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SPORT AVIATION / BALLOONS

ADDENDA and CORRECTIONS

(ALL TIMES IN THIS BULLETIN ARE UTC)

INCIDENT

Aircraft Type and Registration:	Airbus A321-231, G-MIDJ
No & type of Engines:	2 International Aero Engines V2533-A5 turbofan engines
Year of Manufacture:	1999
Date & Time (UTC):	12 July 2006 at 1400 hrs
Location:	Descent towards London (Heathrow) Airport
Type of Flight:	Public Transport
Persons on Board:	Crew - 5 Passengers - 125
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	41 years
Commander's Flying Experience:	10,370 hours (of which 4,694 were on type) Last 90 days - 172 hours Last 28 days - 60 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and company investigation report

Summary

Due to air leaks associated with both air conditioning packs, the packs stopped operating and the cabin altitude rose above 10,000 ft. Crew and passenger masks were used and a normal landing was accomplished at London (Heathrow) Airport.

History of the flight

During the turn round at Glasgow Airport after a flight from London (Heathrow) Airport, the crew and ground engineer noted unusual noises coming from the APU. After discussing the situation, the commander selected the APU off and used an external air source to start the engines. The subsequent takeoff and climb for the return flight were uneventful.

Shortly after commencing descent from FL310 in preparation for the approach to Heathrow, the 'APU BLEED LEAK' caution illuminated followed closely by the 'ENG 1 BLEED LEAK' caution[1]. With the Electronic Centralised Aircraft Monitoring (ECAM) actions completed, the commander advised ATC that the aircraft had a pressurisation problem and was continuing the cleared descent to FL200. He also advised the Senior Cabin Attendant (SCA) of the situation and warned her of the possibility of a rapid descent.

Footnote

1 These cautions indicate that the leak detection loops have detected a temperature of greater than 124°C in the case of the APU bleed leak and 204°C (with the appropriate engine running) for the engine bleed leak.

The co-pilot continued as the handling pilot while the commander reviewed the information in the Quick Reference Handbook (QRH) and the ECAM. He noted that both air conditioning packs were indicating off and that the cabin altitude was indicating a vertical speed increase of approximately 1,000 ft/min. Both pilots donned their oxygen masks as the cabin altitude reached an indicated 10,000 ft. The 'CAB PR EXCESS CAB ALT' warning illuminated and the co-pilot declared a 'PAN' while the commander commenced the ECAM actions. With the cabin altitude continuing to climb, the commander deployed the passenger oxygen masks.

By then, ATC had cleared the aircraft to descend to FL100 and the pilots completed the relevant ECAM actions. After a further descent to FL80, the pilots reviewed the situation and removed their oxygen masks. The commander then briefed the SCA that it was now safe for the passengers to remove their oxygen masks and that he planned to carry out a gentle descent towards Heathrow. The flight crew agreed that the co-pilot, who was very experienced on type, would continue as handling pilot for a normal approach and landing and would maintain a descent of about 700 ft/min. ATC provided appropriate radar vectors commensurate with the desired descent rate and a normal landing was achieved on Runway 27 Left. Once clear of the runway, the aircraft was stopped and communication was established with the AFRS on frequency 121.6 MHz. With no indication of any other problem, the aircraft was cleared to taxi to a stand where the passengers disembarked normally.

Throughout the incident, the commander and SCA made regular PA announcements to the passengers updating them on the situation.

Company actions

After the incident, checks were carried out on the aircraft pressurisation system. The aircraft had been experiencing bleed problems for some time prior to the incident. The problems were first reported on 28 June 2006 but since then, the reported problems had been intermittent and inconsistent. Each event had been investigated and had resulted in either no fault being found or in components being replaced.

Following the incident on 12 July, air leaks were found associated with both air conditioning packs. During the ground checks, other defects were noted that may have contributed to the incident; these defects were rectified by the replacement of No 2 engine bleed, its shut-off valves and the engine transducer. Additionally, the appropriate seals on both engines were replaced and satisfactory leak checks were completed. Thereafter, engine ground runs were carried out to confirm the proper functioning of the pressurisation system. The defect on the APU was investigated and attributed to a fault with an oil pressure switch which was replaced.

Following the release of the aircraft back to service, it was monitored closely for one month with no recurrence of any pressurisation problem.

INCIDENT

Aircraft Type and Registration:	Boeing 747-443, G-VLIP
No & type of Engines:	4 CF6-80C2B1F turbofan engines
Year of Manufacture:	2001
Date & Time (UTC):	5 July 2006 at 0905 hrs
Location:	Taxiway Lima, London (Gatwick) Airport
Type of Flight:	Public Transport (Passenger)
Persons on Board:	Crew - 18 Passengers - 289
Injuries:	Crew - None Passengers - None
Nature of Damage:	Trailing edge skin of right winglet damaged
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	34 years
Commander's Flying Experience:	8,000 hours (of which 6,500 were on type) Last 90 days - 209 hours Last 28 days - 75 hours
Information Source:	Aircraft Accident Report Form submitted by the operator

Synopsis

The right wingtip of the aircraft collided with a blast fence when the aircraft was pushed back into an area of taxiway with insufficient clearance for its wingspan. This and other large aircraft types were prohibited from parking on stands in this area but not from pushing back onto the taxiway adjacent to them. One safety recommendation was made.

History of the flight

The aircraft was parked on Stand 36 Middle at Gatwick Airport prior to departure on a scheduled passenger flight to Antigua, West Indies. The flight crew contacted Ground Movement Control (GMC) to request permission to push back from the stand and start engines. GMC instructed the aircraft to push back and requested that a "long push" be conducted to allow an approaching aircraft to manoeuvre onto the stand as soon as it was vacated.

The pushback was conducted by five ground personnel. Two 'wing walkers', responsible for observing wingtip clearance, a tug driver and a driver's assistant were provided by a ground handling organisation contracted to the aircraft operator. A ground engineer employed by the operator also attended the pushback and was able to communicate with the flight crew using a headset.

During the pushback the wing walkers accompanied the aircraft until it crossed the line indicating the boundary between the stand and the taxiway. The pushback then proceeded with the engineer facing the aircraft and walking beside the nose wheel. The tug driver continued to push the aircraft clockwise along Taxiway Lima towards a position abeam Stand 37 until he was satisfied that G-VLIP was clear of the aircraft which was approaching the vacated stand. Upon confirmation that the pushback was complete the commander applied the parking brake and the engineer gave permission to the tug crew to disconnect the towbar and return to the stand. The flight crew then completed their taxi checks and the engineer unplugged his headset from the aircraft and returned to the stand.

After confirming with the engineer by hand signal that the nosewheel steering bypass pin had been removed, the flight crew requested taxi instructions from GMC. At that moment the flight crew received an interphone call from a cabin crew member stating that the right wing tip had collided with the blast fence located alongside the taxiway. This had been noted by a passenger sitting in a window seat on the right hand side of the aircraft. The flight crew cancelled the taxi request, advising GMC that the aircraft had a technical problem, and arranged for the engineer to return to the aircraft to confirm the collision.

The engineer confirmed that the wing tip had collided with the blast fence. A local emergency was initiated by GMC and the incident was attended by the Aerodrome Fire and Rescue Service and police. The aircraft was then towed to Stand 34 where the passengers disembarked.

Damage to aircraft

The trailing edge of the right winglet had sustained skin damage in its collision with the blast fence. An inspection of the surrounding structure revealed no further damage and the aircraft was returned to service after repair.

Airport information

Stands 31 to 38 are arranged around the circular head of Pier 3, which is located at the north-west end of a spur attached to the South Terminal at Gatwick Airport (see Figure 1). To increase parking flexibility, each stand has Left (L) and Right (R) parking positions, which can be occupied simultaneously by narrow-body aircraft, and a Middle parking lane which is used by single wide-body aircraft. Aircraft manoeuvre to and from the stands via Taxiway Lima, which runs circumferentially around the Pier 3 apron area. The north-east segment of this taxiway is bounded by a blast fence which protects adjacent roadways and buildings.

The edition of the UK Aeronautical Information Package (AIP) current at the time of the incident stated:

> *'Operators of aircraft with wingspans in excess of 61 m must not use Taxiway Lima beyond stand 36 to access stands 37 and 38.'*

Aircraft were not specifically prohibited from pushing back onto the taxiway adjacent to Stands 37 and 38.

Pedestrians were not permitted to enter the taxiway area from the apron associated with each stand. However, ground handling staff involved in aircraft pushback operations were not specifically precluded from entering the taxiway in the course of their duties. Nevertheless, the general prohibition on pedestrians entering this area was widely interpreted to mean that 'wing walkers', for example, were not allowed to do so. Consequently, the 'wing walkers' involved in the pushback of G-VLIP did not leave the stand area and were not able to give guidance to the tug crew as the right wing tip approached the blast fence.

