslope. The commander, whose attention was briefly diverted while he wrote down the instructions, noticed that the aircraft had descended to 1,300 ft (about 1,050 ft above the runway elevation) and was still descending, so he ordered the co-pilot to disengage the autopilot and climb the aircraft immediately to 1,700 ft.

Following an exchange with ATC, the commander, who had maintained visual contact with the runway throughout, received approval to continue the approach to landing.

The commander described a high workload situation for the crew, with the late descent, turns and a frequency change occurring in a short period. It was not clear to the crew exactly how the situation had arisen, but the commander thought that the delay incurred in selecting autopilot functions (rather than flying the aircraft manually) may have been a contributory factor, together with the relative inexperience of the co-pilot and his own distraction at a busy time.

Air Traffic Control report

The Aerodrome Controller observed the aircraft on his monitor to be descending below the ILS glidepath at about 6.5 nm range. He contacted the Approach Controller, as the aircraft had not yet made contact on the Tower frequency, and was told that it had already been transferred. The Aerodrome Controller therefore transmitted to the aircraft and the crew responded. The controller advised the crew that the aircraft was below the glidepath and issued instructions to go around and climb to 3,000 ft. During this period the Approach Funnel Deviation Alert[1] sounded.

The aircraft commander responded with a request to continue the approach visually. At this stage the aircraft, which the controller could see visually, had regained a normal glidepath. As the situation had been resolved, the controller continued to monitor the aircraft and issued an appropriate landing clearance.

Footnote

1 The AFDA system provides the controller with an alerting function if an aircraft on approach deviates from the normal flight path.

INCIDENT

Aircraft Type and Registration:	Boeing 757-28A, G-FCLA
No & Type of Engines:	2 Rolls-Royce RB211-535E4-37 turbofan engines
Year of Manufacture:	1996 (Serial no: 27621)
Date & Time (UTC):	11 October 2012 at 1620 hrs
Location:	Glasgow Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 8 Passengers - 231
Injuries:	Crew - None Passengers - 1 (Minor)
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	57 years
Commander's Flying Experience:	16,000 hours (of which 12,000 were on type) Last 90 days - 227 hours Last 28 days - 88 hours
Information Source:	Aircraft Accident Report Form submitted by the commander and further information from the aircraft operator

Synopsis

Smoke and fumes entered the flight deck and cabin during passenger disembarkation. Both engines were shut down at the time but the Auxiliary Power Unit (APU)[1] was running. The aircraft commander ordered an evacuation of the passengers still on board. This was completed successfully, using a combination of escape slides and the normal disembarkation route. A faulty APU was identified as the source of the smoke and fumes. There was one minor injury.

History of the flight

The aircraft landed at Glasgow after a flight from Dalaman in Turkey. On board were 231 passengers and eight crew members. As the aircraft taxied to Stand 32, the flight crew started the Auxiliary Power Unit (APU), in accordance with normal procedures. It started normally and the aircraft continued to its allocated stand uneventfully. The passenger disembarkation process had begun, and the flight deck crew were occupied with normal post-flight activities, when the commander became aware of a strong smell. It was accompanied by a blue haze emanating from behind the instrument panel and the overhead circuit breaker panel.

Footnote

[1] The APU provides electrical power and air for the air conditioning system once the main engines are shut down.

External power had been connected and, at first, the commander thought the problem may be electrical in nature, although the smell and density of the haze suggested otherwise. There were no fire warnings or other abnormal cockpit indications. The commander opened the flight deck door and discovered that the smoke was not restricted to the flight deck, as he had thought, but that there was thick smoke in the forward passenger cabin, as well. The commander rapidly made his way to Doors 2[2], to contact the cabin crew who were there supervising disembarkation via the airbridge. The smoke was thicker in this area and the commander could see a significant number of passengers, mid-cabin, waiting to disembark; the rear cabin was obscured by the smoke. Passengers in the forward cabin had already disembarked.

The commander ordered that the aircraft be evacuated without delay and returned to the flight deck to shut down the APU and alert the emergency services. The cabin crew began evacuation procedures. The cabin crew at Doors 4 re-armed their doors and deployed both escape slides. Only the right hand slide was deployed at Doors 3 due to obstructions on the other side, and passengers continued to use the airbridge at Doors 2. Doors 1 were not used as the forward cabin was already empty.

The co-pilot left the aircraft via the airbridge and co-ordinated passengers evacuating directly onto the apron via the escape slides. When he was relieved by emergency service crews, he returned to the cabin to assist the evacuation. In the cabin, all the lavatory smoke alarms activated, adding to the noise inside, but the commander was aware of the evacuation instructions being shouted by the cabin crew. He walked back to Doors 3 to inspect the inflated slide there and check that the cabin had been evacuated. The smoke was still thick and acrid but did not seem to be intensifying.

