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INITIAL REPORT

ACCIDENT

Aircraft Type and Registration:	Eurocopter AS332L2 Super Puma, G-REDL
No & Type of Engines:	2 Turbomeca Makila 1A2 turboshaft engines
Year of Manufacture:	2004
Date & Time (UTC):	1 April 2009 at 1255 hrs
Location:	Approximately 11 miles north-east of Peterhead, Scotland
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 2 Passengers - 14
Injuries:	Crew - 2 (Fatal) Passengers - 14 (Fatal)
Nature of Damage:	Helicopter destroyed
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	31 years
Commander's Flying Experience:	2,575 hours (of which 1,870 were on type) Last 90 days - 96 hours Last 28 days - 37 hours
Information Source:	AAIB Field Investigation

The helicopter was operating a return scheduled passenger flight from Aberdeen to the Miller Oil Platform, situated in the North Sea approximately 145 nm north-east of Aberdeen. When it arrived from its previous flight to the Bruce Platform, approximately 190 nm north-east of Aberdeen, a 'rotors running' crew change was carried out. The helicopter was serviceable except for a deferred defect affecting a part of its ice detection system. The daily in-flight checks had already been completed satisfactorily by the off-going crew. The helicopter was refuelled, the passengers boarded, and it lifted off at 1040 hrs. The helicopter landed on the Miller platform, after an uneventful flight, at 1149 hrs, where it was refuelled again with the rotors-running. Fourteen passengers boarded the helicopter for the return flight to Aberdeen when the refuelling was complete. The weather conditions were benign with light south to south-easterly winds, good visibility with generally clear skies but with occasional broken cloud at 5,000 to 6,000 ft. Flying conditions were reported as smooth and the sea was calm.

The helicopter lifted from the Miller Platform at 1203 hrs and climbed to 2,000 ft, tracking inbound towards Aberdeen. Recorded information on the combined Cockpit Voice and Flight Data Recorder (CVFDR) shows that the crew were engaged in routine cockpit activities and there were no operational abnormalities. At 1254 hrs

the co-pilot made a routine call on the company operating frequency stating that the helicopter was serviceable and the ETA was 1314 hrs. Twelve seconds later one of the pilots made a brief MAYDAY call on the ATC frequency. This was followed by a similar call, that included some position information, from the other pilot. The radar controller at Aberdeen acknowledged the MAYDAY call and tried unsuccessfully to contact the crew of G-REDL. He then asked the crew of another helicopter, outbound on a similar routing, to examine the sea in the area of the last radar position.

Recorded radar information showed the aircraft flying inbound towards Aberdeen at 2,000 ft, climbing momentarily to 2,200 ft and then turning right and descending rapidly. Surface visibility was good and an eye witness, working on a supply vessel approximately 2 nm from the accident site, heard the helicopter and saw it descend rapidly before it hit the surface of the sea. Immediately after impact he saw the four main rotor blades, still connected at their hub, strike the water. Around this time, he also heard two bangs close together. He immediately raised the alarm and the ship turned towards the accident site, which by now was marked by a rising column of grey then black smoke. The ship launched a fast rescue boat whilst making way towards the scene. The crew of the fast rescue boat and the helicopter arrived promptly on the scene to discover an area of disturbed water, roughly 150 m in diameter containing debris from the helicopter. Other search and rescue vessels, aircraft and helicopters arrived on scene within 40 minutes. All persons on board were fatally injured.

The Air Accidents Investigation Branch (AAIB) was notified of the accident within minutes and a team of inspectors, including engineers, pilots and flight recorder specialists deployed to Aberdeen that evening. In accordance with established International arrangements the Bureau d'Enquetes et d'Analyses Pour la Securitie de l'Aviation Civile (BEA), representing the State of Manufacture of the helicopter, and The European Aviation Safety Agency (EASA), the Regulator responsible for the certification and continued airworthiness of the helicopter, were informed of the accident. The BEA appointed an Accredited Representative to lead a team of investigators from the BEA, Eurocopter - the helicopter manufacturer, and Turbomeca - the engine manufacturer. The EASA and the UK Civil Aviation Authority also provided assistance to the AAIB team.

Floating wreckage from the helicopter was brought ashore towards the end of the search and rescue phase. As a priority, the CVFDR was located in the debris field and transported to the AAIB as soon as it was raised from the sea bed on Sunday 5 April 2009. By Monday 6 April 2009 the helicopter fuselage with the engines and main rotor gear box attached, the separated rotor head with the main rotors blades still attached and the separated tail boom had been recovered from the sea bed and transported to the AAIB facilities at Farnborough, Hampshire. The CVFDR was successfully downloaded at the AAIB and contained 24 hours of flight data and one hour of cockpit voice recording. A large number of parameters were recorded including engine data and some system warnings which are still being analysed. The CVFDR recording ceased just prior to the first MAYDAY transmission.

In common with similar helicopters operating in the North Sea, the helicopter was additionally equipped with a Health and Usage Monitoring System (HUMS), which comprises a system of sensors around the engines, airframe and drive train. Recorded information includes vibration levels together with gearbox chip detection from a series of magnetic plugs. The data accumulated during

helicopter operations is transferred, usually on a daily basis, to the operator's ground-based computer system. The data is then subjected to mathematical processes that establish basic signatures and enable trends to be monitored for individual components. The HUMS data for the day's operation, including the accident flight, has also been recovered. As the result of the discovery of a particle on the main rotor gearbox epicyclic module magnetic chip detector on 25 March a daily inspection of the epicyclic gearbox magnetic chip detector was initiated. Also, the HUMS data was downloaded and analysed each time the helicopter returned to its base at Aberdeen for the next 25 flying hours. No further abnormalities were identified during this period.

Examination of the wreckage indicates that the accident occurred following a catastrophic failure of the main rotor gearbox (MGB). This resulted in the detachment of the main rotor head from the helicopter and was rapidly followed by main rotor blade strikes on the pylon and tail boom, which became severed from the fuselage. It is apparent that there was also a rupture in the right hand (No2) engine casing, in the plane of the second stage power turbine. This is currently believed to be a secondary feature. Investigations are continuing in order to understand completely the accident sequence.

The investigation has so far revealed that the MGB had suffered from a major failure within the epicyclic module. This is supported by HUMS data; however, this is not yet fully understood. The examination of the MGB is continuing in conjunction with detailed analysis of the HUMS and other recorded information.

Based on the initial findings of the investigation the following three Safety Recommendations are made:

Safety Recommendation 2009-048

It is Recommended that Eurocopter issue an Alert Service Bulletin to require all operators of AS332L2 helicopters to implement a regime of additional inspections and enhanced monitoring to ensure the continued airworthiness of the main rotor gearbox epicyclic module.

Safety Recommendation 2009-049

It is Recommended that the European Aviation Safety Agency (EASA) evaluate the efficacy of the Eurocopter programme of additional inspections and enhanced monitoring and, when satisfied, make the Eurocopter Alert Service Bulletin mandatory by issuing an Airworthiness Directive with immediate effect.

Safety Recommendation 2009-050

It is Recommended that Eurocopter improve the gearbox monitoring and warning systems on the AS332L2 helicopter so as to identify degradation and provide adequate alerts.

Initial Report 2

ACCIDENT

Aircraft Type and Registration:	Eurocopter AS332L2 Super Puma, G-REDL
No & Type of Engines:	2 Turbomeca Makila 1A2 turboshaft engines
Year of Manufacture:	2004
Date & Time (UTC):	1 April 2009 at 1255 hrs
Location:	Approximately 11 miles north-east of Peterhead, Scotland
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 2 Passengers - 14
Injuries:	Crew - 2 (Fatal) Passengers - 14 (Fatal)
Nature of Damage:	Helicopter destroyed
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	31 years
Commander's Flying Experience:	2,575 hours (of which 1,870 were on type) Last 90 days - 96 hours Last 28 days - 37 hours
Information Source:	AAIB Field Investigation

The investigation has determined that a failure within the epicyclic reduction gearbox module of the main rotor gearbox resulted in the rupture of the gearbox case, which allowed the main rotor head to separate from the helicopter. Examination of the remains of the epicyclic gearbox, and associated areas of the helicopter, continues apace with the aim of establishing as soon as possible the sequence of the failure and initiating cause.

Although two Alert Service Bulletins issued by Eurocopter have been mandated by EASA (Emergency Airworthiness Directive 2009-0087-E, dated 11 April 2009), which requires an enhanced monitoring procedure relating to the magnetic plug of the main rotor gearbox epicyclic reduction gear module, this procedure was in effect being carried out on the helicopter involved in the accident. This resulted from the discovery of a small chip of metallic debris on the epicyclic gearbox module chip detector some 34 flying hours before the failure. However, during the period between the discovery of the chip and the accident, no signs of an incipient gearbox failure were detected.

As the cause of the failure has yet to be identified, and the failure occurred without apparent warning to maintenance or flight crews, the following Safety Recommendation is made:

Safety Recommendation 2009-051

It is recommended that Eurocopter, with the European Aviation Safety Agency (EASA), develop and implement an inspection of the internal components of the main rotor gearbox epicyclic module for all AS332L2 and EC225LP helicopters as a matter of urgency to ensure the continued airworthiness of the main rotor gearbox. This inspection is in addition to that specified in EASA Emergency Airworthiness Directive 2009-0087-E, and should be made mandatory with immediate effect by an additional EASA Emergency Airworthiness Directive.

ACCIDENT

Aircraft Type and Registration:	EADS Socata TBM 700C1, N700GY
No & Type of Engines:	1 Pratt & Whitney Canada PT6A-64 turboprop
Year of Manufacture:	2004
Date & Time (UTC):	27 March 2008 at 1039 hrs
Location:	Alderney Airport, Channel Islands
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Major damage to propeller, engine and aircraft nose
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	54 years
Commander's Flying Experience:	17,400 hours (of which approximately 150 were on type) Last 90 days - 240 hours Last 28 days - 90 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and subsequent enquiries by the AAIB

Synopsis

The pilot of a TBM 700 landed with three green lights and a red light showing on the landing gear control and indication panel; the nose gear subsequently collapsed during the rollout. The pilot had interpreted the three greens as indicating that the landing gear was locked down, however the red light signifies that the gear is unlocked and takes precedence over the three greens. Although the correct procedure required the landing gear to be operated manually using the hand pump, it was dependent on the pilot recognising that a red warning light signifies that the landing gear is unlocked, even if three greens are displayed concurrently. The lack of clarity in the TBM 700 Pilot's Operating Handbook (POH) regarding the significance of the red warning light was considered to be a causal factor in this accident.

One Safety Recommendation is made to improve the clarity of the Emergency Procedures in the TBM 700 POH.