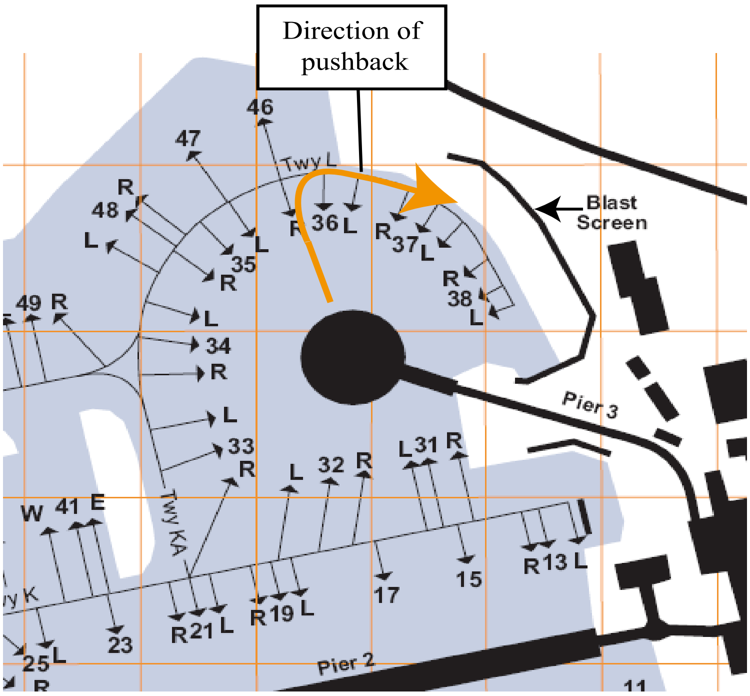


Figure 1

Pier 3, Stands 31-38 and blast fence

Pushback operations

Tug Driver

Tug drivers will commence pushback on receipt of a 'brakes released' signal from the engineer. The tug will then push the aircraft along the stand centreline until the aircraft is clear of the apron and can be manoeuvred onto the taxiway centreline. If requested to accomplish a long push the tug will continue to push the aircraft backwards along the taxiway until the driver has determined that there is sufficient room for another aircraft to turn in front of it and enter the vacated stand. There are, however, no markings on the ground or elsewhere to indicate how far the aircraft should be pushed to achieve this. On completion of the pushback the parking brakes of both the tug and the aircraft are applied and, on instruction from the flight deck, the towbar is disconnected from the aircraft and the tug and towbar are driven back to the apron. The principal duty of the tug driver's assistant is to disconnect the towbar from the aircraft.

The aircraft fuselage was positioned over the taxiway centreline when the wingtip collided with the blast fence.

Engineer

Engineers communicate with the flight crew via a headset plugged into a receptacle on the aircraft nose gear leg. When the flight crew confirm that the aircraft parking brake has been released, the engineer will communicate this to the tug driver and the pushback will begin. During the pushback the engineer will supervise aircraft engine starting. When the pushback is complete the tug driver will communicate this to the engineer who will in turn notify the flight crew and request that the aircraft parking brake be set. When instructed to do so by the flight crew, the engineer will disconnect the headset, remove the steering bypass pin and move to one side of the aircraft to confirm its removal to the flight crew. This completes his involvement in the pushback operation.

The engineer stated that on this occasion he had positioned himself on the left of the aircraft (ie on its port side) during the pushback because this would allow him to see the left wing tip as it passed behind the aircraft parked on Stand 37. He could not see the right wing tip from this position.

Wing walkers

The 'wing walkers' accompanied the aircraft until it crossed the boundary between the stand and the taxiway but, in accordance with the accepted interpretation of Airport Regulations, they did not enter the taxiway. The aircraft operator reported that when it asked for clarification of this point the airport operator stated that it would not object to 'wing walkers' entering the taxiway while carrying out their duties as part of the pushback team.

Ground Movement Control

At the time of the incident, although controllers were not permitted to allocate Stands 37 and 38 to certain aircraft types (including the Boeing 747-400), pushing such aircraft into the area of these stands was not expressly prohibited.

Perception of collision risk

Neither the flight crew nor the ground personnel involved in the pushback were aware that the wing tip had collided with the blast fence. The operator considered that the sweep of the aircraft wing together with the slope of the blast fence would make it difficult for an observer positioned at the front of the aircraft to determine the distance between the aircraft wing tip and the blast fence.

The passenger who alerted the cabin crew to the collision occupied seat 50K, a window seat on the right hand side of the cabin in line with the right wing tip.

Conclusion

The collision occurred when the aircraft was pushed back into an area of Taxiway Lima where insufficient clearance existed between the blast fence and the taxiway centreline to accommodate its wingspan. The pushback was conducted in accordance with standard procedures and the request to conduct a long push onto the taxiway area adjacent to Stands 37 and 38 was not specifically prohibited by existing local instructions. The tug driver had no means of determining when the extremities of a particular aircraft type had entered this area.

Follow-up action

On 5 July 2006 the airport operator issued a Managing Director's Instruction to all operators of large aircraft and all handling agents prohibiting pushbacks into the area of Stands 37 and 38.

> *'Aircraft with wingspan of 61 m or more (this includes B747) on Lima must not be pushed back beyond stand 37R.*

On 7 July 2006 the ground handling organisation published an instruction to all tug drivers, driver's assistants and 'wing walkers' prohibiting long pushbacks of Boeing 747 and Airbus A330 and A340 aircraft, adding:

> *'If at any time you feel that what you are being requested to do is an unsafe practice, do not hesitate to question the procedure.*
>
> *'As a guide to tug drivers, do not push the nose wheel of any wide bodied aircraft past the 36L lead in arrow, but pull forward to straighten up if necessary.'*

On 18 July 2006 the aircraft operator published the following internal notice stating:

> *'With immediate effect, long pushbacks from parking stand 36 are no longer approved. This is due to the restricted wing tip clearance between parking stands 37, 38 and the blast fence located on the opposite side of the taxiway L'.*
>
> *'Crew should no longer be requested by Ground Movement Control (ATC) to conduct a "long push" from this stand. Any request to do so should be queried with the Ground Movement Controller.'*

The aircraft operator reported that members of ground staff involved in pushback operations remained under the impression that they were prohibited from entering the manoeuvring area. 'Wing walkers' perform an important role in the safe manoeuvring of large aircraft.

Consequently, the following recommendation was made:

Safety Recommendation 2006-137

It is recommended that Gatwick Airport Limited should issue a Managing Director's Instruction or equivalent notice advising all operators and handling agents that:

a. Ground staff involved in pushback operations may enter the manoeuvring area adjacent to stands to the extent necessary to provide position guidance.

b. During pushback operations the nosewheel of any wide-bodied aircraft should not be pushed rearwards beyond the Stand 36L lead in arrow.

ACCIDENT

Aircraft Type and Registration:	Cessna 182P, G-BTHA
No & type of Engines:	1 Continental O-470-R piston engine
Year of Manufacture:	1979
Date & Time (UTC):	24 October 2006 at 1645 hrs
Location:	Approach to Runway 27 at Liverpool Airport
Type of Flight:	Private
Persons on Board:	Crew - 1 Passenger - 1
Injuries:	Crew - 1 (Serious) Passenger - 1 (Serious)
Nature of Damage:	Right wing detached, aircraft and engine extensively damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	71 years
Commander's Flying Experience:	534 hours (of which 335 were on type) Last 90 days - 9 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and AAIB inquiries

Synopsis

The pilot, who was blinded by the winter sun, flew into an approach light stanchion that was sited approximately ½ mile from the runway threshold.

History of the flight

On the day of the accident the pilot planned to fly from Liverpool to Wolverhampton, then on to Shobdon and back to Liverpool. The pilot reported that the first two legs, and landings, were uneventful and on returning to Liverpool Airport he received a VFR clearance from the Approach Controller to enter the Liverpool zone. After holding for approximately 10 minutes at Helsby Hill he was cleared to join the circuit on base leg for an approach to Runway 27. The pilot was then transferred to the Tower frequency and, once on finals, was given clearance to land.

The pilot states that as he flew the approach he was blinded by the sun and had difficulty seeing the runway and, therefore, attempted to fly the aircraft along the path of the approach lights. He also found that the visibility was better by flying lower than normal. The pilot considered going around, but approximately half way down the approach he sighted the 'piano keys' and decided to continue the approach using them as his reference point. However, it was not until a late stage on the approach that he was able to see the lights on the PAPIS, which were all red. The pilot, realising that he was very low, applied full power and attempted to climb away. Despite his efforts the aircraft struck and uprooted a 30 foot high wooden stanchion on which one of the approach lights was mounted. Ground marks indicated that the aircraft then struck the ground before hitting and uprooting a second stanchion. During the impacts the right wing was detached and the aircraft came to rest facing back up the approach. The aircraft was extensively damaged and both the pilot and passenger sustained serious injuries.

Report from ATCO

The ATCO on duty reported that he could not see G-BTHA when he cleared the pilot to land, but did establish from the air traffic monitor that the aircraft was three miles out on the final approach. When the ATCO next checked the position of G-BTHA he noted that whilst the aircraft was low the approach appeared to be stable. This did not cause the controller any concern as he was used to seeing training aircraft flying a variety of landing profiles. The controller attended to other aircraft on the airfield and when he looked back towards the approach, G-BTHA was less than half a mile from the threshold and still very low. The controller continued to monitor the progress of the aircraft and when it descended to what he considered was a dangerous height (tree level) he activated the crash alarm; the controller stated that he did not try and contact the pilot as he did not wish to distract him at this late stage of the flight. The aircraft then disappeared from sight and at the same time the captain of a commercial aircraft, which was at hold Golf waiting for takeoff clearance, informed the controller that the aircraft had crashed. The controller immediately instructed a second aircraft which had been following G-BTHA on the approach, to go-around. With depleted fire cover all aircraft movements were halted and the airfield was closed until 1740 hrs. The airfield emergency services were quickly on the scene of the accident and confirmed that the aircraft had crashed and there were two casualties with serious injuries.