Of the 231 passengers, approximately 60 evacuated via the slides, the rest by the airbridge. There was only one very minor injury. Once all the passengers had evacuated, the cabin crew also left the aircraft. They were followed by the flight deck crew, after a brief exchange with fire crews and engineers.

Engineering actions

The APU was identified as the source of the smoke and fumes in the cabin. Removal of the APU was planned for three days after the incident, following which it was to be returned to the manufacturer for a detailed examination. Meanwhile, it was declared inoperative and the aircraft was cleared for further flight, without its use, in accordance with the terms of the Minimum Equipment List.

Subsequent events

The aircraft departed the following morning for a flight to Tenerife South. On board were 241 passengers and eight crew members. With the APU inoperative, engine starts were carried out using a ground air source and cross-bleed air. No unusual smells were evident during the engine starts or while the aircraft was taxiing. However, the flight crew smelt a strong fuel/oil smell as engine thrust was increased for takeoff. The smell seemed to subside during the climb and both pilots, who were aware of the events the day before, were not unduly concerned.

As the aircraft reached its cruise altitude, both pilots started to feel unwell, with some light headedness and dizziness. They donned their oxygen masks, made a

Footnote

[2] Nomenclature for the doors was based on their relative positions inside the cabin, with Doors 1 being the most forward pair and Doors 4 the most aft pair.

PAN PAN call and initiated a diversion to Manchester. They began to action the Smoke and Fumes checklist from the Quick Reference Handbook but, with no smoke or fumes affecting the cabin (although a lavatory smoke detector did activate later prior to the approach to land) and both pilots feeling better, the checklist was discontinued at the first completion point. The aircraft landed safely at Manchester, after which both pilots were checked at a local hospital and later discharged. The aircraft underwent an engineering check and engine ground runs were carried out. No further faults were found and it was suspected that some residual oil may have remained in the conditioning or equipment cooling systems, after the previous day's incident and associated engineering activity.

ACCIDENT

Aircraft Type and Registration:	Cessna R182 Skylane, G-WIFE
No & Type of Engines:	1 Lycoming O-540-J3C5D piston engine
Year of Manufacture:	1978 (Serial no: R182-00244)
Date & Time (UTC):	18 December 2012 at 1214 hrs
Location:	Dundee Airport
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to propeller and forward lower cowlings, engine shock-loaded
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	56 years
Commander's Flying Experience:	1,430 hours (of which 21 were on type) Last 90 days - 50 hours Last 28 days - 20 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot rejoined the visual circuit at Dundee after an engineering test flight intended to check fuel mixture and rpm settings. The weather was fine, with a surface wind from 260° at 10 kt; Runway 27 was in use.

The pilot reported that he selected the landing gear down and saw the main gear lower as normal. However, he did not see a green 'gear down' indicator light until he cupped his hand around the indicator, after which he did see the light. Just before touchdown, he heard the 'landing gear unsafe' warning horn, but ignored it, assuming it to be the stall warning horn. The aircraft continued to pitch nose-down after landing and the propeller struck the ground. It slid to a stop on the hard surface runway without the need to apply wheel brakes.

Photographs taken at the scene showed the nose landing gear to be still retracted with the gear doors closed. A reason for the nose landing gear failing to lower had not been established at the time of this report.

ACCIDENT

Aircraft Type and Registration:	Diamond DA 42 NG Twin Star, G-SELC
No & Type of Engines:	2 Austro E4-B piston engines
Year of Manufacture:	2005 (Serial no: 42.032)
Date & Time (UTC):	28 September 2012 at 1315 hrs
Location:	Runway 22L, Stapleford Aerodrome, Essex
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to propellers and nose cone
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	52 years
Commander's Flying Experience:	2,299 hours (of which 870 were on type) Last 90 days - 37 hours Last 28 days - 15 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and additional information provided by the maintenance organisation

Synopsis

The aircraft was landing after a number of practice touch-and-go exercises. Shortly after the nosewheel was lowered onto the runway, the nose landing gear collapsed. Investigation by the maintenance organisation after the event could find no fault with the retraction/extension or gear warning systems.

History of the flight

The aircraft was engaged on an Instrument Rating training flight, which included general handling and circuit practice. A student occupied the left front seat, the instructor the front right seat and a further student sat in the rear as an observer. After three acceptable touch-and-go exercises on Runway 22L, the decision was made to land. The pre-landing checks were completed, with both the instructor and student checking that three green lights were illuminated, indicating that all the landing gears were down and locked.