History of the flight

The aircraft, with one person on board, took off from Biggin Hill bound for Alderney. When the pilot selected the landing gear up, the green nose gear light did not extinguish and the red landing gear warning light remained on. The pilot, who was an ATPL holder and experienced on large commercial jet transport aircraft,

made a number of unsuccessful attempts to retract the gear before consulting the POH. He elected to continue the flight with the gear down, observing the airspeed limitation in the POH. He considered that the three green lights signified that all three gears were locked down and therefore no further action was required.

The aircraft landed at Alderney with three greens and a continuous red light still showing on the landing gear control and indication panel. At approximately 40 kt during the rollout, the nose gear leg collapsed, causing the propeller and nose to strike the paved runway surface. The aircraft then departed the runway, coming to a stop on a taxiway. The pilot shut down the aircraft and evacuated via the main door.

The aircraft was subsequently lifted using airbags. An engineer was unable to pull the nose gear to lock down, but was able to lock the nose gear down after one and a half pumps on the landing gear hand pump.

Pilot's Operating Handbook

The following description of the TBM 700 landing gear indication system (Figure 1) is provided in Section 7.5 of Revision 0 of the TBM 700 POH:

> *'LANDING GEAR INDICATOR*
>
> *Landing gear position indication is accomplished by 4 warning lights:*
>
> *- 3 green indicator lights (one per landing gear) indicate that each landing gear is down-locked,*
>
> *- 1 red warning light indicates that landing gears are operating, or not locked down or up*
>
> *NOTE:*
> *The red warning light flashes as soon as landing gears are operating and remains continuously on in case of locking problem.'*

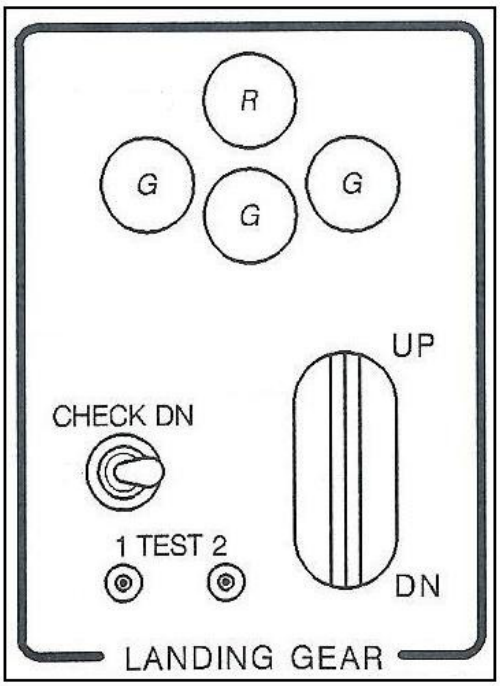


Figure 1

TBM 700 - Landing gear control and indication panel

Extracts of the relevant Emergency Procedures, contained in Section 3 of the POH, are included in the attached Appendix.

According to the aircraft manufacturer, the TBM 700 pilot training includes a review of landing gear emergency procedures. The significance of the red warning light is explained and the emergency procedures to be followed are highlighted. In December 2008, the aircraft manufacturer issued Service Letter SL 70-050, to remind pilots of the necessity to comply with the instructions in the Pilot's Operating Handbook.

Nose gear actuator examination

The nose gear actuator was removed and examined at the manufacturer's facility in the presence of the AAIB and the aircraft manufacturer.

When the actuator was functionally tested on a rig, an anomaly was found. It successfully retracted, giving the correct UP lock indications, but almost simultaneously, the switch indications for DOWN lock were detected. This meant that the actuator would have sent an indication to the landing gear control unit that the nose gear leg was locked both UP and DOWN. This anomaly could have produced the continuous red light reported by the pilot.

When the actuator was disassembled, some faint witness marks were found in the internal mechanism. These could have been indicative of small fragments of material with the potential to cause a malfunction having been present at some stage, however, no contamination was found. The actuator operated normally when functionally tested again after reassembly.

Other incidents

This aircraft had experienced two other similar events in the four months preceding the accident. In both cases the problem occurred during retraction. All post-incident maintenance tests were passed with no fault found. Although the hand pump was not used to manually lower the landing gear manually on those occasions, the nose gear did not collapse.

There have been other reported incidents of TBM 700 nose gear collapse on landing. It was not possible to obtain information on all such occurrences, but details of another similar accident[1] that occurred to a TBM 700 at Paris Le Bourget in September 2007 were available. As in this accident, a red light and a green light remained illuminated after gear-up selection, prompting the pilot to return to Le Bourget. The pilot observed that three greens and a constant red light were illuminated after selecting the gear down. The pilot consulted the ATC controller, who confirmed that all three gear legs appeared to be down. The POH procedure to operate the landing gear hand pump was not followed and the nose gear leg collapsed during the rollout.

Analysis

Whilst it was possible during testing of the nose gear actuator to recreate an anomaly that would explain the red gear unlocked light indication observed by the pilot, it was not possible to establish what had caused this. The fact that the actuator worked satisfactorily on the rig after reassembly would suggest that contamination was the cause although none was found.

Section 7.5 of the TBM 700 POH states that a continuous red warning light indicates a landing gear locking problem, irrespective of the condition of the green lights and the significance of the red warning light should be explained during pilot training. Notwithstanding this, on this, and at least one other occasion, the three green lights led a pilot to believe that the gear was locked down, even though a red light was showing. On most other aircraft types the green lights will only illuminate when the landing gear is locked down and a locking problem is indicated by a failure of the green lights to illuminate. Pilots who fly other aircraft types in addition to the TBM 700 are therefore more likely to assume that three greens signify that the landing gear is locked down, when in fact it is not. If, as in this and the Le Bourget accident, the pilot has interpreted the three green lights to mean that the landing gear is locked down, despite the red warning light showing, then the pilot is likely to

Footnote

[1] BEA report on accident to TBM 700 F-GTJM at Paris Le Bourget on 4 September 2007, published March 2008.

believe that the problem has been resolved and that no further corrective action is required.

Given this situation, and in order to prevent similar accidents from occurring in the future, the POH would benefit from being amended to explain more clearly the significance of a red light, particularly when three green lights are displayed concurrently. For example, the following sentence in Section 7.5 of the POH is potentially misleading because if there is a continuous red light showing together with three greens, the gear is not locked:

> *'3 green indicator lights (one per landing gear) indicate that each landing gear is down-locked'*

The Emergency Procedures in the POH would also benefit from being more explicit with respect to the significance of the red light and that if this is displayed, manual operation of the landing gear is required.

The following Safety Recommendation is therefore made with the aim of clarifying the information contained in the TBM 700 POH:

Safety Recommendation 2009-002

It is recommended that EADS Socata amends the TBM 700 Pilot's Operating Handbook, to clarify the need for manual extension of the landing gear if a continuous red light is showing, even if the green gear lights on the landing gear control and indication panel are lit.

3.11 - LANDING GEAR AND FLAPS

DISCREPANCY WHEN LANDING GEAR GOES UP

- **Red warning light on "LANDING GEAR" control panel remains flashing ON :**

The red warning light on the landing gear control panel flashing at the end of maneuver indicates that the landing gear electrohydraulic pump still operates.

1 - "LDG GR" circuit breaker ..... **PULL**

If the red warning light goes off :

The flight may be continued without any restriction. The electrohydraulic pump starting will be manually controlled with the "LDG GR" circuit breaker for the landing gear extension.

If the red warning light remains fixed ON, apply the following procedure :

- **Red warning light on "LANDING GEAR" control panel remains fixed ON (whatever the condition of the green lights may be) :**

The red warning light on the landing gear control panel is fixed ON at the end of maneuver, the green indicator lights are ON or OFF :

1 - Keep IAS ≤ 128 KIAS.

2 - EXTEND the landing gear.

Appendix - Figure 1

3.11 - LANDING GEAR AND FLAPS

DISCREPANCY WHEN LANDING GEAR GOES UP (Cont'd)

If the fixed red warning light is still on :

Continue flight if necessary at a speed BELOW 178 KIAS, without icing conditions or land.

If landing gear does not lock (incorrect indication), refer to paragraph "DISCREPANCY WHEN LANDING GEAR GOES DOWN".

CAUTION

DO NOT ENTER ICING CONDITIONS (THIS COULD ADVERSELY INCREASE DRAG AND WEIGHT DUE TO ICE ACCUMULATION, AND LOCK WHEELS AND STRUTS).

CLIMB PERFORMANCE WILL BE DEGRADED BY 50 %.

INDICATED AIRSPEED AT CRUISE WILL BE DECREASED BY 50 KIAS.

THIS SHOULD BE TAKEN INTO ACCOUNT WHEN CALCULATING THE AIRCRAFT RANGE.

Appendix - Figure 2

Appendix

3.11 – LANDING GEAR AND FLAPS

DISCREPANCY WHEN LANDING GEAR GOES DOWN

– Red warning light on "LANDING GEAR" control panel remains flashing ON (whatever the condition of the green lights may be) :

The red warning light on the landing gear control panel flashing at the end of maneuver indicates that the landing gear electrohydraulic pump operates correctly.

1 – "LDG GR" circuit breaker ..... **PULL**

If the red warning light goes off :

2 – LAND.

If the red warning light remains fixed ON, apply the following procedure :

– Red warning light on "LANDING GEAR" control panel remains fixed ON (whatever the condition of the green lights may be) :

The red warning light on the landing gear control panel is fixed ON at the end of maneuver, the green indicator lights are ON or OFF, extend the landing gear manually.

1 – "LDG GR" circuit breaker ..... **PULL**

2 – Floor hatch ..... **OPEN**

3 – By-pass selector ..... **FULLY PULL / LOCK**

4 – Landing gear control ..... **DN**

5 – Hand pump ..... **ACTUATE with maximum amplitude**

CAUTION

THE ENTIRE EXTENSION OF THE LANDING GEAR TAKES ABOUT 65 CYCLES. IT IS MANDATORY TO HAVE A CLEAN HARDENING OF THE MANUAL CONTROL AT THE END OF THE MANEUVER

Appendix - Figure 3

3.11 – LANDING GEAR AND FLAPS

DISCREPANCY WHEN LANDING GEAR GOES DOWN (Cont'd)

6 – "LDG GR" circuit breaker ..... **PUSH**

7 – "CHECK DN" inverter ..... **ACTUATE**

If the hardening of the manual control is marked and if the normal indicating shows 3 green indicator lights or the "CHECK DN" indicating shows 3 green indicator lights.

8 – LAND.

If the manual control remains soft or if one (or several) green indicator light(s) miss(es) on the normal indicating and on the "CHECK DN" indicating, the bad locking of a landing gear in down position is confirmed. Recycle the landing gear as follows :

9 – By-pass selector ..... **UNLOCK / PUSH**

10 – Wait a minute.

11 – Landing gear control (IAS ≤ 128 KIAS) ..... **UP**

Perform tests of landing gear extension in the NORMAL mode by applying positive load factors during the maneuver as well as skidding.