Comment

The pilot had a valid medical certificate that had been issued six weeks before the accident and his revalidation check flight was valid until 28 August 2007. He stated that he did not appreciate how poor the visibility towards the sun was until he turned on to finals. He had set the airfield QFE on his altimeter, but deliberately flew the aircraft lower than normal without reference to the altimeter because he believed that the visibility was better and the ‘piano keys’ would gave him a suitable visual reference by which to fly the approach. In retrospect, the pilot believes that he should have gone around and held off until the sun had settled below the horizon.

ACCIDENT

Aircraft Type and Registration:	Cessna A152 Aerobat, G-FLAP
No & type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1979
Date & Time (UTC):	15 September 2006 at 0915 hrs
Location:	Sandtoft Airfield near Scunthorpe, Lincolnshire
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Nose landing gear collapsed, propeller, engine, left main landing gear damaged, fuselage distorted
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	27 years
Commander's Flying Experience:	1,520 hours (of which 1,430 were on type) Last 90 days - 170 hours Last 28 days - 16 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft encountered a downdraft on final approach and landed heavily. The downdraft was probably caused by disturbance of the surface airflow over industrial units upwind of the final approach track.

History of the flight

The instructor was accompanied on his first flight of the day by a student preparing for his first solo flight. The instructor was demonstrating the circuit pattern because the student had not previously operated from the runway in use, Runway 05 Left. The surface wind was from 360º at 10 to 15 kt. The circuit was uneventful until, on final approach, conditions became "slightly bumpy" as the aircraft descended through a height of approximately 80 ft, maintaining a drift angle of between 5º and 8º. At this point the instructor judged that the aircraft was above the ideal approach path, having an aiming point approximately 215 m beyond the touchdown threshold. Therefore, he reduced power to increase the rate of descent whilst maintaining the target airspeed of 65 kt. Simultaneously the aircraft encountered a downdraft and descended rapidly. Before the instructor could take corrective action, the aircraft's nosewheel struck a barbed wire fence in the Runway 05 undershoot. The collision partially arrested the aircraft and caused it to touch down very firmly on the runway in a nose-down attitude.

The impact displaced the nose landing gear rearwards, allowing the propeller to hit the asphalt runway surface. The main landing gear legs were also displaced causing local deformation of the fuselage structure. The uninjured occupants were able to disembark without assistance and there was no fire.

Discussion

Before the accident the aircraft was in constant use and had been flown frequently by the same instructor without incident. There was no evidence of pre-existing mechanical defects which could have contributed to the accident.

The instructor considered that the downdraft was caused by disturbance of surface airflow over industrial units to the north and north-west of the airfield. He commented that in future he would conduct the first approach of the day with more caution, aiming for a higher approach path and a touchdown further along the runway in order to increase the margin of safety while assessing the wind conditions.

Buildings and steeply undulating terrain upwind of an aerodrome can cause turbulence, updrafts and downdrafts. Guidance on local conditions can normally be obtained from the aerodrome operator. Information about conditions affecting flight safety which occur at an aerodrome when specific wind conditions exist should be published in the UK Aeronautical Information Package (AIP). However, the AIP entry for Sandtoft contains no such information and neither the flying instructor involved in the accident nor pilots with local experience considered the approach to Runway 05 to be notably affected by unusual surface wind conditions.

Where buildings or local topography result in turbulence close to the normal landing threshold, it may be possible, as the instructor suggested, to minimise the effect of such turbulence by touching down further along the runway. Pilots must ensure, however, that sufficient runway remains beyond the likely touchdown point in which to stop the aircraft safely.

ACCIDENT

Aircraft Type and Registration:	Fuji FA-200-160, G-FEWG
No & type of Engines:	1 Lycoming O-320-D2A piston engine
Year of Manufacture:	1973
Date & Time (UTC):	22 June 2006 at 1645 hrs
Location:	Near Grantham, Lincs
Type of Flight:	Private
Persons on Board:	Crew 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to propeller
Commander's Licence:	Private Pilot's Licence
Commander's Age:	32 years
Commander's Flying Experience:	613 hours (of which 9 were on type) Last 90 days - 101 hours Last 28 days - 24 hours
Information Source:	AAIB Field Investigation

Synopsis

Following the onset of severe vibration, the pilot carried out a successful forced landing at a military airfield. Examination of the aircraft revealed that the outer six inches of one propeller blade were missing. The failure was associated with the development of a fatigue crack across approximately two thirds of the blade chord. Damage, minor in nature when compared to that typically found on in-service propellers, was identified on the blade leading edge very close to the origin of the crack.

History of the flight

Whilst in a gentle descent, just to the north of Grantham, during the latter stages of a flight from Turweston to Temple Bruer (approximately 2.5 nm NNW of RAF Cranwell), the aircraft was passing 1,900 ft when it suddenly began to shake violently. Suspecting a catastrophic engine failure, the pilot immediately retarded the throttle and mixture controls and initiated a turn into wind, whilst transmitting a MAYDAY call to Cranwell. It was difficult for him to read the engine instruments because of the severe vibration, but, so far as he could tell, the temperatures and pressures were all within normal limits. In light of this, the pilot suspected a propeller problem and decided to shut down the engine and switched off both magnetos. However, the propeller continued to windmill and the shaking and vibration continued.

After completing his turn into wind, with the intention of landing in a field, the pilot received a call from Cranwell informing him that the airfield at Barkstone Heath was 'in his 2 o'clock'; it was actually behind him at that stage but, upon checking its position visually, he found himself looking straight down Runway 06. He knew that it was some 1,800 m in length and therefore decided to carry out a downwind gliding approach to land on this runway. The approach was carried out without incident, using first-stage flap earlier than normal to compensate for his excess height, and the touchdown was executed at slightly higher indicated air airspeed than normal. Although the brakes were not used during the landing roll, because the pilot was unsure if there had been any damage caused by the vibration, the aircraft came to rest with some 500-600m of runway remaining. Upon vacating the aircraft it became apparent that approximately six inches was missing from the tip of one of the propeller blades. It was subsequently noted that two of the exhaust pipes were loose at their manifold attachments but, in other respects, the aircraft appeared undamaged.

Propeller history

The pilot reported that the aircraft had been serviceable prior to the flight. During his pre-flight inspection of the propeller he saw no signs of cracking and recalled that the leading edges were fairly clean and were certainly not nicked to any large extent.

The maintenance organisation for the aircraft reported that the propeller in question[1] was fitted by an approved organisation as a new component on 11 February 1987, at 4,853 airframe hours, after which the aircraft did not fly until February of the following year. During the next 10 years, the aircraft underwent a series of unexceptional 50 hr, Annual, and Star Annual inspections. The logbook shows no specific reference to the propeller during this period, except for an entry during the 1996 Star Annual inspection at 5,161 hrs, stating '*Attached propeller dynamically balanced to 0.2 IPS*'. In March 1999, with the propeller by that time having accumulated some 673 hours, the aircraft was put into storage. A subsequent logbook entry made during a Star Annual Inspection records that its leading edges had been dressed. The propeller subsequently accumulated a further 43 flying hours up to the time of the failure, making a total of 716 hours since new.

Propeller examination

The condition of the propeller generally, and of the leading edge regions in particular, appeared excellent with very little of the 'stone chip' damage typically seen on propellers which have been in service for some time. The propeller was taken for detailed examination to the AAIB facilities at Farnborough, where the section of the tip containing the fracture was excised. This was then taken to a specialist laboratory for more detailed metallographic examination, including optical and scanning electron microscopy. Here, it was established that the propeller had failed as a result of a fatigue crack, the origin being very close to the leading edge. The crack had propagated across the blade over a distance of approximately two thirds of its chord towards the trailing edge, before the remaining section failed in overload. The characteristics of the crack indicated that it had probably been propagating for a period of time well in excess of the duration of the subject flight.

Examination of the origin region under high magnification revealed a very small flattened area of the outer surface, close to the origin, within which shallow scrape marks were evident. This was consistent with there having been a very small bruise on the leading edge at this location. The size and topography of this feature, in

Footnote

1 Macauley Pt. No. IC172/MGM 7656 S/N GE006 (Batch No. 120668)

terms of its stress-raising potential, was very small when compared with the damage typically found on in-service propellers. To date, it has not been possible to determine why this apparently trivial damage appears to have initiated a crack in this case. Investigation of the failure, and of the material properties in particular, continues. An addendum will be issued in a future AAIB Bulletin should the underlying cause of the fatigue crack be positively determined.

ACCIDENT

Aircraft Type and Registration:	Glos-Airtourer Super 150, G-AZHI
No & type of Engines:	1 Lycoming O-320-E1A piston engine
Year of Manufacture:	1971
Date & Time (UTC):	20 October 2006 at 1545 hrs
Location:	1 mile north of Leeds Castle, Kent
Type of Flight:	Private
Persons on Board:	Crew -1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Starboard upper engine cowl missing, scratched windscreen and puctured elevator skin and tailplane leading edge
Commander's Licence:	Private Pilot's Licence
Commander's Age:	31 years
Commander's Flying Experience:	250 hours (of which 112 were on type) Last 90 days - 12 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Prior to the flight the pilot carried out an 'A' Check on the aircraft which required the opening of both upper engine cowls. Following the check he closed the cowls and recalls securing all the over-centre cowl latches. After levelling off, following some aerobatic manoeuvres, the upper right engine cowl became unlocked and after a few seconds departed the aircraft. The cowl was recovered and, together with the aircraft, was examined by a licensed aircraft engineer. The engineer could find no evidence of distress or damage on the three over-centre latches or the latch receivers.