The green lights were checked again as landing flap was lowered on final approach and touchdown occurred on the mainwheels just before the runway identification markings. The control column was held back before lowering the nosewheel onto the runway. All appeared normal until about three seconds later when the nose landing gear collapsed, causing the propellers to contact the runway. The aircraft came to a halt in a straight line close to the runway centreline. After informing

the control tower, all systems were shut down and the three occupants vacated the aircraft normally. Given the fact that everything had appeared normal and all three green lights had illuminated and were checked twice, the instructor was at a loss to explain the reason for the nosewheel collapse.

Additional information

The DA42 Twin Star has a tricycle landing gear configuration which is fully retractable. The nose gear retracts forwards and the main gears retract inwards. The gear is operated by hydraulic actuators powered by an electro-hydraulic pump. A manual 'free-fall' emergency system is provided for lowering the gear if the normal system has failed. In addition to the normal 'three greens' indication lights, there is a red GEAR UNSAFE indication whenever the gear is selected down and one or more of the legs is not locked down. A warning horn sounds in the cockpit if any gear is not locked down and either landing flap is selected, or the engines are at very low power.

Staff from the maintenance organisation attended to recover the aircraft. Several people pulled down on the rear fuselage to raise the nose off the ground. It was found that the nose gear leg then dropped down freely and went into lock. The aircraft was towed back to the hangar normally and placed on jacks. Approximately thirty retraction/extension cycles were performed with no malfunctions of the system or the associated warning. Maintenance company staff were of the opinion that, had there been pressure in the DOWN hydraulic line to the nose gear and if landing loads were being reacted by the retraction/extension system instead of the downlock mechanism, there would have been damage to the mechanism. However, no such damage was found.

ACCIDENT

Aircraft Type and Registration:	Jodel D150 Mascaret, G-BHEG
No & Type of Engines:	1 Continental Motors Corp O-200-A piston engine
Year of Manufacture:	1964 (Serial no: 46)
Date & Time (UTC):	27 October 2012 at 1323 hrs
Location:	Dunkeswell Airfield, Devon
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to left wing spar, undercarriage, fuel tank and propeller
Commander's Licence:	Private Pilot's Licence
Commander's Age:	56 years
Commander's Flying Experience:	721 hours (of which 470 were on type) Last 90 days - 7 hours Last 28 days - 0 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further discussions with the Light Aircraft Association and the pilot

Synopsis

Whilst climbing out after takeoff, the pilot heard a thud and saw that the landing light cover on the left wing leading edge had failed. He experienced severe control difficulties and an attempted forced landing back at the airfield resulted in the left wing striking the ground, slewing the aircraft to a halt on the grass. The landing light cover had been made using an inappropriate method.

History of the flight

The aircraft had taken off from Runway 35R at Dunkeswell when, at a height of approximately 400 ft, the pilot heard a thud. From the corner of his eye he saw that the landing light cover on the left wing leading edge had split along the centreline of the leading edge with the upper half deflected upwards and the lower half downwards. This had the effect of funnelling the airflow into the wing structure and, because there was a gap underneath the front spar which allowed air into the rest of the structure, he could see the fabric covering bulging under the pressure.

The pilot levelled out, intending to do a right hand circuit to land but found that, despite full control deflection, he was unable to prevent the aircraft from yawing and rolling to the left. With the attitude approaching 90º

of bank and the height decreasing, he throttled back and the controls started to respond, although somewhat sluggishly. After getting the wings nearly level, he levelled out at about 50 ft but still felt that he had almost no directional control and that attempts to apply power in anything other than short bursts made the aircraft very unstable. The pilot radioed a MAYDAY call and found that, fortuitously, the aircraft was heading back in the direction of Dunkeswell. He felt that he might be able to reach Runway 17, albeit downwind but, as he lowered the nose, and despite full opposite control application, the aircraft started to turn left towards some taxiing aircraft on Runway 23/05. He pulled the nose up to clear the aircraft on the ground and then lowered it again to regain airspeed. This had the effect of yawing the aircraft to the left again and the left wing struck the ground, slewing the aircraft around to a halt on the grass runway at the end of Runway 17. The pilot estimates that the entire incident had lasted about four minutes or less.