In case of failure, refer to Chapter 3.7 "EMERGENCY LANDINGS", Paragraph "LANDING WITH UNLOCKED MAIN LANDING GEAR" or Paragraph "LANDING WITH DEFECTIVE NOSE LANDING GEAR".

Indication :
If a main landing gear is not in the down position, it is preferable to land with landing gear up (Refer to Chapter 3.7, Paragraph "LANDING WITH GEAR UP").

Appendix - Figure 4

SERIOUS INCIDENT

Aircraft Type and Registration:	Fokker F.28 Mark 0070, PH-KZB
No & Type of Engines:	2 Rolls-Royce Tay 620-15 turbofan engines
Year of Manufacture:	1996
Date & Time (UTC):	29 September 2008 at 1705 hrs
Location:	Manchester Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 4 Passengers - 70
Injuries:	Crew - None Passengers - 2 (Minor)
Nature of Damage:	Emergency inverter cooling fan capacitor burnt out
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	43
Commander's Flying Experience:	9,820 hours (of which 3,908 were on type) Last 90 days - 153 hours Last 28 days - 54 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft was taxied onto Stand 214C (centre) using the right engine with the left engine shut down and the APU running. As soon as the right engine was shut down, there was a strong smell of electrical burning and smoke began to accumulate on the flight deck. Following a brief discussion between the commander and the Cabin Service Supervisor, the aircraft was evacuated.

An engineering investigation identified that the emergency inverter cooling fan capacitor, was completely burnt out. This had released smoke and fumes into the flight deck area.

History of the flight

The aircraft had completed an uneventful flight from Amsterdam, Schiphol Airport to Manchester Airport. Having landed on Runway 23R the aircraft was taxied to parking Stand 214 (centre) using the right engine with the left engine shut down and the Auxiliary Power Unit (APU) running. After arrival on stand, the parking brake was set and the right engine shut down. The cabin crew were instructed to open the airstair door at the front left side of the aircraft. The flight crew remained in their seats on the flight deck with the Cabin Service Supervisor (CSS) at the front left door and the second cabin attendant stood at the rear of the aircraft.

Immediately after the right engine was shut down, the pilots noticed a strong smell of electrical burning. Both

pilots noticed wisps of smoke and the co-pilot opened his sliding window to try and clear it. The commander called the CSS on the interphone and asked if there was any sign of smoke or a smell of burning in the cabin. She did not detect either and was asked to go onto the flight deck. As she opened the flight deck door, the smoke increased and she was immediately aware of the significant presence of smoke and the smell of burning. The flight crew believed the smoke was coming from multiple sources including behind the co-pilot, various vents and behind the instrument panel.

The commander firmly instructed the CSS to get the passengers off as quickly as possible. He then contacted ATC on the ground frequency and informed them that his aircraft had smoke on the flight deck and requested the immediate attendance of the Airport Fire Service (AFS).

The CSS left the flight deck, stood on the aircraft steps and told the Dispatcher that the aircraft had smoke in the cockpit and that the passengers would be disembarking immediately. She then used the cabin public address system to tell the passengers to:

> *'get off the aircraft now. Hurry, evacuate the aircraft.'*

The passengers were stood up retrieving their personal belongings and appeared not to react to the CSS's instructions. She then added:

> *'evacuate the aircraft but leave your luggage behind'*

to which the passengers responded appropriately. The cabin attendant in the rear of the aircraft saw a lady at the right side overwing exit release the door and throw it through the opening onto the wing. Passengers were leaving the aircraft quickly by the forward left door and the right side overwing exit.

The cabin crew member at the rear of the aircraft, realising that an emergency evacuation was in progress, kept the passengers moving forward. As the last passengers vacated the aircraft, both cabin attendants met near the overwing exit and confirmed all the passengers had left. The rear cabin attendant exited through the overwing exit and the CSS, having informed the commander that all the passengers were off, vacated the aircraft though the airstair door.

The flight crew attempted to locate the source of the smoke but given the imminent arrival of the AFS and not wishing to prolong the problem, shut down the APU and switched OFF the electrical power. The co-pilot completed the 'Termination' checklist and exited the aircraft. The commander made a final check of the cabin area and toilets to confirm that there were no persons still onboard. He then left the aircraft through the airstair door and joined the passengers and crew on the parking area.

When all passengers were accounted for, they were directed by ground staff into the terminal building. Two of the passengers were treated by the ambulance service for minor injuries sustained when moving off the aircraft wing.

Aircraft operating procedures

The procedure for an emergency evacuation is contained in the operator's Abnormal Checklist and is set out in Table 1.

ON GROUND EMERGENCY/EVACUATION	
When aircraft is stationary	
• ... Captain commands	ON GROUND EMERGENCY. TAKE ACTION
• PARK BRAKE (PF).....	SET

PILOT LH SEAT	PILOT RH SEAT
• Inform ATC	• Flaps.....42
	• Thrust levers ..... IDLE
	• Reverse levers ..... FULL DOWN
	• Lift dumpers..... DISARM
	• Both fuel levers ..... SHUT
	• Both fire handles .....PULL ROTATE OUTWARDS
	• APU DISCH switch .....ON
• PAS..... COMMAND 'EVACUATE AIRCRAFT'	
• EMER lights .....ON	
When leaving cockpit	
• BATTERIES ..... OFF	

NOTE: Use VHF1 to notify ATC

Table 1

Abnormal Checklist

The principles of the procedure are to facilitate a safe evacuation of the aircraft with the main engines and APU shut down, fire extinguishant discharged into the engine/APU bays and electrical system switched OFF. The flaps are lowered to allow passengers and crew to slide down the flap surface reducing the height they have to descend to the ground and increasing the distance of the flap trailing edge from the engine inlets.

Flaps are lowered by hydraulic actuators which are pressurised using engine driven pumps located on the main engines. The APU does not have a hydraulic pump and therefore, with both engines shut down hydraulic power is not available. An alternative method of lowering the flaps in flight is provided by an electrical motor which can be used as a backup means of lowering the flaps in the event of the loss of hydraulic pressure. On the ground, it is possible to pressurise the system with an electric pump which then allows normal flap selection. The APU generates sufficient electrical power to operate this backup system. To lower the flaps fully, using the hydraulic system takes 14 to 18 seconds and using the electrical backup system takes approximately 90 seconds.

Safety and survival

Manchester Airport has a comprehensive set of Standard Operating Procedures (SOPs) included in their Manual of Air Traffic Services (MATS) Part 2. These cover both aircraft arriving with an emergency situation and aircraft developing an emergency whilst on the ground. Aircraft arriving with an emergency will either be dealt with on the runway or allocated a remote stand, depending on the severity of the situation. A ground response team will be assembled which comprises assets from the emergency services and coaches to transport passengers and crew with specific reception areas made available in the terminal. The airport SOP covering aircraft evacuations is set out below:

*'**Aircraft Evacuations***

During the emergency evacuation of an aircraft, it is impossible to account for all passengers and crew until a head count has been carried out. People may be some distance from the aircraft until they have all been marshalled together. Manchester Airport and NATS have therefore agreed a procedure to cater for this scenario.

Whenever there is an emergency evacuation of an aircraft at Manchester Airport, regardless of where the aircraft is situated on the airfield, all aircraft movements are to be immediately suspended until the Airport Duty Manager (ADM) confirms that all evacuees have been accounted for. This means that no further departures are to commence their take-off roll, aircraft on final approach are to be instructed to commence a missed approach and aircraft on the ground are to be instructed to hold position.

Normal operations may re-commence when the ADM is satisfied that all evacuees have been accounted for. Experience shows that this normally takes a maximum of 6 to 7 minutes to achieve.'

The incident occurred at 1705 hrs and airfield operations were immediately suspended by the ADM. All evacuees were accounted for and airfield operations were re-instated at 1711 hrs. An aircraft due to park on the stand adjacent to the incident aircraft was redirected to another stand by ATC.

Airport Fire Service (AFS) response

The AFS were notified of the incident by ATC and immediately deployed four major foam tenders, a domestic appliance and the emergency tender directly to the scene. They arrived within one minute of the initial response and the AFS Incident Commander (I/C) established that the evacuation was virtually complete. Two fire fighters entered the aircraft and established that although there was a smell of burning, there were no visible signs of smoke or flames and there were no persons onboard. A thermal camera was used to inspect the flight deck area and a fuse panel behind the co-pilot's seat was correctly identified as being the source of the smoke and burning smell. The aircraft commander and a maintenance engineer assisted the AFS by ensuring that the aircraft was in a safe condition with the electrical system OFF.

The AFS I/C liaised with the ADM to establish the best method of keeping the site secure. There had been a number of approaches by ground personnel to gain access to the aircraft in order to remove the baggage. At 1845 hrs it was agreed that the fire risk to the aircraft was minimal and the scene was handed over to the police.

The AFS I/C summarised his assessment of the incident and his recommendations in his report as:

> *'A successful conclusion to this incident was in my opinion down to the excellent communication links and liaison that I, the I/C had with the ADM and his team. A concern of mine during the incident was of the amount of non-essential personnel trying to gain access to the A/C. Not only is this a dangerous occurrence for these persons entering a risk area, but it is also removing my fire personnel away from their tasks to shepherd ground staff away. A recommendation of Manchester Airport Security or Greater Manchester Police to cordon the area off until approval to enter is given by the Fire I/C or ADM.'*

Following the incident, Manchester Airport Emergency Planning Committee reviewed their response to the incident and in particular the issue of persons entering a risk area. The airport intends to establish that the airport police and security team leader attend ground incidents. The police will be asked to assist the AFS I/C to manage the inner cordon to ensure that only authorised staff attend the inner scene.

Aircraft examination

Although the aircraft was inspected 18 hours after the incident, the smell of electrical burning remained very strong on the flight deck. The crew had reported that the smoke initially appeared from the circuit breaker panels behind the co-pilot's seat and the fire service attending the incident had opened these panels to identify the source. Inspection of the wiring behind both the upper and lower panels did not identify any evidence of overheat or burning. The maintenance provider had reported a similar recent incident on another of their Fokker 70 aircraft, where the emergency inverter was suspected as being at fault. The inverter is located behind the panel adjacent to the upper circuit breaker panel and the inverter's cooling fan vents directly through a hole in the dividing wall into the area behind the circuit breaker panel. Again no evidence of burning or overheat was immediately obvious around the inverter or on its connector and external wiring. However, when the unit itself was removed, there was a similar strong electrical burning smell around the exit of the cooling fan.

A serviceable spare emergency inverter was fitted and the aircraft was electrically powered up using ground power and subsequently all the on-board power sources including the battery, APU and engines. The aircraft was left for an extended period of time with power on, but there was no re-occurrence of the smoke. No failure codes were evident on the maintenance display and all electrically powered systems were functioning correctly. On this basis the removed emergency inverter was retained for further investigation and the aircraft returned to service without reported incident.