History of the flight

Prior to the flight the pilot, who was part owner of the aircraft, carried out an 'A' Check during which he opened both upper engine cowls. After checking the engine oil contents, using the dipstick located on the right side of the engine, he closed the right upper engine cowl and recalls securing all three over-centre cowl latches.

The purpose of the flight was to practise some aerobatic manoeuvres. Having carried out a number of manoeuvres, the pilot levelled the aircraft at 3,000 ft, with an airspeed of about 120 kt. At this point the right upper engine cowl became unlatched and started to oscillate violently between fully open and fully closed. The pilot immediately cut the engine power and raised the aircraft's nose to reduce the airspeed. After about 5 seconds the cowl departed from the aircraft, struck the windscreen and disappeared from the pilot's view. The pilot made an RTF PAN call and successfully returned to his departure airfield and landed. He noted that the accelerometer mounted on the instrument panel indicated +3g and -1g.

Engineering examination

The engine cowl was recovered and, together with the aircraft, was examined by a licensed aircraft engineer. The engineer could find no evidence of distress or damage on the three over-centre latches or the latch receivers. The engineer informed the AAIB that the aircraft was booked in to have a scheduled maintenance check two weeks after the accident. Part of that maintenance check was to upgrade the upper engine cowl fasteners.

INCIDENT

Aircraft Type and Registration:	Grumman AA-5, G-BLFW
No & type of Engines:	1 Lycoming O-320-E2G piston engine
Year of Manufacture:	1975
Date & Time (UTC):	5 November 2006 at 1105 hrs
Location:	Old Sarum Airfield, Salisbury
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Nose landing gear bent, small bend in propeller, and minor damage to structure
Commander's Licence:	Private Pilot's Licence
Commander's Age:	45 years
Commander's Flying Experience:	113 hours (of which 17 were on type) Last 90 days - 6 hours Last 28 days - 0 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

After making a slightly fast approach in light wind conditions, the aircraft landed long, failed to stop and passed at relatively low speed through a barbed wire fence at the airfield boundary.

History of the flight

When approaching Old Sarum Airfield from the south, at the conclusion of his journey from Draycott Farm, Swindon, the pilot turned west before initiating a base leg join for Runway 06. In response to his base leg call to the airfield, he was passed information that confirmed Runway 06 was active and that the wind was 'light and variable'. His airspeed at this stage was about 10 mph higher than normal so, on final approach, he selected full flap and reduced power. The pilot realised at this time that he would land long but did not consider that it would be overly long and therefore continued his approach. However, after landing, the aircraft did not decelerate as expected and full braking was applied. The pilot reported that from this point on, everything happened very quickly. Despite the application of full braking, he realised that he would not stop before reaching the airfield boundary. Judging it too late at that point to apply power and go-around, he tried to 'zigzag' whilst braking hard in an effort to slow the aircraft. He limited these attempts out of a concern that they could cause the aircraft to turn over. Shortly after straightening the aircraft again, it broached a small barbed wire fence at the airfield boundary and continued, at relatively low speed, across a small access road beyond the fence. It finally came to rest against an earth bank on the far side of the road. The impact with the bank was not severe, and neither occupant was injured. After switching both the master and magneto switches to OFF, the canopy was opened without difficulty and both occupants vacated the aircraft normally.

The pilot attributes the accident to a deeper than normal touchdown, due to lack of wind, combined with a late realisation of his predicament, by which time it was too late for him to effect a go-around. He believes that if he had made an earlier decision to go-around, the accident could have been avoided.

ACCIDENT

Aircraft Type and Registration:	Jodel D112, G-BHKT
No & type of Engines:	1 Continental A65-8F piston engine
Year of Manufacture:	1964
Date & Time (UTC):	5 November 2006 at 1215 hrs
Location:	Clipgate Farm, Lodge Lees, Denton, Canterbury
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Aircraft seriously damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	55 years
Commander's Flying Experience:	571 hours (of which 80 were on type) Last 90 days - 10 hours Last 28 days - 3.3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft landed approximately one third of the way down the runway and at a higher than normal speed. After initial braking, the pilot realised that he had insufficient distance available to stop and attempted to go-around. The aircraft failed to get fully airborne and passed through the airfield boundary hedge at high speed. It came to rest inverted in an adjacent field and the pilot was able to exit the aircraft unaided through the aircraft's damaged canopy.

History of the flight

After establishing the aircraft on final approach for Runway 20 at Clipgate Farm, the pilot realised that he was approximately 50 ft lower than normal and increased power to re-establish the correct approach path. The aircraft encountered some sinking air as it passed over a wooded area and the pilot responded with a further increase of power. However, this resulted in the airspeed rising to 55 kt, 10 kt faster than the normal approach speed. The aircraft touched down at 50 kt, approximately one third of the way down the runway. Initially the pilot believed that the aircraft could be brought to a halt in the remaining distance and applied the brakes. As the aircraft slowed, he realised that it was not going to stop before the end of the runway and applied full power to go-around. The aircraft failed to get fully airborne and passed through the boundary hedge at high speed, coming to rest inverted in the adjacent field. The pilot made his escape through a hole in the aircraft's canopy, having suffered mild concussion and bruising.

In a full and frank report the pilot stated that, in his opinion, the accident was the result of a delayed decision to go-around following a fast approach and late touchdown.

ACCIDENT

Aircraft Type and Registration:	Morane Saulnier Rallye 235E, G-MELV
No & type of Engines:	1 Lycoming O-540-B4B5 piston engine
Year of Manufacture:	1981
Date & Time (UTC):	24 August 2006 at 1130 hrs
Location:	New road, ½ mile south of Leominster, Herefordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Severe damage to both wings and landing gear
Commander's Licence:	Private Pilot's Licence
Commander's Age:	68 years
Commander's Flying Experience:	1,207 hours (of which 186 were on type) Last 90 days - 4 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The pilot unintentionally landed on a road which he had misidentified as Shobdon's Runway 27. The aircraft ran over a speed bump which caused the aircraft to veer off the road and hit a lamp post and a tree.

History of the flight

The pilot was on a cross-country flight from Coventry to Shobdon Aerodrome. The weather was good with a visibility greater than 10 km, a cloud base of 3,000 ft, and a northerly wind of 15 to 20 kt. The pilot had not recently flown to Shobdon and had only landed there three times in his previous 27 years of flying. On approaching Shobdon he contacted Shobdon Radio and discovered that there were three other aircraft and a microlight also on approach to the airfield. Runway 27 (paved) was in use, with a landing distance available of 842 m and a width of 18 m. When the pilot believed that he had the runway in sight he manoeuvred the aircraft to enter the circuit on a left base for Runway 27 and announced his intentions over the radio. Once on final approach he reported 'finals' but did not receive a reply. The 'runway' ahead was clear so he proceeded with the landing. When close to touchdown the pilot noticed that the airfield was different from what he remembered. After touching down, the pilot noticed a kerb to the side and lamp posts to his left. The pilot had unintentionally landed on a new road that had not yet been opened. Shortly after touching down, the aircraft ran over a speed bump which caused it to veer left and leave the road. The left wing hit a small tree and the right wing hit a lamp post, causing the right wing to shear off almost completely. Once the aircraft came to rest the pilot was able to exit unassisted via the sliding canopy.

The road that the aircraft had landed on was 4 nm east of Shobdon airfield. It was approximately 600 m long and was positioned in the same east-west direction as Runway 27 at Shobdon. The road was closed with concrete blocks and gates positioned at each end.

Pilot's assessment of the cause

The pilot reported that he misidentified the road for the runway because of its similar length and orientation.

ACCIDENT

Aircraft Type and Registration:	Pierre Robin DR400/180, G-LARA
No & type of Engines:	1 Lycoming O-360-A3A piston engine
Year of Manufacture:	1991
Date & Time (UTC):	31 July 2006 at 1815 hrs
Location:	Private grass airfield, Hayling Island, Hampshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to left wing and left tailplane
Commander's Licence:	Private Pilot's Licence
Commander's Age:	56 years
Commander's Flying Experience:	597 hours (of which 550 were on type) Last 90 days - 18 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft veered left on landing and was damaged.

History of the flight

After touchdown the aircraft veered left. The left wing tip struck a bank which caused the aircraft to veer further left, resulting in the left wing and left tailplane striking some fence posts. Once the aircraft came to rest the pilot was able to exit normally. The pilot reported that the accident may have been caused by wind shear or by his misjudgement.

ACCIDENT

Aircraft Type and Registration:	Piper PA-18-150 Super Cub, G-BAKV
No & type of Engines:	1 Lycoming O-320-A2B piston engine
Year of Manufacture:	1972
Date & Time (UTC):	6 September 2006 at 0930 hrs
Location:	Thruxton Airfield, Hampshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Propeller, engine, right wing strut and vertical stabiliser damaged
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	46 years
Commander's Flying Experience:	300 hours (of which 5 were on type) Last 90 days - 45 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The pilot attempted to go around from an unsatisfactory approach by opening the throttle rapidly. The engine did not respond immediately, probably because carburettor heat was selected causing the engine to rich cut. The pilot then attempted to land the aircraft but during the landing ground roll the engine responded to the throttle which had remained open. The aircraft accelerated, departed the left-hand edge of the runway, somersaulted and came to rest inverted.