Upon examination, it was found that the landing light cover had been made of polycarbonate material bent around the leading edge profile. This induced residual stresses in the material and probably led to cracking and failure; when this occurred, the material reverted to its natural, flat shape. The correct component uses perspex moulded to the shape of the leading edge. The Light Aircraft Association (LAA) has published an article about this accident in the January 2013 edition of their magazine *Light Aviation* in which the pitfalls of making the cover using an incorrect method are highlighted as well as considerable discussion about the possible effects on controllability should such a failure occur. An informal query to the French accident investigation authority, the BEA, suggested that they were not aware of any accidents caused by such a failure.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28RT-201T Turbo Cherokee Arrow IV, G-BNTC
No & Type of Engines:	1 Continental Motors Corp TSIO-360-FB piston engine
Year of Manufacture:	1981 (Serial no: 28R-8131081)
Date & Time (UTC):	3 November 2012 at 1445 hrs
Location:	Near Sherburn Airfield, Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Aircraft damaged beyond economic repair
Commander's Licence:	Private Pilot's Licence
Commander's Age:	36 years
Commander's Flying Experience:	129 hours (of which 7 were on type) Last 90 days - 23 hours Last 28 days - 8 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot was on a flight from Cranfield Airport to Sherburn Airfield. Approaching Sherburn, he descended from 4,500 ft to 2,500 ft and selected landing gear down; he observed a red 'gear unsafe' indication but did not mention in his statement if there were any green 'down and locked' indications. He reselected the gear but to no avail, but then he became aware of smoke emanating from under the seats. He wanted to reduce engine power but "in panic" pulled the propeller rpm lever instead. This action meant that the engine rpm would not exceed 2,000 even with full power and because of this he decided to conduct a forced landing in a field near his destination. During the landing the aircraft was severely damaged but the pilot and his passenger were uninjured.

It is possible that the smoke the pilot saw had come from the electro-hydraulic landing gear motor, but this has not been confirmed. During the event he made no attempt to use the emergency extension facility which would have released hydraulic pressure in the system and allowed the gear to lock down under gravity.

ACCIDENT

Aircraft Type and Registration:	Skyranger Swift, G-CEUJ
No & Type of Engines:	1 Rotax 912 ULS piston engine
Year of Manufacture:	2007 (Serial no: BMAA/HB/548)
Date & Time (UTC):	14 November 2012 at 1530 hrs
Location:	Sackville Farm Airfield, Bedfordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - 1 (Minor)
Nature of Damage:	Damage to engine mounts and firewall, propeller and spinner, nose landing gear
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	71 years
Commander's Flying Experience:	235 hours (of which 141 were on type) Last 90 days - 7 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft's engine began running abnormally soon after takeoff, so the pilot carried out an immediate return and landing. The landing was fast and heavy, and the aircraft bounced and pitched fore and aft before the nosewheel dug in to soft ground, causing the aircraft to flip over. One of the two occupants suffered minor injuries.

History of the flight

The aircraft was being flown for the first time after replacement of rubber fuel hoses and fuel filters. The engine was ground run before the flight, with fuel pressure and flow appearing normal.

Early that morning the visibility at Sackville Farm was 4,000 m, in mist, although this was forecast to improve during the day. The temperature and dew point were 12° and 9°C respectively and the surface wind was from the south-east at 5 kt. The grass runway was 800 m long and orientated 13/31. Full power was achieved during the takeoff and initial climb but, at about 500 ft, the engine produced what the pilot described as a "surge" in power. The pilot stopped the climb and positioned the aircraft for an immediate return to the airfield. The engine surged again as the aircraft was lined up on final approach to Runway 13 for a precautionary forced landing.

The aircraft arrived at the runway with half flap selected and excess airspeed. Just before touchdown, the pilot switched off the magneto switches in order to avoid complications should there be a further surge in power. The aircraft touched down heavily on the initial part of the runway, which sloped downwards. It bounced a few times before the nosewheel dug in to the grass surface, causing the aircraft to come to a sudden stop and flip forward onto its back. The pilot's passenger suffered minor injuries, but both occupants were able to vacate the inverted aircraft via the side doors.

The pilot reported that ground witness marks indicated the aircraft had been pitching fore and aft during the landing run, and had possibly been travelling on its nosewheel alone at some point. Its motions were probably exaggerated by the undulating surface and pilot-induced oscillations. The nosewheel had dug into soft ground and the nose leg had suffered an overload failure. At the time of reporting, the reason for the abnormal engine running had not been established, although the pilot thought carburettor icing was unlikely given that the aircraft was equipped with a water jacket carburettor heating system.