The right overwing emergency exit had been used during the emergency evacuation. The exit door was of the type which is completely removed by pulling the release handle down and then pushing the door out of the aircraft. Inspection of the removed door showed that it had operated correctly. No damage was found on the wing top surface as a result of the door landing on it.

Detailed examination

The emergency inverter was taken to an overhaul facility for further disassembly and investigation. Initially when the cover was removed there was no obvious sign of burning or overheat, although the strong electrical burning smell was again present. It was decided that the unit should be tested using the

test bench power supply. As soon as electrical power was applied, smoke emanated from the area around the cooling fan. Further disassembly of the unit identified that a capacitor in the cooling fan power supply circuit was completely burnt out. (Figure 1) The capacitor was too badly damaged to allow any further analysis of why it had failed. The inverter was then repaired and tested, with no further anomalies identified.

Emergency inverter

The emergency inverter converts a 28V dc supply into a 115V ac supply to maintain electrical power to the aircraft's emergency busbar in the event of a loss of normal ac supply. The inverter is continually powered while the aircraft is electrically powered and as its operation is completely autonomous, the only means of isolating it is to pull the 28 V supply circuit breaker or to completely de-power the aircraft. The overheated capacitor which caused the smoke was part of a modification to the unit installed during aircraft development, to reduce the fan speed and therefore the level of noise which it generated on the flight deck. Should the cooling fan fail to operate, a thermistor within the inverter isolates the power supply when the temperature reaches 110ºC.

Figure 1

Burnt out capacitor

Previous history

The inverter unit under investigation was only fitted two days prior to the incident. The unit which it replaced, although removed from service for a different reason, had evidence of overheat on the same capacitor though to a lesser extent. A review of the overhaul records for inverters since introduction of the aircraft in 1994, identified a further four instances where this capacitor was found to have overheated. The last of these had occurred 22 months previously, again on this aircraft. At the time of this event, the Fokker 70 fleet had accumulated 1,226,309 flight hours since entry into service.

The operator reviewed the aircraft's build standard and found it to be consistent with the rest of their Fokker 70 fleet. The capacitor was manufactured by a component supplier, who confirmed the part number had been out of production for the last 10 years and was not used in any other application.

Analysis

Operational matters

With both main engines shut down and the passengers standing retrieving their belongings, the situation was outside the circumstances which would normally exist in an emergency evacuation as set out in the abnormal checklist. There was no time to prepare the passengers and crew to carry out an evacuation.

The commander, seeing the smoke developing, wanted the passengers off the aircraft as his first priority and firmly instructed the CSS to do this. Her initial attempt to get the passengers to leave the aircraft by saying,

> *'get off the aircraft now. Hurry, evacuate the aircraft,'*

produced little response. Given the strength of the commander's instruction and the urgency of the situation, the CSS raised the assertiveness in her voice and carried out the evacuation drill. The evacuation proceeded rapidly whilst the flight crew alerted ATC, attempted to identify where the smoke was coming from and ultimately shut down the aircraft. Whilst he had not specifically ordered an 'evacuation', the commander fully supported the decision and actions of the CSS.

The movement of the passengers off the wing would have been made safer by lowering the flaps. Without the hydraulic system to power the flap actuators the electrical system would have been the only method of achieving this. Using this system would have either meant delaying the use of the overwing exits whilst the flaps were lowered or having the flaps travelling as passengers were on or possibly under them. Both of these options carried associated additional risk.

The airport Emergency Planning Committee has addressed the concerns of the Airport Fire Service, Officer in Charge regarding the entry of unauthorised persons into a risk area.

Engineering

During the incident, a cooling fan power supply capacitor, located adjacent to the fan within the emergency inverter unit, overheated and generated a significant quantity of smoke. The cooling fan continued to operate, drawing the smoke out of the inverter casing and through the hole in the dividing wall between the inverter equipment bay and the area behind the upper circuit breaker panel. As this space was completely enclosed, it then entered the flight deck via the gaps around the panel. The co-pilot opened his sliding window to allow the smoke to clear, but this most likely set up a circulation cell

within the flight deck which drew the smoke behind the equipment panels such that it then appeared to come from various sources around the flight deck. This may have contributed to the pilots' perception of the seriousness of the incident. As the pilots could not locate the source of the smoke and given that the inverter remained electrically powered as long as the aircraft did, they were not able to prevent the capacitor from continuing to overheat and generate smoke until the aircraft was completely electrically de-powered.

It has not been possible to isolate the reason for the capacitor overheating due to the severity of the damage. Previous failures of this component are low in number, although the recent frequency of failures may suggest that the failure rate is beginning to increase. Given the time since manufacture of the capacitors, the failure mode may potentially be a service life related issue. This event is the first recorded incident where smoke in the flight deck has been reported as a consequence of this capacitor overheating. No anomalies could be identified which might explain the number of overheat failures associated with this aircraft. Routine fleet airworthiness reviews between the inverter manufacturer and the Civil Aviation Authority (Netherlands) aim to identify any adverse trend in reliability and ensure mitigating action is taken if necessary.

SERIOUS INCIDENT

Aircraft Type and Registration:	Hawker Hunter F6.A Hunter, G-KAXF
No & Type of Engines:	1 Rolls-Royce Avon MK 207 turbojet engine
Year of Manufacture:	1956
Date & Time (UTC):	18 October 2008 at 1032 hrs
Location:	Runway 26, Exeter Airport
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	150 gallon drop tank damaged beyond repair
Commander's Licence:	Private Pilot's Licence
Commander's Age:	69 years
Commander's Flying Experience:	13,967 hours (of which n/k were on type) Last 90 days - 9 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

As the aircraft touched down on Runway 26 at Exeter Airport, an external fuel tank fell from its wing and landed on the grass to the south of the runway. The tank hit a runway edge light and damaged the runway surface. The tank was held onto the wing by an electromagnetic tank release unit. The jaws of the unit opened on touchdown releasing the tank.

History of the flight

The aircraft took off from Runway 26 at Exeter Airport for a general handling flight and the pilot selected the landing gear up. Although it seemed to the pilot that the landing gear retracted fully, there was an indication in the cockpit that the nosewheel door remained unlocked. The pilot selected the landing gear down, obtained indications that it was down and locked, and decided to curtail the flight and land. He informed ATC that he had a technical problem, stressed it was not an emergency, and flew on for about 10 minutes to reduce the aircraft's mass to the maximum allowable for landing. The pilot then flew the aircraft to the airfield overhead and joined the right hand circuit.

As the aircraft touched down, the external fuel tank fell from its left wing and landed on the grass to the south of the runway. The tank, which contained approximately two gallons of fuel, hit a runway edge light and damaged the runway surface. The pilot did not notice

anything unusual and was informed of the incident by the aerodrome controller. He continued to taxi and shut down normally. Part of the runway was closed for 30 minutes while the damage was assessed. The pilot did not recall the landing as being 'heavy'.

Tank release unit

The fuel tank was held under the wing by an electromagnetic tank release unit whose jaws closed around a lug on top of the tank. It appeared that the force on the jaws, imparted by the tank at the moment of landing, was sufficient to cause them to open and release the tank. There was no evidence that the release unit was unserviceable before the event. Similar release units were removed from the operator's other aircraft, tested for serviceability and refitted.

Advice on jettisoning tanks

Civil Aviation Publication (CAP) 632 details the terms under which ex-military aircraft can be operated on the UK register under a Permit-to-Fly. It states that;

> *'drop tanks should only be jettisoned as a last resort and when their retention would imperil the aircraft and crew and bring increased risk to persons on the ground'. It also states that 'pilots should be aware that empty drop tanks have a negligible effect on gliding or range performance of jet aircraft. Therefore, consideration should be given to retaining them in the event of forced landing.'*

Anecdotal evidence from Hunter pilots suggested they concur with this advice as aircraft have landed safely on the tanks following partial lowering of the landing gear. There was also concern that asymmetric release of the tanks would make a given situation worse.

Aircraft certification

A clamp lock, in use with Swiss registered Hunters, clamps around the jaws of the release unit to prevent them from opening, the tanks cannot be jettisoned either deliberately or inadvertently. The Hunter was accepted onto the UK register under a Permit-to-Fly based on the safety record it gained during military service. The aircraft standard accepted onto the register did not include the Swiss modification which is not, therefore, cleared for use on UK aircraft.

Analysis

Advice from the CAA suggests that to jettison empty drop tanks would be of negligible benefit to an aircraft in an emergency. Authorising the Swiss modification for use would prevent accidental jettison such as that which occurred in this incident. However, the safety record of the aircraft standard currently cleared for flight does not give grounds for concern. The argument is finely balanced and the evidence in this report does not support any recommendations.

INCIDENT

Aircraft Type and Registration:	Cessna 172R Skyhawk, G-OPFT
No & Type of Engines:	1 Lycoming IO-360-L2A piston engine
Year of Manufacture:	1998
Date & Time (UTC):	23 February 2009 at 1241 hrs
Location:	Durham Tees Valley Airport
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Left mainwheel fairing and runway light damaged
Commander's Licence:	Student
Commander's Age:	54 years
Commander's Flying Experience:	14 hours (of which 4 were on type) Last 90 days - 2 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and comments from the instructor

The incident occurred during the student pilot's first solo flight. Following a normal circuit and approach to Runway 23, the aircraft drifted to the left during the landing flare and bounced several times; the left wheel fairing struck a runway edge light, damaging both. Control was regained and the landing was completed without further incident. The reported surface wind was 280°/7 kt.

The student pilot had satisfactorily completed nine circuits and landings with his instructor immediately prior to this flight. A check flight with the Chief Flying Instructor will be completed before he is authorised for further solo flight.

SERIOUS INCIDENT

Aircraft Type and Registration:	CZAW SportCruiser, G-OCRZ
No & Type of Engines:	1 Rotax 912 ULS piston engine
Year of Manufacture:	2008
Date & Time (UTC):	15 February 2009 at 1100 hrs
Location:	Firs Farm, north-west of Newbury
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to one propeller tip and dent on left wing leading edge
Commander's Licence:	Private Pilot's Licence
Commander's Age:	52 years
Commander's Flying Experience:	217 hours (of which 13 were on type) Last 90 days - 6 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

During the takeoff roll, the aircraft failed to accelerate as expected and the pilot elected to abandon the takeoff by closing the throttle and applying the brakes. He was unable to stop the aircraft before the end of the runway and steered onto open ground to the right, where the left wing and a propeller blade tip struck a wooden post in the ground, before the aircraft came to a stop. The pilot considered that the accident was caused by a poor choice of runway, given the wind direction, and his delay in electing to abandon the takeoff based on his belief that the downward slope of the runway would assist with the acceleration of the aircraft.