History of the flight

The pilot was in the process of converting his NPPL[1] to a PPL and had decided to conduct the required flying training on a tailwheel aircraft, because he intended to own and operate an aircraft with this landing gear configuration. His total experience on tailwheel types was the five hours training he had completed on this Super Cub. On the morning of the accident he flew with an instructor for 45 minutes, during which he completed six takeoffs and landings. He then went solo.

The pilot considered that his first solo landing on the tarmac Runway 25 was satisfactory. On the second approach, judging that the aircraft was slightly low, he opened the throttle momentarily in order to remain airborne until crossing the landing threshold. During the landing flare the aircraft ballooned slightly and the

Footnote

[1] National Private Pilots Licence, a licence issued by the UK CAA which accords restricted privileges.

pilot decided to go around rather than attempt to recover the approach. When he advanced the throttle rapidly, however, the engine "spluttered" but did not produce more power. He pushed forward on the control column in order to lower the nose and maintain airspeed, and the aircraft landed in what observers considered to be a normal three-point attitude. As it did so, the engine started to deliver more power. The aircraft then accelerated and was seen to swerve before departing the left-hand edge of the runway, in a nose-down attitude, onto the adjacent grass taxiway. The propeller struck the grass and the forward momentum of the aircraft caused it to somersault and come to rest inverted. The uninjured pilot vacated the aircraft without assistance using the entrance door on the right-hand side of the fuselage. The AFRS attended shortly afterwards but there was no fire.

Meteorological information

The surface wind reported at the time of the accident was from 270º at 8 kt with visibility in excess of 10 km and no cloud below 5,000 ft.

Aircraft information

The Super Cub is a two-seat high-wing monoplane with tailwheel landing gear. Aircraft in this configuration, where the CG is behind the main landing gear, are less stable on the ground than those with a tricycle undercarriage. If the aircraft begins to yaw on the ground a swing will develop if uncorrected. An over-correction will cause a swing in the opposite direction, which itself must be positively corrected. The correct technique for directional control on the ground can be learned with practice.

The engine is conventional and simple to operate but it is susceptible to a rich cut[2] in certain circumstances, particularly if the throttle is opened abruptly with carburettor heat selected.

Discussion

The pilot commented that, when the engine failed to respond, he should have closed the throttle and then opened it more gradually. He also believed that in attempting to recover the aircraft he focused on his immediate surroundings and lost his awareness of the aircraft's attitude. He did not recall selecting carburettor heat off or closing the throttle at any time during the landing or subsequent ground manoeuvres. He remarked that the engine fitted to the aircraft type most familiar to him responded satisfactorily to abrupt throttle movements but noted that this was not an appropriate technique for most engines.

Footnote

[2] A rich cut is said to occur if the fuel and air mixture becomes too fuel rich to support combustion.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28-140 Cherokee, G-AVGD
No & type of Engines:	Lycoming IO-320-E2A piston engine
Year of Manufacture:	1967
Date & Time (UTC):	9 September 2006 at 1324 hrs
Location:	Wellesbourne Mountford Airfield, Warwickshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Minor) Passengers - 1 (Minor)
Nature of Damage:	Collapsed nosewheel, damage to right wing tip, nose underside, propeller and engine mounts
Commander's Licence:	Private Pilot's Licence
Commander's Age:	47 years
Commander's Flying Experience:	105 hours (of which 9 were on type) Last 90 days - 10 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Whilst landing in a cross-wind from the left, the aircraft veered violently to the left as the nosewheel contacted the ground. The pilot believed that this resulted from a combination of a gust of wind and the application of too much left rudder together with left aileron.

History of the flight

Following an uneventful flight from Cranfield, the aircraft joined the circuit at Wellesbourne Mountford and positioned onto final approach for Runway 18. The wind was reported as 100º/11 kt and the pilot adopted the crab technique as he aligned the aircraft with the runway centreline. On short final approach he selected full flap and changed to the wing down method, ie he applied left aileron and right rudder. As the aircraft crossed the threshold the speed had reduced to about 65 mph; the pilot increased it slightly by applying a little more power. Touchdown on the main wheels was reportedly smooth and occurred approximately 180 m from the threshold. However, when the nosewheel contacted the runway, the aircraft veered violently to the left and actually turned onto a disused runway that intersected Runway 18 some 250 m from the threshold. During the turn, the right wing tip struck the ground but the aircraft subsequently righted itself. As it did so, the nosewheel collapsed, the propeller struck the ground and the aircraft came to an immediate halt. The pilot turned off the fuel and master switch, and both occupants vacated the aircraft without difficulty. The only injuries were a graze to the passenger's left leg, with the pilot sustaining a cut finger.

The pilot has subsequently commented that the aircraft may have encountered a gust between the main and nosewheels touching down. As an instinctive reaction to being pushed to the right, he considered that he may have inadvertently applied too much left rudder, which, with left aileron already applied, may have caused the violent turn to the left.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28-161 Cherokee Warrior II, G-BYKR
No & type of Engines:	1 Lycoming O-320-D3G piston engine
Year of Manufacture:	1988
Date & Time (UTC):	30 August 2006 at 0810 hrs
Location:	Oxford Airport, Kidlington
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Aircraft damaged beyond economic repair
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	28 years
Commander's Flying Experience:	1,019 hours (of which 800 were on type) Last 90 days - 44 hours Last 28 days - 25 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft suffered a loss of engine power shortly after takeoff but the instructor pilot was able to land back on the runway. However, there was insufficient distance available in which to stop and the aircraft overran the end of the paved surface and passed through the airport boundary fence, coming to rest inverted on a public road. Although it was substantially damaged and leaking fuel, there was no fire.

Examination and testing of the engine and other components did not identify any defects that could have accounted for the loss of engine power.

History of the flight

The aircraft was one of several operated by a flight training organisation based at Oxford Airport and the accident occurred on the first flight of the day. This was intended to be a training detail. There were three occupants: the instructor, a student and a passenger seated in the rear, who was also a student at the flying school.

The weather recorded by ATC at Oxford Airport at 0750 hrs was: CAVOK, temperature +9ºC, dewpoint +8ºC and wind 220º/5 kt. The temperature and dewpoint figures indicate a Relative Humidity (RH) of 88%.

Soon after startup, the instructor realised that the engine showed symptoms of carburettor icing, so the engine speed was set at between 1,300 rpm and 1,400 rpm, instead of the recommended 800 rpm to 1,200 rpm, to warm it up more quickly. The aircraft was parked on the apron in front of the control tower and, with Runway 19 in use, this necessitated a relatively long taxi to the departure point of approximately 1,000 m. After taxiing, the power and before-takeoff checks were performed, with satisfactory results. Carburettor heat was re-applied for about 15 seconds at the holding point prior to takeoff; no signs of carburettor icing were noted.

After backtracking the active runway a short distance beyond the intersection with Runway 11/29, the student commenced the takeoff by applying full power. The engine temperature, pressure and speed indications appeared normal but, shortly after rotation, there was loss of power and the engine was heard to 'cough'. The instructor immediately took control and, after putting out a radio call, landed the aircraft back on the runway. He braked heavily but the aircraft overran the end of the paved surface and continued through the airport boundary fence and hedge. It then pitched over and came to rest, inverted, in Langford Lane, a public road bordering the southern end of the airport (Figure 1). The left wing had completely separated from the fuselage, the right wing almost so, which allowed a considerable quantity of fuel to leak from both wings, but there was no fire.

The occupants, who had been wearing lap straps and shoulder belts, were uninjured and exited the aircraft unaided, albeit with some difficulty, after turning off the battery master switch. The cabin door was partially obstructed and had to be kicked several times in order to make it open. The emergency services were in attendance within two to three minutes, by which time the occupants had already vacated the aircraft.

Aircraft information

The Piper PA-28-161 is a single-engined low-wing monoplane of all-metal construction. It is equipped with a 160-hp normally-aspirated, carburetted piston engine, incorporating dual, independent ignition systems. The aircraft has a total fuel capacity of 50 US gallons (190 litres), contained in two tanks, one in each wing. Each tank is equipped with a fuel sampling/drain valve. Fuel pressure to the carburettor is provided by a conventional engine-driven diaphragm pump and a supplementary electrically-driven pump. The engine is equipped with a conventional carburettor air heat system which, when selected, ducts unfiltered warm air, sourced from a heat exchanger around the exhaust manifolds, into the carburettor inlet.

The aircraft was not carrying any deferred defects relevant to the accident and no maintenance had been performed on the engine or fuel system immediately prior to the accident.

Wreckage examination

The aircraft wreckage was recovered to a hangar at Oxford Airport, where it was examined by the AAIB.

Figure 1
Photograph of aircraft wreckage

The wing spars had been severed at the wing root by the impact, disrupting the fuel pipes, and the fuselage, empennage and nose landing gear had also sustained severe damage.

Chord-wise scrape marks on the propeller blades and circumferential scoring of the spinner indicated that the propeller was turning when the aircraft struck the boundary fence, but the lack of any distortion of the propeller blades suggested that the engine had been running at low power.

The engine contained sufficient oil and had not seized, and mechanical continuity of the valve train was confirmed. The engine controls operated correctly, with the exception of the mixture control. This was extremely stiff to operate due to the operating cable becoming trapped by nose landing gear support structure, which had been badly distorted in the impact. The spark plugs were found to be in good condition and their leads were securely attached. Both magnetos appeared to be in good condition and were securely mounted. The fuel selector handle was found set to the right-hand tank and the fuel primer was in the locked position.

The disruption to the fuel tanks and fuel pipes in the wings was such that the contents of the tanks had completely drained out following the accident. However, small quantities of fuel were found in the gascolator, electric fuel pump and the fuel hoses in the engine bay, and these samples were collected and subjected to quality testing.