ACCIDENT

Aircraft Type and Registration:	Vans RV-6, G-RVCL
No & Type of Engines:	1 Lycoming O-360-A3A piston engine
Year of Manufacture:	2007 (Serial no: PFA 181A-13439)
Date & Time (UTC):	19 October 2012 at 0900 hrs
Location:	Private airstrip near Kidlington, Oxfordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to propeller and engine mount, engine shock-loaded
Commander's Licence:	Private Pilot's Licence
Commander's Age:	42 years
Commander's Flying Experience:	650 hours (of which 150 were on type) Last 90 days - 20 hours Last 28 days - 10 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft was landing on a grass airstrip, 400 m long orientated 12/30. The surface wind was calm. The pilot reported that the aircraft landed in the north-westerly direction, but landed further along the strip than was intended and a little fast. The grass was damp and the pilot was unable to stop the aircraft before the end of the strip. It overran into a ploughed field and tipped forward onto its nose before settling back into an upright attitude. The pilot, who was uninjured, secured the aircraft and vacated it. She attributed the accident to a lack of experience.

ACCIDENT

Aircraft Type and Registration:	Aeroprakt A22-L Foxbat, G-CEOP
No & Type of Engines:	1 Rotax 912 ULS piston engine
Year of Manufacture:	2007 (Serial no: PFA 317A-14671)
Date & Time (UTC):	11 January 2013 at 1155 hrs
Location:	5 nm west of Lanark, South Lanarkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to landing gear and propeller
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	58 years
Commander's Flying Experience:	125 hours (of which 100 were on type) Last 90 days - 13 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft took off for a local flight from a private airstrip which was orientated 06/24. The weather was fair, with a surface wind from 220° at 8 kt and good visibility. On returning to the airstrip, the pilot flew an approach in a south-westerly direction but experienced sink on short finals. He applied full power, but was unable to prevent the aircraft striking the ground about 20 m short of the airstrip, damaging the landing gear and causing the propeller to strike the ground. The pilot, who was uninjured, secured the aircraft and vacated through the left-hand door. He considered that the aircraft had been affected by turbulence caused by the presence of trees to the south of the airstrip.

ACCIDENT

Aircraft Type and Registration:	Jabiru UL-430, G-BYIM
No & Type of Engines:	1 Jabiru 2200A piston engine
Year of Manufacture:	1999 (Serial no: PFA 274A-13397)
Date & Time (UTC):	12 August 2012 at 1915 hrs
Location:	Ince Airfield, Liverpool
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Collapsed main undercarriage[1] and nose leg, damaged propeller and right wing
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	49 years
Commander's Flying Experience:	377 hours (of which 300 were on type) Last 90 days - 26 hours Last 28 days - 8 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and AAIB enquiries

Synopsis

The right undercarriage collapsed shortly after the aircraft landed as a result of a nut having pulled off the forward outboard attachment bolt. The nut, which had also bottomed out on the bolt thread, was manufactured from a softer steel alloy than the bolt.

History of the flight

The pilot reported that following an uneventful flight of 20 minutes, he made a normal approach and landing on Runway 29 at Ince Airfield. However, approximately 10 to 20 m after touching down, the right main undercarriage, followed by the nose leg, collapsed and the right wingtip and propeller blade struck the ground. At the time of the accident the wind was calm and the grass runway was described as being slightly soft.

Aircraft description

The Jabiru UL-430 is a high-wing two-seat microlight aircraft equipped with a tricycle undercarriage. The nose undercarriage leg is mounted onto a fibreglass structure,

Footnote

[1] The normal nomenclature used by the AAIB is 'landing gear', however in this report the term 'undercarriage' has been used to reflect the nomenclature used by the aircraft manufacturer.

which is bolted to the engine bulkhead. The main undercarriage consists of separate left and right cantilever spring legs, each of which is secured by one inboard and two outboard 5/16" (AN5) attachment bolts (Figure 1).

G-BYIM was equipped with wheel spats and had the large wheel configuration that weighed approximately 15 kg more than the standard wheel configuration. The aircraft was last weighed on 28 July 2010 when the empty weight was calculated to be 545.8 lb (248 kg). The aircraft was re-sprayed, without first removing the old paint coating, on 16 October 2010 and the last inspection for the Permit to Fly renewal was carried out on 12 November 2011.

The maximum permitted empty weight of the Jabiru UL-430 is 248 kg and the maximum takeoff weight is 430 kg.

Inspection of aircraft

The right cantilever spring leg collapsed as a result of the nut having come off the forward outboard attachment bolt. The rear attachment bolt, which had bent during the accident sequence, was still intact with its nut in place. The inside of the attachment clamp was highly polished, which the UK Jabiru agent advised was unusual. The six undercarriage attachment bolts were all 5/16" bolts.

While the attachment bolts that secure the nose leg mounting structure to the engine bulkhead were still in place, all the bolts had pulled out of the fibreglass mounting resulting in the nose leg detaching from the aircraft.