ACCIDENT

Aircraft Type and Registration:	Glasair IIS RG, G-KSIR
No & Type of Engines:	1 Lycoming IO-360-B1E piston engine
Year of Manufacture:	1995
Date & Time (UTC):	18 November 2008 at 1050 hrs
Location:	Upfield Airfield, Whitson, Newport
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Nose landing gear collapsed, engine shock-loaded
Commander's Licence:	Private Pilot's Licence
Commander's Age:	69 years
Commander's Flying Experience:	1,100 hours (of which 99 were on type) Last 90 days - 8 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot and additional AAIB inquiries

Synopsis

The aircraft had returned from a navigation exercise and made a normal approach to Runway 05 at Upton Airfield. On touching down, the nose landing gear collapsed rearwards, allowing the aircraft's nose to descend until the propeller struck the runway. The aircraft slid to a halt on the concrete surface, following which the occupants exited without difficulty.

Examination

The Glasair IIS RG is a two seat retractable tricycle landing gear aircraft of composite material construction. After the accident it was apparent that the nosewheel had become partially detached from the nose leg fork, as a result of the loss of the nut that retains the wheel axle bolt. The bolt normally passes through the wheel hub and both halves of the fork and the loss of the nut had allowed it to migrate from its correct position. This allowed the wheel to tilt within the fork and also to move rearwards, so that it contacted a guide strap that passed around the rear of the wheel. This resulted in it becoming jammed and to effectively act as a locked wheel on touchdown; the consequent force on the nose leg, generated by friction between the surface and the tyre, caused the leg to collapse rearwards.

A drawing of the nosewheel fork and hub assembly is shown in Figure 1, and it can be seen that it specifies

an AN364-428A nut to attach to the AN4-56A axle bolt. The nut is of the self-locking type in that it has a nylon thread insert.

The owner/pilot was unsure as to why the nut had become detached. Thread debris was present on the end of the spindle bolt suggesting that the thread within the nut may have suffered an overload failure in tension.

In May 2007 Glasair issued Service Bulletin (SB) 160 (which was also issued as Glastar/Sportsman Service Bulletin 61), which addressed the issue of nut detachment. The SB noted that there had been:

> *'...two Glasair incidents since 2001 in which the nose wheel axle detached from the nose wheel fork causing substantial damage to the engine and prop (and the airframe as well in one case). The exact cause in both incidents is unclear; however, in light of the combined hundreds of thousands of successful take-off and landings with the Glasair and Sportsman nose fork and axle design, we speculate that something out of the ordinary must have contributed to these incidents.*
>
> *Notwithstanding, because nose gear shimmy can cause fairly severe side loads to the axle and fork assembly, replacement of the AN364-428A (shear) nut with an A365-428A (tension[1]) nut would be a prudent change.'*

The owner of G-KSIR considered that his aircraft had been equipped with the shear nut; examples of both are shown in Figure 2.

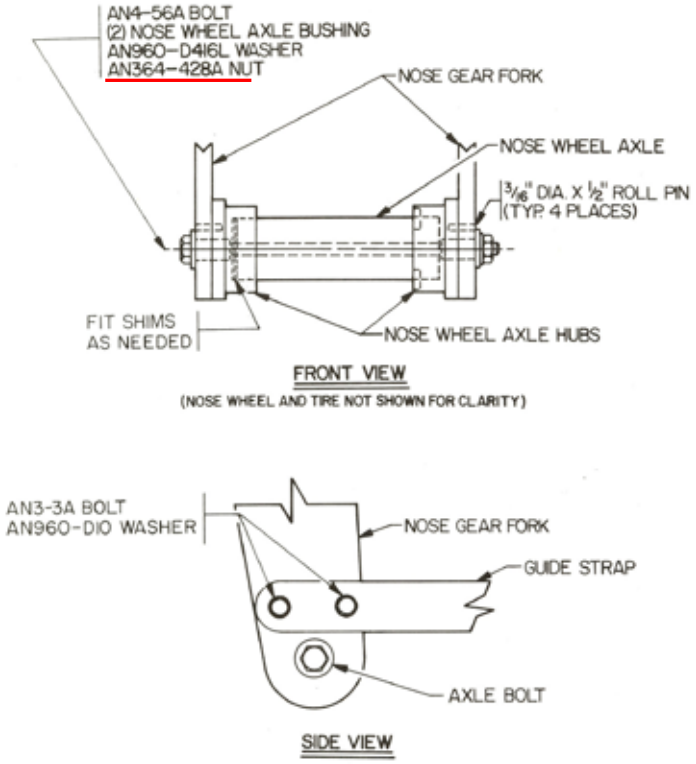
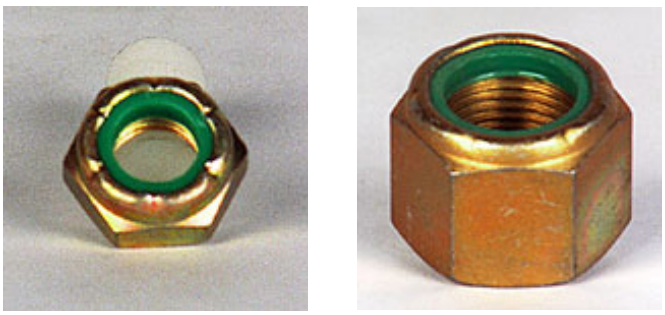


Figure 1

The tension nut is deeper than the shear nut, which increases the overall width of the fork assembly, although in fact the SB does not specify a longer axle bolt. However it does advise that for retractable gear aircraft, such as G-KSIR, it may not be feasible to use the AN365 tension nut due to width constraints in the nosegear well. In such a case, it advises using a 'lower height' MS21042-4 steel self-locking nut, which offers high tensile strength.



AN364-428A (shear) AN365-428A (tension)

Figure 2

Footnote

[1] A shear nut is intended to restrain a bolt in its installation where it experiences predominantly shear loading; it is not designed to resist any significant axial load in the bolt. Where such axial loads exists, a tension nut is used.

ACCIDENT

Aircraft Type and Registration:	Piper L4J Cub, G-AKTH
No & Type of Engines:	1 Continental Motors Corp A65-8 piston engine
Year of Manufacture:	1945
Date & Time (UTC):	1 March 2009 at 1610 hrs
Location:	Lains Farm Airstrip, 1 mile south of Thruxton, Hampshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to left wing and propeller
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	44 years
Commander's Flying Experience:	3,514 hours (of which 24 were on type) Last 90 days - 65 hours Last 28 days - 14 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft was taxiing for Runway 26 at Lains Farm Airstrip when it struck a bracing cable attached to a tall electrical power supply pole. This was adjacent to a low hedge forming the boundary to the airstrip. When the pilot saw the cable, he decided he did not have sufficient time to turn right or stop to avoid the impact so, in an attempt to minimise the damage, he turned left and braked. The left wing struck the cable and the aircraft yawed further left, allowing the propeller to strike the cable; this caused the engine to stop suddenly. Both occupants were uninjured. The pilot reported that he was distracted from maintaining directional control by looking across to the windsock and inside the aircraft to check the instruments.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28-161 Cherokee Warrior II, G-EMSL
No & Type of Engines:	1 Lycoming O-320-D3G piston engine
Year of Manufacture:	1982
Date & Time (UTC):	21 February 2009 at 1416 hrs
Location:	Rochester Airfield, Kent
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Extensive damage to engine, landing gear, wings, lower rear fuselage
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	45 years
Commander's Flying Experience:	1,923 hours (of which 1,280 were on type) Last 90 days - 78 hours Last 28 days - 29 hours
Information Source:	Aircraft Accident Report Form submitted by both crew members and additional AAIB inquiries

Synopsis

The accident occurred during a check flight, with a PPL holder and an instructor on board. The crew had briefed for a 'touch-and-go' at Rochester Airport. However, the aircraft landed a long way into the runway and, although the pilot applied the brakes with the intention of stopping, the instructor took control and opened the throttle in an attempt to take off. By this time there was insufficient runway remaining; the aircraft struck some small trees and came to rest on an embankment at the airfield boundary.

Circumstances of the accident

The pilot in the left seat was a PPL holder with 158 hours experience of which only one hour was flown within the last 90 days. Her total time as pilot in command was 29 hours. The flying club required that a check flight be conducted for any pilot who had not flown within the previous 28 days. The aircraft took off from Biggin Hill with the intention of conducting such a check flight; the supervising pilot happened to be the same instructor who had taught the pilot during some of her PPL training.

Having conducted some general handling the crew briefed for a touch-and-go at Rochester Airport prior to returning to Biggin Hill. The aircraft joined overhead

Rochester for Runway 20 Relief, which is an unmarked grass strip immediately to the left of Runway 20 Main. The entry into the circuit pattern, together with the turn onto base leg were, in the instructor's opinion, flown slightly too close to the runway, which resulted in the aircraft being high on the approach. In addition, there was initial confusion on the part of the pilot as to which runway to line up on, necessitating a correction during the approach. Touchdown was deep into the runway and the instructor expected an immediate application of power and takeoff; however, the pilot applied the brakes, having decided to stop the aircraft. The instructor decided that there was insufficient runway remaining in which to stop, so took control. Although he realised that it was marginal for a touch-and-go, he applied full power. It became apparent, however, that the aircraft was not going to complete the takeoff in the available distance, so the instructor maintained up elevator and prepared for impact. The aircraft struck a derelict car used for practice by the Airfield Fire Service, and some small trees beyond the end of the runway, slid down an embankment and came to rest close to a road that bordered the airfield. The occupants were uninjured although the aircraft was extensively damaged.

Subsequent investigation

After the accident, the pilot stated that she had considered going around at the point where the aircraft had become high on the approach but, reassured by the presence of the instructor, had kept these thoughts to herself and continued with the landing. Realising that the landing was long, she decided to attempt to stop the aircraft, again without communicating her intentions to the instructor, who was taken by surprise by this course of action.

The flying school conducted its own investigation into the accident; this focused on the human factor issues associated with the differences between instructing and supervising. The investigation included re-flying the exercise in another aircraft with the instructor and Training Director aboard.

Discussion

The problems began when the aircraft turned onto final approach and both crew members determined that they were slightly high. This was compounded by the confusion as to which of the two adjacent runways was in use. This confusion may have caused some distraction due to the necessity to realign the aircraft with the correct runway. Nevertheless, an accident was not inevitable at this stage, as the pilot could have elected to fly a missed approach. However, the reassurance provided by the presence of the instructor convinced her to continue. Her statement to this effect suggests that she had mentally reverted to being a student, a supposition made more plausible in that the instructor had taught her during her PPL training.

In a dual check flight, the pilot under supervision is being checked for his or her competence to act as pilot-in-command of a club aircraft. The requirement for such a flight in this case arose from a pilot who was not in current practice and who was also relatively inexperienced. There is a responsibility on the PPL holder to fly the aircraft in accordance with the agreed brief, with any intended deviation being communicated to the supervising pilot in a timely manner. However, it was apparent that there was a lack of communication during this flight between the pilot and instructor.