Engine testing

The engine, including the carburettor, had suffered only minor damage in the accident, so it was decided to install it as a complete unit in an engine test facility, without making any adjustments, and assess its performance. As it had not been possible to recover sufficient fuel from the aircraft, an alternative supply of Avgas 100LL was used.

The engine started easily and, once warmed up, high power runs were completed satisfactorily. The engine showed no signs of hesitation at any power setting or during rapid throttle advancements. At full throttle, measurements confirmed that the engine was developing close to the nominal rated power quoted by the engine manufacturer.

Component testing/examination

The fuel tank vent pipes and the fuel lines between the tanks and the engine were found to be free from obstruction. The gascolator was clean and its filter was free of debris. The electric fuel pump and the ignition switch were also tested and found to be satisfactory. Bench tests of the carburettor confirmed that this was correctly adjusted and, when stripped for internal examination, it was found to be in good condition and free of debris. Both fuel tank filler caps were in good condition.

Fuelling records

Fuelling records showed that G-BYKR was refuelled from Bowser AV3 twice on the day before the accident, uplifting a total of 62 litres of Avgas 100LL. The times of refuelling were not established as this information is not recorded by the fuel provider.

The daily inspection sheet for Bowser AV3 for 29 August 2006 shows that a fuel quality check was carried out at 0720 hrs, prior to the first refuelling of the day. Further quality checks were performed at 1330 hrs following replenishment of the bowser and after the first subsequent refuelling of an aircraft. The results of these checks were recorded as satisfactory. The records show that the bowser had refuelled about 40 aircraft that day and the AAIB is not aware of any reports of engine problems with any of these aircraft, other than G-BYKR.

A sample of fuel was taken from the bowser after the accident and provided to the AAIB for testing.

Fuel sample testing

The small samples of fuel recovered from the aircraft were found to be free of water and exhibited the characteristic blue colour of Avgas 100LL. Tests showed that they were very similar to both a known good reference sample of Avgas and the sample of fuel taken from Bowser AV3. Tests on this sample confirmed that it met the specification for Avgas 100LL.

Discussion

As large quantities of fuel were seen leaking from both wings after the accident, it is therefore reasonable to conclude that the aircraft did not run out of fuel.

Examination and testing of the fuel system and the engine did not identify any technical defects that could account for the loss of engine power after takeoff. An intermittent ignition problem could not be ruled out but this seems unlikely, given that the engine is equipped with two independent ignition systems and the fact that the engine performed satisfactorily during test runs.

No evidence of debris or blockage was found in the fuel system but the possibility of water contamination of the fuel must be considered. It is unlikely that the fuel from Bowser AV3 was contaminated, given that numerous other aircraft were refuelled from the bowser on the same day with no reports of subsequent engine problems. Condensation inside an aircraft's fuel tanks may cause significant quantities of water to accumulate over a period of time, but this is unlikely on flying school aircraft which have a high utilisation, as these are frequently refuelled and regularly sampled during the pre-flight checks. Another potential source of water ingress into fuel tanks is poorly sealing fuel filler caps. However, this could be ruled out on G-BYKR as both cap seals were found to be in good condition.

A potential cause of loss of engine power is carburettor icing. With a relative humidity of 88% and a temperature of +9ºC, the conditions at the time of the accident were highly conducive to carburettor icing at any power setting, and this is supported by the fact that such icing occurred soon after the engine was started. The subsequent long taxi at a low power setting would probably have increased the likelihood of ice re-forming in the carburettor. Although the crew carried out carburettor heat checks at the holding point, in accordance with recommended practice, it is possible that, on this occasion, this was not completely effective in removing all the ice that may have accumulated within the carburettor. Alternatively, ice may have been forming in the time taken to taxi from the holding point until shortly after takeoff, when the loss of power occurred.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28RT-201T Cherokee Arrow IV, N2CL
No & type of Engines:	1 Continental TSIO-360 piston engine
Year of Manufacture:	1980
Date & Time (UTC):	31 August 2006 at 1739 hrs
Location:	Frensham Airstrip, Churt, Surrey
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - None Passengers - None
Nature of Damage:	Extensive damage to left wing and left main landing gear
Commander's Licence:	Private Pilot's Licence
Commander's Age:	68 years
Commander's Flying Experience:	1,590 hours (of which 691 were on type) Last 90 days - 21 hours Last 28 days - 9 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Just before touch-down the aircraft drifted to the right and its right wing tip contacted a maize crop bordering the airstrip. The aircraft swung to the right and came to rest in the crop with its left main landing gear collapsed.

History of the flight

After an uneventful flight from France, the pilot commenced his approach to Runway 25. This was at an airstrip from which he had operated since 1979. The airstrip has a length of 1,000 m and a short grass surface which was dry at the time. The weather was good with a forecast surface wind in the local area of 220º/12 kt gusting to 24 kt.

As the pilot flared the aircraft, he was aware of the stall warning sounding. N2CL started drifting to the right and its right wing tip contacted a maize crop bordering the edge of the airstrip. The aircraft swung through almost 90º to the right and came to rest in the crop with the left main landing gear collapsed.

The pilot considered that a gust of wind had caused the drift to the right but he acknowledged that, having returned to his home airstrip after a few days abroad, he may have relaxed and suffered a momentary lapse of concentration.

ACCIDENT

Aircraft Type and Registration:	Piper PA-38-112 Tomahawk, G-BGWU
No & type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1978
Date & Time (UTC):	30 September 2006 at 1800 hrs
Location:	Full Sutton Airfield, Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to landing gear, left wing, propeller and fuselage
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	61 years
Commander's Flying Experience:	167 hours (of which 71 were on type) Last 90 days - 32 hours Last 28 days - 7 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

After landing, when the nosewheel made contact with the ground, the aircraft veered uncontrollably to the left. The aircraft struck a low grass bank, damaging the propeller and fuselage, causing the nose and left landing gear to break off. Both the pilot and passenger were uninjured. An examination of aircraft immediately after the incident showed that the left landing gear attachment bolt had failed at the location of a pre-existing crack, associated with an area of bolt deformation.

History of the flight

After a reportedly normal touchdown on the main wheels on Runway 22, the aircraft veered to the left after the nosewheel made contact with the ground. Despite the application of opposite rudder and right brake, the aircraft continued to turn left, departed the runway and traversed the corner of a small grass bank surrounding an irrigation pond. The impact with the bank resulted in the separation of the nose and left landing gear and damage to the propeller, left wing and fuselage. The aircraft came to rest on a taxiway at the holding point for Runway 22.

An inspection of the aircraft after the incident revealed that the nosewheel steering mechanism and torque link were intact and that the left landing gear main attachment bolt had failed. Examination of the bolt showed it had failed in a region where the bolt had been deformed. Approximately 65% of the fracture surface showed evidence of crack progression due to a fatigue mechanism, with the remaining 35% exhibiting the characteristics of an overload failure. Discolouration of the fatigue fracture surface indicated that the crack had been present in the bolt for some time before it failed.

The most probable cause of the deformation was considered to have been a heavy landing, and this may also have been the initiating event for the fatigue crack. The aircraft logbook contained no record of such an event so it was not possible to determine for how long the damage had been present prior to the accident.

ACCIDENT

Aircraft Type and Registration:	Piper PA-38-112 Tomahawk, G-BMML
No & type of Engines:	1 Lycoming O-235-L2A piston engine
Year of Manufacture:	1980
Date & Time (UTC):	12 September 2006 at 1524 hrs
Location:	Barton Aerodrome, Manchester
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Aircraft damaged beyond economic repair
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	43 years
Commander's Flying Experience:	762 hours (of which 327 were on type) Last 90 days - 78 hours Last 28 days - 31 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and AAIB inquiries

Synopsis

The instructor was teaching his student the short field takeoff technique from a grass strip. Shortly after taking off the aircraft was seen to stall and crash into a hedge. Both the instructor and student were unhurt but the aircraft was damaged beyond economic repair.

History of the flight

The instructor had briefed the student on the short field takeoff technique with the intention that he would talk him through the departure and follow him through on the controls. The aircraft was lined up on the threshold of Runway 09L, which is a grass runway with a Takeoff Run Available (TORA) of 518 m. One notch of flap (21°) was selected and the aircraft was held on the brakes as the engine power was increased. The brakes were released and as the air speed increased the instructor noted that the engine gauges read normally. The rotation, acceleration in ground effect and the initial part of the climb went without incident, but as the aircraft began to climb away the instructor noted that the nose of the aircraft was too high. He therefore lowered the nose into the correct attitude and instructed the student to maintain this attitude; however the nose again began to rise and so the instructor took control of the aircraft. At this point the instructor reported that the controls felt 'sloppy' and he became aware that the aircraft was descending. He therefore lowered the nose and checked that the throttle lever was fully forward. With insufficient runway remaining on which to land, and conscious of a busy road directly ahead, the instructor reported that he steered the aircraft towards a hedge into which it then crashed. The instructor and student, who were both unhurt, vacated the aircraft through the normal exits. The aircraft was extensively damaged as a result of hitting two concrete posts concealed in the hedge.

Report from Flight Information Service Officer (FISO)

The FISO, who observed the aircraft taking off from the tower, reported that at the time of the accident the wind was from 160º at 5 kts. He reported that during the takeoff run the acceleration seemed slow and once the aircraft reached the intersection of Runway 02/20 the aircraft pitched up and appeared to struggle to climb away. On reaching the end of Runway 09L the aircraft appeared to stall and to enter a steep nose-down pitch attitude.