Following the accident, the aircraft was weighed by the UK Jabiru agent and the empty weight, with no fuel

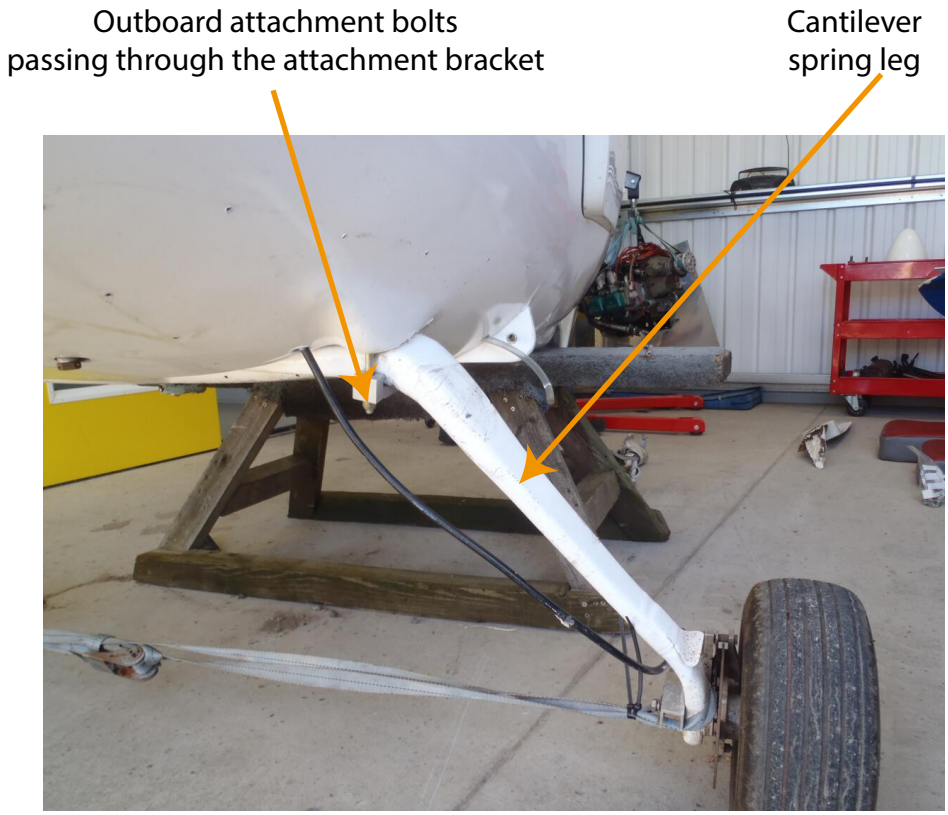

Figure 1

Undercarriage attachment

and no non-essential items on board, was found to be 276.5 kg. The non-essential items weighed 8 kg.

Detailed examination of failed bolt

Examination of the forward outboard attachment bolt was carried out using a high magnification optical device and a Scanning Electron Microscope. The composition of the bolt and nut were inferred from Energy Dispersive X-ray (EDX) analysis.

The thread on the bolt, which remained intact, contained remnants of the thread from the nut that had been pulled off the bolt. The damage to the thread from the nut was such that it was not possible to establish if the thread had failed as a result of fatigue or overload. The position of the debris on the thread of the bolt, and damage to the cadmium coating on the thread run-out, indicated that the nut may have bottomed out on the bottom of the bolt thread (Figure 2). Damage to the cadmium coating on the taper at the end of the shank also indicated that there was some contact in this area.

The EDX analysis of the surfaces showed that the bolt had been manufactured from a low alloy steel and was cadmium coated. The nut was found to have been manufactured from a softer steel than that of the bolt. Traces of a polymeric material found in the thread suggest that the nut had a polymeric insert such as nylon.

Undercarriage attachment bolts

In 2003 the Popular Flying Association (PFA) identified a concern that the rear outboard undercarriage attachment bolt might not be sufficiently strong and that the bolts needed to be regularly re-tightened. Consequently, the