The expectations of the instructor will vary according to whether he is teaching or supervising, although he could be doing both during the course of a check flight; accordingly there will be different thresholds at which he will intervene.

In this case, the accident occurred after the pilot took a different action from what was briefed, ie the attempt to halt the aircraft instead of conducting a touch-and go, leaving insufficient runway to achieve either. Notwithstanding the possible delay caused by the instructor being caught out by the pilot's decision to stop, it is likely that at some point during the approach, at least one of the options of a full stop or touch-and-go became unavailable. Following their investigation the flying school have re-briefed their instructors, with the instructor involved in this accident having additionally revised part of his Instructor's Rating, paying particular attention to student management.

The pilot has reported that the flying school were very supportive and she has undergone further training since the accident.

ACCIDENT

Aircraft Type and Registration:	Stolp Acroduster Too SA750, G-BUGB
No & Type of Engines:	1 Lycoming O-360-A1D piston engine
Year of Manufacture:	1997
Date & Time (UTC):	26 July 2008 at 1457 hrs
Location:	Near Farthing Corner (Stoneacre Farm) Airfield, Kent
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Serious) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	52
Commander's Flying Experience:	9,738 hours (of which 174 were on type) Last 90 days - 137 hours Last 28 days - 47 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft departed from Runway 06 at Farthing Corner Airfield in Kent and was seen to climb to a height of 300-400 ft. The aircraft then turned back towards the airfield and flew in the direction of the hangar complex. As it approached the hangars, the nose pitched up and what appeared to be an aileron roll to the right was commenced. When the aircraft became inverted, the rate of roll appeared to slow or stop momentarily. The roll continued but the manoeuvre then appeared to become more of a barrel roll. The aircraft descended and struck tall trees before impacting the grass surface of an orchard.

Members of the public were quickly on the scene but were unable to release the pilot who received serious burns from the ensuing fire.

History of the flight

The pilot had flown from Rochester Airport to Farthing Corner Airfield to meet a friend and discus flying training. He was seen at Rochester earlier in the day working on his aircraft and met acquaintances in the airport café. He departed from Runway 34 at 1402 hrs and recorded his landing time on Runway 24 at Farthing Corner as 1410 hrs.

Having parked his aircraft near the hangars, the pilot met his friend and they went to the caravan clubhouse for tea. They were joined by three other pilots who were working on their aircraft and all remained outside. The pilot of the Acroduster was relaxed, in good spirits and after tea went to the hangar to look at an aircraft which was being maintained.

He had to return to Rochester to undertake a training flight with another pilot and started his aircraft and taxied to grass Runway 06 for departure. He was heard to carry out the engine power checks and then seen accelerating along Runway 06. The aircraft became airborne approximately halfway along the runway and climbed quickly to a height of about 300-400 ft agl. Some witnesses thought the aircraft turned left after takeoff and one person thought it turned to the right, but all agreed that the aircraft turned back towards the airfield and headed towards the hangars. Electricity cables suspended between pylons cross the airfield in a line to the west of Runway 06 and parallel to it. They are approximately 100 ft high and witnesses estimated that the aircraft was about 150-200 ft above the pylons when it crossed them. The aircraft then commenced what three witnesses described as an aileron roll and one witness thought was "an axial climbing roll to the right", which appeared to have an upward vector and was well executed. When the aircraft became inverted, that witness thought the roll stopped momentarily and all the witnesses agreed that the aircraft then entered a pronounced barrel roll type of manoeuvre in a nose down attitude. The aircraft was described as "mushing" downwards and disappeared behind the trees.

The occupants of a nearby farmhouse, the owner of which was an experienced pilot and owner of the airfield, were sitting outside having lunch with friends. They heard the aircraft coming and thought from the sound that it was performing an aerobatic manoeuvre but could not see it because of the high trees. The aircraft appeared in a nose-down attitude and struck the ground sliding into the orchard. A small fire ignited in the area of the aircraft nose. The people at the farmhouse ran to assist the pilot and were joined by the witnesses from the airfield, one of them a doctor. Some of those present fought the fire with fire extinguishers located nearby whilst others poured water over the pilot. The doctor released the pilot's five-point harness and attempted unsuccessfully to lift him from the cockpit. He thought that the pilot was trapped by his seat and despite exerting a level of force that would normally have raised him, he could not be lifted from the cockpit. The rescuers were unaware that a second lap strap was fitted in each cockpit. The fire spread to the forward cockpit and the rescuers, being unable to release the pilot, moved the aircraft tail through 45°, to allow the light breeze to take the flames away from the pilot. The fire was eventually extinguished and a doctor and paramedic arrived by air ambulance. Shortly after, the fire brigade arrived and the pilot was removed from the wreckage and transported to hospital in the air ambulance. He had suffered full depth burns to 55% of his body.

Subsequent inspection of the rear cockpit showed that the second lap strap in the rear cockpit was undone. Neither the air ambulance crew, nor the members of the public who attempted to rescue the pilot, nor the fire crew members who released him, recalled undoing the lap strap.

Meteorological information

The weather for the flight was good and an unofficial observation was made at Rochester Airport shortly after the accident. This gave the surface wind as South Westerly at less than 5 kt, visibility greater than 20 km, a QNH of 1016 hPa and the outside air temperature (OAT) of +26°C. Witnesses at the scene described the weather at the time of the accident as a calm wind, bright and sunny with medium level cloud and good visibility. Photographs taken at the scene whilst the pilot was being extracted confirmed the conditions.

Aerodrome information

Farthing Corner is a private airfield 4 nm east-south-east of Rochester Airport. It has a single, bi-directional grass runway 380 m long and 20 m wide, orientated 06/24. There is a windsock located to the west of the runway about half-way along it. A set of electricity cables is supported on metal pylons approximately 100 ft high and runs across the field 140 m west and parallel to the runway. There are two hangars 200 m to the west of the runway and a private property 100 m west of the hangars. The airfield elevation is 420 ft amsl, six feet lower than Rochester Airport (elevation 426 ft).

Pilot information

The pilot started flying in 1980 and his PPL was issued on 30 March 1981. He worked as a Flying Instructor gaining his CPL on 19 August 1987 and began flying on commercial aircraft operations. His ATPL was issued on 11 April 1990 and he moved to airline operations on medium size jet aircraft becoming a Type Rating Instructor/Examiner (TRI/E) on the Airbus A319 aircraft. He held a valid Class 1 medical certificate with no limitations.

Whilst pursuing his airline career he continued to fly light aircraft and acquired G-BUGB on

Figure 1

23 December 1999. He performed basic aerobatics such as loops, rolls and wingover manoeuvres but always at altitude with a minimum recovery floor of 1,500 ft. There is no evidence that he had performed low level aerobatics prior to the accident flight. His initial introduction to aerobatics was on his instructor course. Some eight years later he received formal aerobatic training on the Tiger Moth which consisted of basic aerobatic manoeuvres with their associated recovery techniques. In addition, the pilot had also received formal check flights to carry out basic aerobatics on the Stearman and Harvard aircraft. When he purchased the Acroduster the pilot applied his previous aerobatic experience to developing his skills on that aircraft.

There were numerous examples of the pilot's attitude towards safety. He was fastidious with the maintenance of his aircraft which, as a capable engineer, he carried out himself. Equally, in the conduct of his flights, those who flew with him emphasised his strict adherence to following a cautious and safe approach to flying.

Safety and survival

The pilot normally wore a flame retardent flying suit, flying boots, gloves and a lightweight protective helmet. On the day of the accident, the weather was hot and he was wearing the light weight helmet, knee length shorts, trainers and a T shirt with his flying gloves placed to the left of his seat. During the impact the pilot received injuries which probably rendered him unconscious. His five-point harness was secured but it could not be positively established if his secondary lap strap was secured. The accident was survivable and had the aircraft not caught fire or had the pilot been able to extricate himself from the aircraft when the fire first started, he would not have suffered the serious burns. If the rescuers had been able to release the pilot on their arrival at the scene, the level of burns would have been significantly reduced.

Rolling manoeuvre

The aircraft was cleared to perform rolling manoeuvres. The minimum recommended entry speed to carry out an aileron roll is 120 mph but the pilot normally used an entry speed of 140 mph. This ensured a more rapid rate of roll with minimum nose drop. It should also be noted that the normal cruising speed for this aircraft is 120-140 kt.

The Permit to Fly, Flight Test Schedule recorded the V_{NE} achieved of 200 mph at 2,400 propeller rpm. This was below the propeller rpm limit and confirmed that the safe entry speed for the manoeuvre could be achieved without exceeding the maximum propeller rpm limit of 2,700 rpm

Weight and Centre of Gravity (CG)

The maximum authorised takeoff weight for the aircraft was 1,800 lbs with the CG limits +20.5 inches to +26.5 inches aft of the CG datum. The aircraft weight at the time of the accident was approximately 1,346 lbs with a CG position of 22.12 inches aft of the CG datum. Therefore, the aircraft was being operated within the permitted weight and CG range.

Civil Aviation Authority (CAA) Safety Sense Leaflet

The CAA publishes a Safety Sense Leaflet Number 19a entitled *Aerobatics*. This document contains valuable information and guidance for pilots carrying out aerobatics. The following text is taken from the three areas which have a relevance to the accident.

*'**Personal Equipment and clothing***

Whilst there are no requirements to wear or use specific garments or equipment, the following options are strongly recommended.

- *Gloves help to protect against fire and abrasion in an accident. They also absorb perspiration, improving grip.*
- *Overalls made from natural fibres, with zippered pockets and close fitting ankles,collar and wrists also give protection, as do leather flying boots.*
- *Particularly when flying open cockpit aeroplanes a lightweight helmet gives protection whilst minimising discomfort under increased 'G' loading.*

Instruction

Ensure you learn the safest way of recovering from each manoeuvre if it goes wrong and be prepared to use it in the future. Continuing to pull is usually less safe than rolling to the nearest horizon.

Aircraft checks

Check that items of cockpit equipment, such as seat cushions and the fire extinguisher, are properly secured and check VERY carefully for any loose objects which might be present. Even the most insignificant item could lodge in such a manner as to restrict control movement. Dust and dirt from the floor, under negative 'G' situations, can get in the pilot's eyes.'

Engineering

Site examination

The aircraft had come to rest in a disused orchard close to the farmhouse witnesses. It had clipped the top of some trees, without incurring any significant damage, before impacting the ground heavily in a nose-down attitude on the main landing gear and engine, collapsing the former. The line between the tree and ground impact showed it had been travelling approximately on a heading of 180º, although it was found pointing 225º. Rescuers later explained that the aircraft had been dragged into this position to try and protect the pilot from the flames and had originally come to rest on a more southerly heading. Fire had consumed much of the aluminium and fabric structure forward of the rear cockpit.