The FISO reported that the emergency services responded in good time, with the Airport Fire Service responding immediately and the local fire service, ambulance and police arriving shortly afterwards.

Comments

The instructor reported that the aircraft was equipped with a vane type stall warner and that he was not aware of it operating during the accident. He believes that the accident happened because the aircraft pitched up too much during the climb causing the aircraft to enter a stall.

ACCIDENT

Aircraft Type and Registration:	PZL-104 Wilga 80, G-WLGA
No & type of Engines:	1 PZL Kalisz AI-14RA piston engine
Year of Manufacture:	1990
Date & Time (UTC):	29 October 2006 at 0930 hrs
Location:	Lingcroft Farm, Ullock, Workington
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to propeller, engine cowl, bulkhead/cockpit frame, left main landing gear, windshield and front fuselage
Commander's Licence:	Private Pilot's Licence
Commander's Age:	52 years
Commander's Flying Experience:	151 hours (of which 13 were on type) Last 90 days - 22 hours Last 28 days - 12 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

During takeoff the left front wheel 'dug in' to a soft area of the grass runway. The aircraft departed the runway and came to rest, inverted, in a stream that ran parallel to the runway. The pilot attributed the accident to inadequacies in the runoff areas of the runway and to the fact that he did not carry out a sufficient examination of the runway condition prior to the flight.

History of the flight

The intention of the flight was to fly from the farm strip at Lingcroft Farm, Ullock to Carlisle. The aircraft checks, engine start and taxi across the field to the start of the grass Runway 05 were without incident. During the takeoff the acceleration appeared normal. However, on reaching the speed necessary for rotation, the left front wheel 'dug in' to a soft and wet area of the runway. As the wheel 'dug in' the aircraft decelerated rapidly and veered to the left. The pilot's attempts to regain the runway centre line were not successful and the aircraft departed the runway, briefly became airborne over an area of low ground, after which it struck the ground. The pilot was unable to stop the aircraft before it entered a stream that ran parallel with the runway. The aircraft's front wheels then struck the far bank of the stream, causing the aircraft to pitch forward and come to rest inverted. The pilot and passenger, who were wearing lap strap and diagonal harnesses, were unhurt and were able to exit the aircraft using the entry doors.

The pilot had used the farm strip the week before, from the opposite direction. This was just after a period of heavy and prolonged rain, and it appeared that the drainage system had worked as there had been no problems with the takeoff or landing.

The runway surface on the day of the accident appeared to be similar to that of the week before, although the pilot did notice several wet patches in the surrounding fields. The weather on the day was dry with a light and variable wind and good visibility. However, there had been periods of heavy rain on the previous few days.

In a full and frank statement, the pilot, who also owns the farm strip, attributed the accident to inadequacies in the design of the farm strip, especially the runoff areas. He also explained that he did not carry out a sufficient examination of his strip before the flight, relying on his experience of the runway condition the week before.

ACCIDENT

Aircraft Type and Registration:	Reims Cessna F152, G-BMCV
No & type of Engines:	1 Lycoming O-235-N2C piston engine
Year of Manufacture:	1963
Date & Time (UTC):	24 August 2006 at 1310 hrs
Location:	Leicester Airport, Leicestershire
Type of Flight:	Training
Persons on Board:	Crew 1 Passengers None
Injuries:	Crew None Passengers N/A
Nature of Damage:	Damage to propeller and right wing
Commander's Licence:	Student pilot
Commander's Age:	18 years
Commander's Flying Experience:	32 hours (of which all were on type) Last 90 days - 32 hours Last 28 days - 11 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and metallurgical examination of damaged components

Synopsis

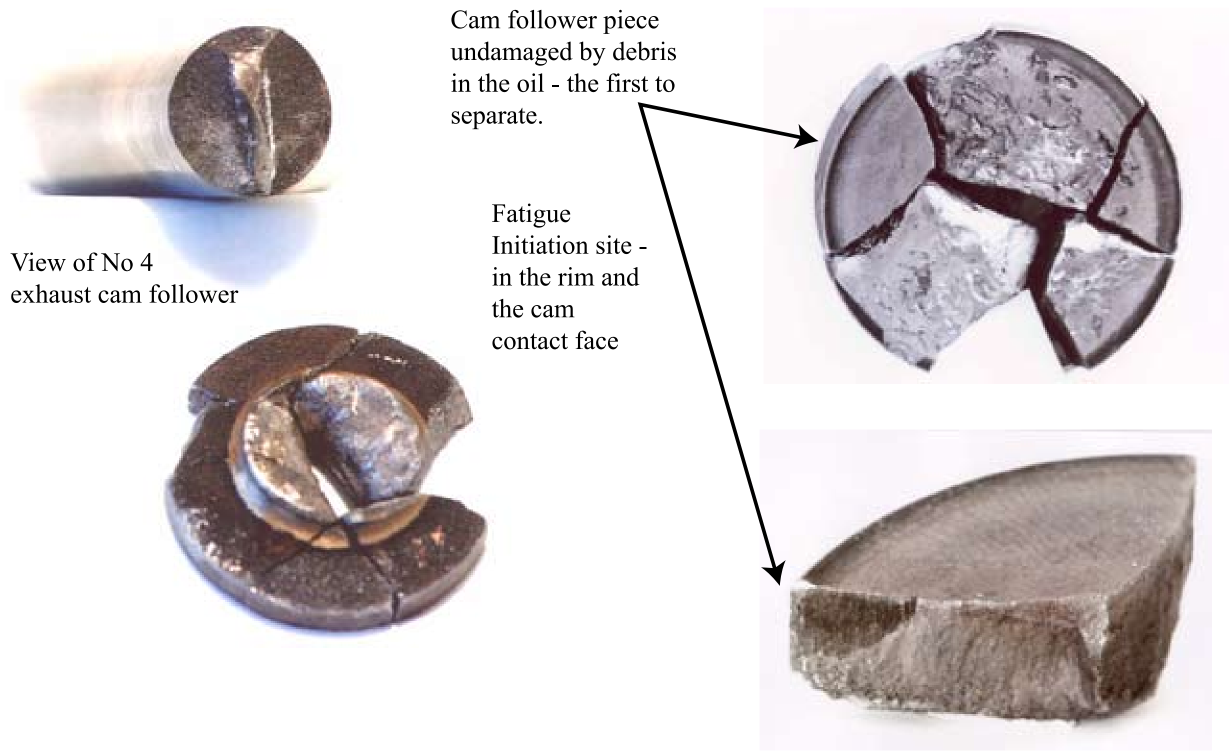
At around 2,000 ft while in the Leicester Airfield overhead, the engine lost power and the student pilot performed a forced landing onto the runway. He landed successfully but overshot the end of the runway. The cause of the power loss was due to the break-up of the No 4 cylinder cam follower.

History of the flight

The training flight was authorised by the instructor as a solo VFR navigation exercise from the Leicester overhead to the Sywell overhead, then to Conington and returning to land at Leicester. The student pilot performed his pre-flight checks and the aircraft took off and climbed normally into the overhead position to begin the exercise. At around 2,000 ft, the pilot noticed the engine noise become fainter, the indicated rpm dropped and the aircraft stopped climbing. The pilot declared a 'MAYDAY'. The aircraft descended and, despite the throttle being fully open, the engine continued to lose power. The pilot turned the aircraft onto final approach and closed the throttle; the touchdown was a considerable distance beyond the threshold to the extent that the aircraft overshot the end of the runway, coming to rest in an adjacent field.

Engine examination

The engine was dismantled and inspected by the overhaul agency. The loss of power was due to the failure of



(Photos: H T Consultants)

Figure 1

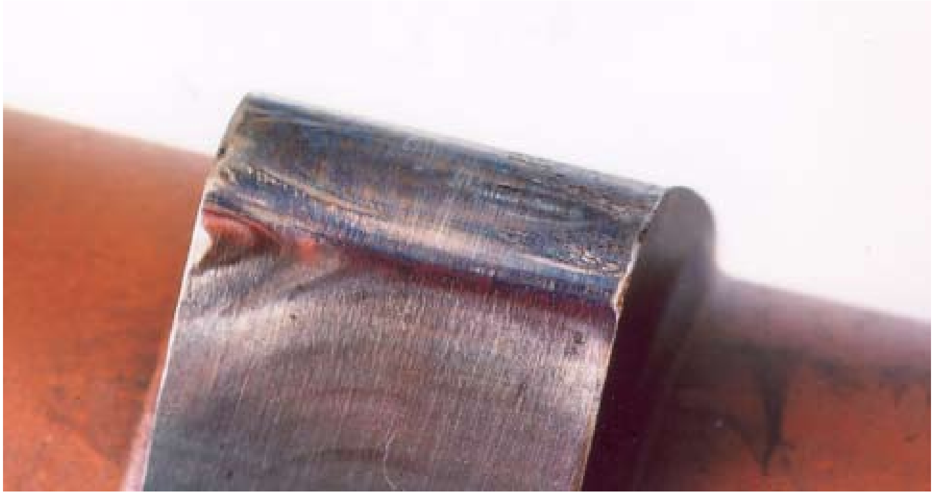
Damaged cam follower

the No 4 exhaust cam follower, the head of which had broken away from its shaft (see Figure 1) and was found in several pieces in the bottom of the oil sump. There was also consequential damage to the engine caused by the debris from the failed cam follower.