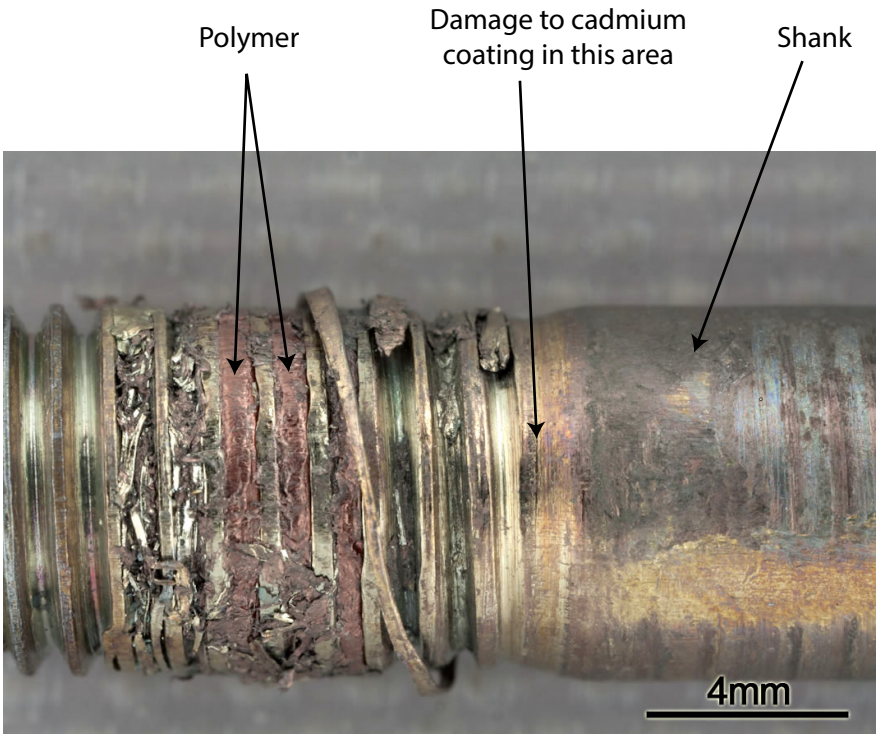

Figure 2

Thread on forward outboard attachment bolt

PFA introduced an optional modification (Mod 10818) to replace the outboard rear 5/16″ (AN5) attachment bolt with 3/8″ (AN6) bolt and advised their members on the need to check regularly the torque of these bolts. This advice is contained in the LAA Type Acceptance Data Sheet (TADS 274A) for the Jabiru UL-430.

The aircraft manufacturer also introduced two non-mandatory Service Bulletins (SB) relating to the attachment bolts:

Service Bulletin JSB 008-1 was issued on the 31 March 2005 as a result of the failure of the undercarriage attachment bolts on the heavier Jabiru J400 aircraft. The manufacturer recommended that the 5/16″ attachment bolts should be replaced with 3/8″ bolts on the J400 family of aircraft. To ensure commonality of parts, the large bolts were also permitted to be used on other Jabiru aircraft.

Service Bulletin JSB 025-2 was issued on the 7 May 2009 and recommended a 500-hour life on the undercarriage attachment bolts fitted to all models of the Jabiru aircraft.

The LAA provided information on a number of known issues with the Jabiru undercarriage attachment and advice on how to address these issues in TADS 274A. The TADS states that '*bolts of doubtful quality'* have been found fitted on a Jabiru involved in an accident. It also recommended that owing to variations in the thickness of glass-fibre in the fuselage, the length of the shank on the undercarriage attachment bolts should be checked on assembly to ensure that the nuts do not bottom out at the end of the thread.

Main undercarriage maintenance

A worksheet that was completed during the Permit renewal inspection carried out in August 2010 had an entry '*U/Carriage to fuselage loose'* which was cleared by the entry '*Washers fitted + nuts tightened*'. The LAA inspector, who carried out the inspection, advised that it was the left undercarriage attachment that was loose.

The same inspector carried out a Permit renewal inspection in November 2011 and informed the AAIB that he checked to see if the undercarriage was loose by lifting each wing upwards, in turn, and checking for movement between the cantilever spring leg and the fuselage. He detected no movement in either spring leg.

There was no record in the aircraft log book[2], provided to the AAIB, of the torque on the undercarriage attachment bolts having been checked or any reference to Service Bulletins JSB 008-1 and JSB 025-2 having been embodied. The owner informed the AAIB that he was unaware of these Service Bulletins and had not seen the TADS for his aircraft.

Safety action

After reviewing the findings of this investigation, and the relevant Jabiru Service Bulletins, the LAA have taken action to:

- Introduce a mandatory life of 500 hours for the undercarriage attachment bolts fitted to all models of Jabiru aircraft.
- Ensure that any 5/16" (AN5) bolts still fitted to the undercarriage on Jabiru aircraft are replaced with 3/8" (AN6) bolts.

Footnote

[2] The AAIB was provided with the second aircraft log book that contained entries from April 2007 and 399 flying hours.

- Remind owners and inspectors of the need to check regularly the torque of the undercarriage attachment bolts.

- Remind owners and inspectors of the need to reweigh aircraft after they have been painted.

AAIB comment

The investigation determined that the right main undercarriage collapsed as a result of the nut having been pulled off the forward outboard attachment bolt. It was not possible to establish the mode of failure of the thread on the nut, although it was made of a softer steel than that of the bolt.