Before it came to rest, the aircraft's wings had struck three apple trees which had severely damaged both upper and lower wings on both sides. This had a fortuitous effect since it had slowed the aircraft rapidly before the fuselage could have struck another tree. The total ground slide had been only three fuselage lengths. The propeller had shed about 30 cm of the tip of one blade as it struck the ground, indicating significant power at impact with the hard ground.

The pilot's five-point harness and secondary lap belt were found unfastened in the rear cockpit and several items (apparently from the small baggage compartment behind the pilot's head and covered with a fabric flap secured with velcro) were found scattered on the floor. The pilot appeared to have placed his flying gloves and map down the left side of his seat and, although they were rubbing against the left rudder cable, they did not appear to impede operation of the rudder.

In the front cockpit, the empty seat harness and lap strap were properly secure. The rear cockpit fuel selector was found selected to the No 2 tank (the fuselage tank in front of the front instrument panel). This was the position always used by the pilot, irrespective of the type of flight he intended to perform. This also ensured fuel supply to the engine during inverted flight. There was provision for a second fuel tank to be installed in the upper wing centre section but this was not fitted. The throttles were in the full power selected position, although disruption of the engine mountings meant this was not necessarily the pre-impact selection. The rudder and elevator control circuits were still connected and responded to pedal and stick movement: the aileron linkages were connected to the control stick in the fuselage. The disruption of the wings required a more detailed examination when the aircraft was transported to the AAIB hangar at Aldershot.

Subsequent examination

The severely damaged aileron control runs in the wings were reconstructed. No disconnections were found and all failures were consistent with impact. No obvious signs of control restriction by foreign objects were observed. The rear cockpit altimeter had been set to 1016 mb.

Fire and survivability

The ground impact had been very severe and yet both cockpits seemed to have remained a viable space for survival; there was little distortion of the steel spaceframe structure aft of the engine firewall, although most of the engine mount tubes had fractured. The pilot's seat belt attachments had remained intact, although there was some evidence that his head had struck the instrument panel. The fuselage fuel tank was severely burnt in the fire but did not appear to have been ruptured by the impact: broken fuel lines and gascolator were probably feeding the fire with fuel at a measured rate, which is consistent with witness reports that the fire developed relatively slowly and was difficult to extinguish.

The fire damage to the rear cockpit was much less severe, due to the efforts of the rescuers who poured water over the pilot whilst attempts to extricate him from the wreckage continued. The rudder pedals for the rear pilot are located either side of the front seat. This was significantly affected by fire, resulting in the pilot's feet and lower legs being severely burned.

Analysis

The pilot was properly licensed to conduct the flight and held a valid medical certificate. The aircraft was properly maintained and no technical faults or failures connected to the aircraft structure or its systems were identified.

The accident manoeuvre

Whilst the pilot had demonstrated at altitude his ability to carry out aerobatic manoeuvres, there was no evidence of him having performed them at 300 ft, the estimated height at which he entered the accident manoeuvre.

There was no evidence from any of the witnesses who spoke to the pilot before he departed Rochester Airfield, or those he met at Farthing Corner, that he was going to perform a low-level aileron roll. At some point after departure, the pilot would have had to turn left to return to Rochester but the direct track would not have taken him over the hangars. It is therefore possible that the roll was an impromptu manoeuvre performed to pass over the witnesses at the hangar.

The pilot was aware of the electricity cables running across the airfield and, flying at a height of 300 ft, he was clear of them. His altimeter was set to the Rochester QNH of 1016 hPa and with the height difference in

airfield elevations between Rochester and Farthing Corner of six feet, misinterpretation of the height above the ground at Farthing Corner by sole reference to the altimeter was not considered a factor.

The aircraft was heard accelerating on its approach to the hangars and the entry into the barrel or aileron roll had an upward vector and appeared to be flown properly. The rate of roll described by the witnesses suggested the airspeed was between the 120 mph minimum entry speed and the 140 mph normally used by the pilot. Up to the point where the aircraft became inverted, the manoeuvre appeared normal. When the aircraft became inverted, the nose drop created a downward vector and the subsequent barrelling of the roll suggests that there may have been a loss of airspeed or some degree of disorientation, distraction or partial incapacitation of the pilot. The pilot appears to have attempted to correct the manoeuvre with coordinated use of rudder and elevator, rolling to the nearest horizon and attempting to raise the nose. There was insufficient height, however, for the aircraft to be recovered to safe flight before contacting the tree. There was some evidence of potential loose articles but none was considered to have distracted the pilot.

Safety and survival

The accident was survivable but the pilot suffered life-threatening burns as a result of the fire. Wearing a flame retardant flying suit with gloves and boots, as recommended in the CAA Safety Sense Leaflet, may have reduced the severity of his burns.

The fire did not ignite immediately and had it been possible to extract the pilot without undue delay, he would only have suffered impact injuries. Being trapped in the cockpit may have been due to the aircraft structure pressing on his legs or the secondary lap strap harness holding him in his seat or a combination of both. The fact that the rescuers were not aware of the secondary harness was considered a significant safety issue. The Light Aircraft Association estimate that there are about 200 aircraft which may have dual restraint harnesses.

Safety Recommendation 2009-046

It is recommended that the Civil Aviation Authority and the Light Aircraft Association consider introducing a requirement to install a placard adjacent to the cockpit, advising potential rescuers that the aircraft seats are fitted with more than one restraint harness.

Conclusions

The accident occurred when the aircraft struck the tree as it descended during recovery from a low-level rolling manoeuvre. The pilot had not flown low-level aerobatic manoeuvres previously and had not stated any intention to perform such a manoeuvre. Therefore it could not be established whether this manoeuvre was intentional.

ACCIDENT

Aircraft Type and Registration:	Enstrom F-28A, G-BRZG
No & Type of Engines:	1 Lycoming HIO-360-C1A piston engine
Year of Manufacture:	1973
Date & Time (UTC):	10 May 2008 at 1022 hrs
Location:	Beverley Airfield, East Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to tail rotor, tail rotor drive, and skids
Commander's Licence:	Private Pilot's Licence
Commander's Age:	63 years
Commander's Flying Experience:	81 hours (of which 17 were on type) Last 90 days - 17 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and metallurigical examination

Synopsis

Moments after becoming airborne the pilot experienced difficulty in yaw control. He landed the helicopter heavily a few feet from its takeoff position, but exited the aircraft uninjured. The yaw control system was inspected and several items were subjected to metallurgical examination, however no evidence was found of any pre-existing defects that could have accounted for the yaw control problem.

History of the flight

The pilot intended to make a local flight from Beverley Airfield. Having completed the pre-flight and power checks satisfactorily, he increased power and raised the collective lever. As the helicopter lifted from the ground, it started to yaw to the left, so he immediately started to apply right pedal to compensate. As the helicopter rose slightly higher off the ground it began to yaw to the right. Application of left yaw pedal failed to correct the yaw and the helicopter rotated through 360° before the pilot, fearing a tail rotor malfunction, reduced power and lowered the collective lever fully. The helicopter landed heavily on its skids, in a level attitude. After shutting down the engine, the pilot, who was uninjured, exited via his own door.

The pilot reported that there was a light easterly wind, no cloud and 12 km visibility. This was consistent with the Met Office's aftercast for the airfield at that time.

Aircraft information

The Enstrom F-28A is a piston engine powered helicopter that has been out of production for over 30 years. The two-bladed tail rotor is driven via a driveshaft which has a flexible coupling located just forward of the tail rotor gearbox. A multi-stranded steel cable, which is part of the tail rotor pitch control system, runs external to the fuselage in the region of the tail rotor.

Engineering investigation

One of the tail rotor blades was severely bent inwards and backwards and exhibited a series of regular witness marks consistent with the blade having struck a multi-stranded control cable. The tail rotor could be turned independently of the main rotor and the skids had sustained significant damage in the heavy landing. Further inspection revealed that the tail rotor driveshaft had failed inside the hub of the flexible coupling. There was reportedly no evidence at the scene of any ground marks from the tailskid or tail rotor, and the tailskid was undamaged.

The flexible coupling assembly was examined by a materials specialist. The characteristics of the tail rotor driveshaft fracture were consistent with the shaft having failed in shear due to torsional overload. The material hardness, elemental analysis, and dimensions of the driveshaft and coupling components were found to be satisfactory.

Comment

The failure of the tail rotor driveshaft was consistent with it having failed in overload due to excessive torque, such as might be expected to occur if the tail rotor had struck a substantial object. The badly damaged tail rotor blade had witness marks apparently caused by contact with the tail rotor pitch control cable but it was not clear how the tail rotor blade had come to strike the cable. No pre-existing defects were found which could have accounted for the yaw control difficulties experienced by the pilot.

ACCIDENT

Aircraft Type and Registration:	Robinson R44 Astro, G-YIIK
No & Type of Engines:	1 Lycoming O-540-F1B5 piston engine
Year of Manufacture:	1999
Date & Time (UTC):	21 July 2008 at 1230 hrs
Location:	Delph, near Oldham, Lancashire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Serious) Passengers - N/A
Nature of Damage:	Damaged beyond economic repair
Commander's Licence:	Private Pilot's Licence
Commander's Age:	48 years
Commander's Flying Experience:	360 hours (of which 21 were on type) Last 90 days - 11 hours Last 28 days - 11 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

The pilot lost control of the helicopter, after entering the hover at a private site at Delph, near Oldham, Lancashire. A large change in wind direction caused the aircraft to begin to rotate. The pilot managed to increase the helicopter's height as it continued to rotate. At about 200 ft agl the helicopter stopped rotating and the low main rotor rpm (N_R) warning sounded. The pilot lowered the collective lever and elected to land in a field below. Just before impacting the ground the pilot raised the collective lever to try and cushion the impact. Nevertheless, the pilot was seriously injured and the helicopter was damaged beyond economic repair.

History of the flight

The pilot stated that he was returning to a landing site outside his house at Delph, near Oldham, Lancashire and approached it from the north-east. The site is situated in a valley and is about 885 ft amsl. As he approached the site he noted from the windsock that the wind was from the north-north-west at approximately 20 kt and flew downwind for approximately ½ nm. He turned into wind and approached the site on a north-easterly heading which was his normal approach heading with a northerly wind. Just after entering the hover over the landing site, at approximately 30 ft, he noticed the windsock went vertically upwards and at the same time the helicopter started to rotate clockwise. The pilot responded by applying full left pedal but the rotation

continued. The helicopter started to drift downwind towards some trees while continuing to rotate, so the pilot raised the collective lever fully to increase the helicopter's height. Having climbed to about 200 ft agl the helicopter stopped rotating and was now flying downwind with zero kt IAS. The pilot pushed forward on the cyclic to try to increase the IAS but the low main rotor rpm (N_R) warning sounded (N_R less than 97%), so the pilot lowered the collective to try to increase the N_R. The helicopter subsequently desended rapidly.