Previous experience indicates that the loading on the rear outer attachment bolt is greater than the load on the forward bolt and, therefore, in a heavy or over-weight landing the rear attachment bolt would be expected to fail first. In this accident the rear bolt remained intact so the landing force, and weight of the aircraft, were probably not the primary cause of the failure.

The polished surface on the attachment bracket indicated that there had been some relative movement between the spring leg and the bracket. This could be a result of the nut on the attachment bolt becoming loose, or as a consequence of the nut bottoming out such that the clamping force between the spring leg and bracket was insufficient. All of these issues had previously been identified by the LAA who had brought it to the attention of their inspectors and members through the Jabiru UL-430 TADS.

The owner was surprised by the increase in the weight of his aircraft following the re-spray and did not realise that it exceeded the maximum empty weight limit. He also stated that he was unaware of the need to re-weigh his aircraft after it had been painted. Moreover, the inspector who undertook the subsequent Permit renewal inspection stated that he did not realise that the aircraft had been painted since the last time it had been weighed. While the pilot may have operated the aircraft within its maximum takeoff weight, there is a risk in painting control surfaces without first removing the old paint, that the change in weight and balance could increase the risk of control flutter and structural failure.

The LAA had previously taken appropriate action to advise their members and inspectors on a number of issues that might affect the integrity of the undercarriage attachment bolts fitted on Jabiru aircraft. The safety action that the LAA initiated as a result of this accident will reinforce this message and the mandatory use of AN6 bolts should help to reduce the number of failures of the undercarriage in the future. The LAA is also reviewing the circumstances surrounding the painting, weighing and Permit renewal of G-BYIM and will use their findings to inform their members on the necessity to weigh aircraft after they have been painted and the correct procedures to follow.

Miscellaneous

This section contains Addenda, Corrections and a list of the ten most recent Aircraft Accident ('Formal') Reports published by the AAIB.

The complete reports can be downloaded from the AAIB website (www.aaib.gov.uk).

BULLETIN ADDENDUM

Aircraft Type and Registration:	Rotorsport UK Calidus, G-ETOJ
Date & Time (UTC):	29 September 2012 at 1618 hrs
Location:	Shoreham Airport, West Sussex
Information Source:	Aircraft Accident Report Form submitted by the pilot

AAIB Bulletin No 1/2013, page 73 refers

Following the publication of the report into the accident to G-ETOJ in Issue 1/2013 of the AAIB Bulletin, the pilot has asked that it include mention of a possible factor which he feels may have contributed to the apparent over-rotation of the gyrocopter on takeoff. He stated that he was aware of a number of anecdotal reports where inadvertent operation of the electro-pneumatic trim system in a fully nose-up direction during the ground roll had been encountered.

G-ETOJ had a two-axis trim system, powered by an electrical pneumatic motor which builds up pressure in pitch and roll cylinders attached to the flying controls. The system is signalled by buttons on the top of the control column (stick), four for trim and one for pre-rotator engagement. Other models used a 'coolie hat' arrangement for trim. In the Calidus, when trimmed fully nose-down, the pitch cylinder is unpressurised but when nose-up trim is required, the pilot presses the aft button of the four, opening a valve and operating the electric motor. When sufficient pneumatic pressure has built up in the nose-up sense, the pilot releases the button, closing the valve and trapping the pressure. This pressure, which is displayed on a gauge mounted on the instrument panel, is therefore an indication of the amount of nose-up trim applied. Pressing the forward nose-down button progressively releases the air in the cylinder.

The pilot of G-ETOJ stated that he had heard reports of one or more instances where, when applying fully aft stick at commencement of the takeoff roll, the nose-up trim button was accidentally pressed. This was reportedly more likely when the pilot was of larger build and could occur if the stick top made contact with the seat harness buckle. The AAIB consulted a recognised authority on gyroplane flying who had experience of the Calidus fitted with this type of stick top and he confirmed that inadvertent trim application had occurred to him on about six occasions, although apparently without incident.

It should be noted that the trim does not apply extra pitch authority when the stick is already fully back. It could, however, be construed as a restriction when checking forward as required when the nosewheel lifts off, which the pilot did not report. However, the agent has agreed to incorporate a caution in the next edition of the Pilot's Operating Handbook for the Calidus.

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

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

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

Published November 2010.

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

Published December 2010.

1/2011 Eurocopter EC225 LP Super Puma, G-REDU near the Eastern Trough Area Project Central Production Facility Platform in the North Sea on 18 February 2009.

Published September 2011.

2/2011 Aerospatiale (Eurocopter) AS332 L2 Super Puma, G-REDL 11 nm NE of Peterhead, Scotland on 1 April 2009.

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