The pilot elected to land on a relatively flat area in a field beneath him rather than risk a more dangerous landing on a very steep area further downwind. Just prior to touchdown the pilot raised the collective to cushion the landing. The helicopter landing heavily in an upright attitude before rolling over onto its left side. The pilot was seriously injured but was able to turn off the engine and fuel supply. He was removed from the helicopter about 10 mins after the accident by paramedics from an air ambulance and taken to hospital.

Pilot's comments

The pilot commented that, from his experience, landings can be 'tricky' with the wind from the north-west as the wind tends to 'shift a lot.' He added that he felt he was a little slow in applying the left rudder pedal and did not check the N_R after the low N_R warning sounded.

Weather

An aftercast was obtained from the Met Office. It stated that at the time of the accident the wind at 1,000 ft amsl was likely to have been from 340º/25-32 kt and the surface wind from 320º/15-25 kt. It added that the surrounding terrain could have caused localized rapid changes in the wind's speed and direction.

Discussion

The helicopter entered the hover, out of ground effect, with the wind from the 10 o'clock direction and was subjected to a large wind shift. As a result the pilot lost directional control, possibly due to loss of tail rotor effectiveness (LTE).

The pilot applied full left rudder to counter the rotation and raised the collective to gain height; this over-pitched the main rotor blades causing the N_R to reduce. At approximately 200 ft agl the helicopter was now in the avoid curve with a low N_R. Having tried to regain the N_R by lowering the collective the pilot was committed to landing due to the high rate of descent and insufficient height available to recover to normal flight.

The pilot did not check the N_R after the warning sounded and therefore the amount of N_R decay is unknown. Had he done so, and the N_R had been close to the normal operating range, it would have been an option to lower the collective lever partially, to compensate for the low N_R. This would have reduced the pitch on the main rotor and may have enabled the helicopter to fly away with a reduced N_R before the IAS increased.

ACCIDENT

Aircraft Type and Registration:	Flight Design CTSW, G-CEWT
No & Type of Engines:	1 Rotax 912 ULS piston engine
Year of Manufacture:	2007
Date & Time (UTC):	7 March 2009 at 1200 hrs
Location:	Priory Farm, Norfolk
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Propeller and spinner destroyed, landing gear damaged and minor damage to wingtips
Commander's Licence:	National Private Pilot's Licence (Microlights)
Commander's Age:	56 years
Commander's Flying Experience:	576 hours (of which 23 were on type) Last 90 days - 18 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The pilot flared the aircraft late on touchdown, causing the aircraft to land heavily and the nosewheel to collapse. The aircraft nosed over, becoming inverted but neither occupant was injured.

History of the flight

The pilot, together with a passenger, was on a flight from Old Buckenham Airfield to Priory Farm, a grass airstrip. The weather was good, although there was a crosswind of approximately 10 kt at the destination. The pilot was familiar with the airstrip and stated she flew a normal approach but flared the aircraft late causing it to land heavily. The aircraft touched down on the rear wheels first but with sufficient force to cause the nosewheel to impact the surface and collapse. The aircraft slowed rapidly and gently nosed over, ending up inverted. Neither occupant was injured in the accident and, after making the aircraft safe, the pilot and passenger were able to vacate the aircraft, unaided, through the right door.

AIRCRAFT ACCIDENT REPORT No 2/2009

This report was published on 16 April 2009 and is available on the AAIB Website www.aaib.gov.uk

REPORT ON THE ACCIDENT TO BOEING 777-222, N786UA AT LONDON HEATHROW AIRPORT ON 26 FEBRUARY 2007

Operator:	United Airlines Incorporated
Aircraft Type and Model:	Boeing 777-222
Registration:	N786UA
Location:	London (Heathrow) Airport, UK Latitude: N 051° 29' Longitude: W 000° 28'
Date and Time:	26 February 2007 at 1000 hrs All times in this report are UTC

Synopsis

The aircraft operator's duty manager at Heathrow notified the Air Accidents Investigation Branch (AAIB) of the accident at 1140 hrs on 26 February 2007 and the investigation commenced the next day. The AAIB investigation team comprised:

Mr K Conradi	(Investigator-in-Charge)
Mr N Dann	(Operations)
Mr S Hawkins	(Engineering)
Mr R James	(Flight Recorders)

A preliminary report on the initial findings from the accident was published in AAIB Special Bulletin S2-2007 on 17 April 2007. This formal report contains the final findings and Safety Recommendations from the investigation.

The accident occurred during engine start after pushback from the stand. After the right generator came online an electrical failure occurred in the right main bus. The failure resulted in severe internal arcing and short circuits inside the two main power contactors of the right main bus. The heat generated during the failure resulted in the contactor casings becoming compromised, causing molten metal droplets to fall down onto the insulation blankets below. The insulation blankets ignited and a fire spread underneath a floor panel to the opposite electrical panel (P205), causing heat and fire damage to structure, cooling ducts and wiring. The flight crew responded to the bus failure and a burning smell by shutting down the right engine and taxiing to a nearby stand. The Airfield Fire Service attended the aircraft when it arrived on stand and entered the Main Equipment Centre where they discovered significant smoke but no fire. The passengers were evacuated uneventfully via steps.

The investigation identified the following causal factors:

1. An internal failure of the Right Generator Circuit Breaker or Right Bus Tie Breaker contactor on the P200 power panel inside the Main Equipment Centre resulted in severe internal arcing and short-circuits which melted the contactor casings. The root cause of contactor failure could not be determined.

2. The open base of the P200 power panel allowed molten metal droplets from the failed contactors to drop down onto the insulation blankets and ignite them.

3. The aircraft's electrical protection system was not designed to detect and rapidly remove power from a contactor suffering from severe internal arcing and short-circuits.

4. The contactors had internal design features that probably contributed to the uncontained failures.

Five Safety Recommendations were made.

Findings

1. The aircraft was serviceable and there were no indications of any problems until the right Integrated Drive Generator (IDG) came online after engine start.

2. Within five seconds of the 'No Break Power Transfer', the Bus Power Control Unit (BPCU) detected a fault with the Right Generator Circuit Breaker (RGCB), a Right Main Bus under-voltage was detected, and an unusual 'growling' noise was heard by the flight crew which emanated from the region near the P200 power panel.

3. An 'ELEC AC BUS R' failure caution message appeared on the Engine Indication and Crew Alerting System (EICAS) and the flight crew carried out the checklist items for this message.

4. The RGCB and Right Bus Tie Breaker (RBTB) suffered from severe internal arcing and short circuits which generated temperatures in excess of 1,000°C, and resulted in uncontained failures. The RGCB was probably the first to fail.

5. Molten copper and silver droplets from the failed contactors dropped down through the open base of the P200 panel and ignited the insulation blankets below.

6. The insulation blanket fire spread underneath a floor panel to the opposite P205 power panel, causing heat and fire damage to structure, cooling ducts and wiring.

7. The Main Equipment Centre (MEC) smoke detector was triggered 42 seconds after the electrical failure event.

8. The detection of smoke in the MEC triggered the 'Equipment Cooling Override' mode and displayed a 'EQUIP COOLING OVRD' advisory message to the flight crew but no 'smoke' message.

9. The flight crew first became aware of the smoke four and a half minutes after the

failure event, when the tug driver noticed smoke emanating from one of the MEC vents and notified the flight crew via the interphone.

10. The flight crew decided to shut down the right engine and taxi to a nearby stand in order to evacuate the passengers using the steps.

11. The Airfield Fire Service attended the aircraft when it arrived on stand, entered the MEC and discovered significant smoke but no fire.

12. The insulation blankets had self-extinguished and tests revealed that the insulation had similar flame retardant properties to new insulation of the same type.

13. The RGCB and RBTB contactors had suffered such severe internal damage that it was not possible to determine the initiating point of failure or the root cause of failure.

14. A number of possible causes of contactor failure were considered, but there was insufficient evidence to select a most probable cause of failure.

15. The most likely causes of contactor failure included a debris induced short-circuit, a debris induced fouling of the armature, a loss of over-travel due to heat build-up, erosion and/or assembly errors, and arc tracking across the unprotected region of the stationary contact support block.

16. A number of modifications to the contactor design have been carried out that should make the contactor more resistant to failure and more resistant to an uncontained failure.

17. The electrical protection system was not designed to detect and rapidly remove power from a contactor suffering from severe internal arcing and short-circuits.

18. Since the accident a containment tray modification to the power panel has been developed which could have prevented the molten metal droplets from igniting the insulation blankets.

Safety Recommendations

The following Safety Recommendations have been made:

Safety Recommendation 2009-021

Boeing Commercial Airplanes should consider implementing differential current fault protection of main power contactors when designing future electrical systems.

Safety Recommendation 2009-022

The Federal Aviation Administration, in conjunction with the European Aviation Safety Agency, should consider mandating the replacement of ELM 827-1 contactors with ELM 827-3 contactors on all Boeing 777 aircraft, to reduce the risk of a contactor breakdown that results in uncontained hot debris.

Safety Recommendation 2009-023

Tyco Electronics Corporation should introduce mitigating action to reduce the risk of auxiliary contact

blade failure in ELM 827 and ELM 828 contactors, in order to prevent a broken blade from causing a short-circuit failure.

Safety Recommendation 2009-024

The Federal Aviation Administration, in conjunction with the European Aviation Safety Agency, should mandate that all Boeing 777 aircraft be equipped, at the earliest opportunity, with a software update that will generate a caution message to alert flight crew of the presence of smoke in the Main Equipment Centre.

The aircraft manufacturer responded to this Safety Recommendation by stating:

'Boeing is undertaking a review of system architecture, smoke detection, flight deck indications, and flight crew procedures across all of our production models to ensure a consistent approach to fireworthiness and flight crew indication, and identify safety enhancements that may be warranted. This work will include a review of the "SMOKE EQUIP COOLING" message for 777 passenger aircraft.'

Safety Recommendation 2009-025

The Federal Aviation Administration, in conjunction with the European Aviation Safety Agency, should mandate that all Boeing 777 aircraft be equipped, at the earliest opportunity, with a containment tray below the open base of the P100, P200 and P300 power panels, to prevent any hot debris from a failed contactor from falling on to insulation blankets or other components and causing heat and fire damage.

FORMAL AIRCRAFT ACCIDENT REPORTS ISSUED BY THE AIR ACCIDENTS INVESTIGATION BRANCH

2008

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

Published January 2008.

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

Published January 2008.

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

Published February 2008.

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

Published February 2008.

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

Published April 2008.

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

Published August 2008.

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

Published October 2008.

2009

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

Published January 2009.

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

Published April 2009.

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