The No 4 cam follower, the camshaft and the crankcase were returned to the AAIB for metallurgical examination. The cam follower head had broken into seven pieces; many of the failures showed evidence of flexural fatigue from loads applied by the associated cam lobe. All but one of the pieces recovered had been damaged on the cam lobe contact face by circulating debris; the undamaged piece was considered to be the first to have separated. It contained a fatigue initiation site, in the junction between the rim and the cam contact face, which had progressed more slowly than the separations on the other pieces (see Figure 1).

Examination of the camshaft showed that the surface of the rear lobe (No 4) had been mechanically damaged. The other lobes showed offset wear indicating that the shaft had not been sitting square with the related cam follower head for a considerable period of engine running time (see Figure 2). Microsection examination of the cam shaft material showed that it had been carburised and case-hardened before final machining; microhardness tests on the case-hardened layer were satisfactory.

The crankcase showed no visual evidence of distortion; the right side had been mechanically damaged, consistent with high energy contact with the cam follower pieces. The camshaft bearing faces on both crankcase sides had been scored, most likely from debris circulating in the oil. The bearing lands on the camshaft were also scored, the nature of the damage indicating that it had resulted from cam follower debris in the oil.



(Photo: H T Consultants)

Figure 2

Integral cam for No 2 cylinder exhaust cam follower showing offset wear

Engine history

The engine (serial No L-20058-15) was last overhauled in February 2003, at which time a new camshaft was fitted. In September 2005, following the reported tightness of the crankshaft when rotated by hand using the propeller, the engine was removed from G-BMCV. The engine was dismantled and the crankcase was found to be fretted. The crankcase was replaced with an overhauled component and the engine was reassembled.

The engine had accumulated 1,293 hours 5 minutes since the overhaul and 396 hours 15 minutes since the re-build in 2005.

Discussion

It was concluded that the break-up of the cam follower resulted from a flexural fatigue mechanism caused by offset cyclic loading from the related camshaft lobe. No conclusion could be made about the cause of the offset loading.

ACCIDENT

Aircraft Type and Registration:	Reims Cessna F172N Skyhawk, G-DENR
No & type of Engines:	1 Lycoming O-320-H2AD piston engine
Year of Manufacture:	1979
Date & Time (UTC):	20 August 2006 at 1140 hrs
Location:	Lower Widdon Farm, near Ashburton, Devon
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - None Passengers - None
Nature of Damage:	Engine cowling, firewall, wheel struts, left wing tip, wing skins, tailplanes, elevators and cabin interior
Commander's Licence:	Private Pilot's Licence
Commander's Age:	45 years
Commander's Flying Experience:	107 hours (of which 31 were on type) Last 90 days - 12 hours Last 28 days - 0.5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

The aircraft was on a VFR flight from Bournemouth, Dorset, to Truro, Cornwall. When it was approximately 15 nm south-west of Exmouth, Devon, and at 2,800 ft altitude, the engine began to run roughly before stopping. The pilot completed engine failure checks without success and subsequently flew a forced landing into a field. The aircraft landed heavily and suffered severe damage. The occupants vacated the aircraft uninjured.

Cessna 172 fuel system

The engine fuel selector is located on the floor below the instrument panel and is easily accessible to both pilots. The selector can be used to feed the engine from the left or right tank or both tanks. To turn the fuel OFF the pointer is turned to face directly aft. There is no safeguard on the OFF position, so care is required when changing the selection. For all normal operations the fuel selector should be placed in the BOTH position. If the tank levels become uneven it is possible to select the higher quantity tank in cruising flight to balance the tank levels.

When refuelling, the fuel selector should be placed in the LEFT or RIGHT position to minimise cross-feeding between tanks. After refuelling the tanks to full, fuel from the left tank can vent overboard from the air vent pipe on the underside of the left wing. This can be avoided by under-filling the left tank by two gallons or the left tank can be selected initially after start. Once a small amount of fuel has been used the selector can then be returned to BOTH. The selector should be selected to BOTH for takeoff, climb and landing; this requirement was placarded on the fuel selector in G-DENR as shown in Figure 1 below.

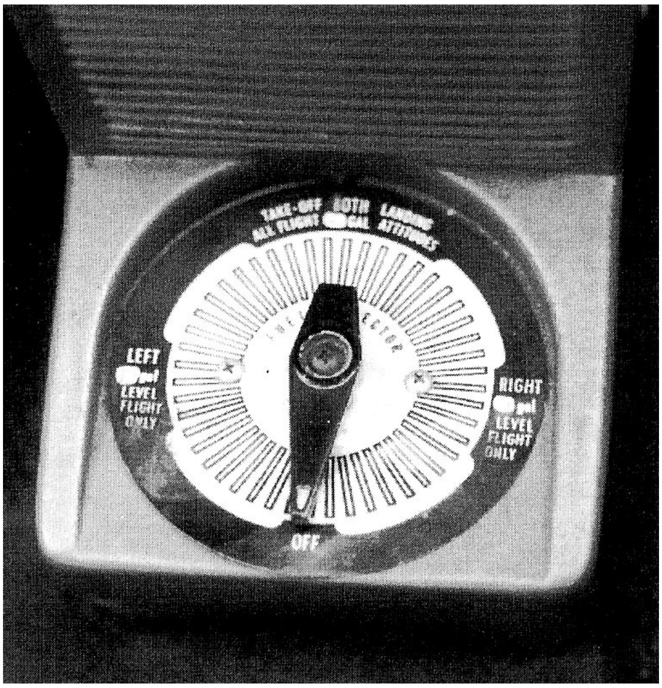


Figure 1

Fuel Selector

In addition to the fuel tanks and tank selector, the Cessna 172 fuel system consists of a fuel strainer, a strainer bowl and the carburettor downstream of the fuel selector. The strainer bowl has a volume of 0.196 litre. If the fuel supply to the fuel strainer is shut off, its design prevents fuel in the bowl portion being drawn into the carburettor and so the engine will not be able to draw fuel from the fuel strainer. Consequently, the engine will run until the fuel contained in the carburetor float bowl is exhausted; this is predicted to be for no longer than 20 seconds at cruise power.

Background information

The pilot stated that he was fully conversant with the operation of the fuel selector and he had recently demonstrated this to an examiner during his 'Single Engine Piston' aircraft skills test.

History of the flight

The pilot reported that before departure from Bournemouth, the owner (not the pilot) filled the right tank to FULL and the left tank to two gallons short of FULL. The owner checked these quantities visually. The owner advised the pilot to take off with the selector on LEFT and to select BOTH after takeoff during his first routine in-flight check. The aircraft subsequently took off at approximately 1000 hrs with the LEFT tank selected.

The flight progressed uneventfully with the pilot performing a routine in-flight check over Dorchester, 23 track miles from Bournemouth, where he selected the fuel selector to BOTH and applied precautionary carburettor heat. As he approached Lyme Regis he contacted Exeter radar and requested a Flight Information Service. They requested that he report overhead Exmouth, which he complied with; at this point the aircraft was at 2,000 ft amsl and had flown a further 38 track miles. The pilot then carried out another routine in-flight check, including the use of carburettor heat, before commencing a cruise climb to 3,300 ft amsl at 95 kt and 2,300 rpm.

As the aircraft climbed through 2,800 ft amsl the engine began to run roughly and the rpm reduced slightly. The pilot selected the carburettor heat ON, with no initial change in the engine's rpm. He then reduced the IAS to the aircraft's best glide speed of 65 kt but the engine rpm then started to fluctuate slightly before it stopped; at this point the aircraft was 15 nm south-west of Exmouth. The pilot carried out the Engine Failure checklist from memory and declared an emergency to Exeter ATC. Having appreciated that the engine was not going to restart, the pilot then concentrated on flying a forced landing into a field. At that time the aircraft was on the eastern edge of Dartmoor where the height of the predominantly undulating ground was approximately 500 to 1,000 ft amsl. This situation left the pilot with a limited choice of fields and a restricted amount of time before landing.

For the forced landing the pilot selected the fuel selector to OFF in order to reduce the risk of fire after landing. Having selected a field, the pilot positioned the aircraft downwind before turning on to a base leg. Realising that he had turned too early, he elected to cross this field and a tree line and land in the next field. On crossing the tree line the aircraft's elevator clipped the top of the trees; the left wing tip subsequently contacted the ground just before the aircraft landed heavily on a down slope in the field. Upon coming to a stop, the pilot made the aircraft safe and the occupants vacated the aircraft uninjured.

The pilot added that his recollections of his actions before and during the engine failure are imprecise and as such he is not sure what cockpit selections he might have made. He feels that one possibility could be that he misidentified the fuel selector position and turned it from BOTH to OFF. While he does not recall doing this, he accepts it as a possibility.

Weather

The Met Office provided an aftercast for the time of the accident. There was a weak decaying frontal system over the British Isles and a relatively moist westerly flow covering south-west England.

The METAR for Exeter issued 10 minutes before the accident showed that the surface wind was from 260º at 12 kt with visibility in excess of 10 km, scattered cloud at 1,400 ft above airfield level and broken cloud at 4,000 ft aal. At the surface the temperature was 18ºC and the dew point was 13ºC.

Carburettor icing

When the ground level temperature and dew point for Exeter are plotted on the Carburettor Icing chart in Safety Sense Leaflet 14 found in LASORS they fall in the *Moderate Icing – cruise power* area close to the 80% humidity line. Given that the aircraft was within a few hundred feet of the cloud base when the engine lost power, the relative humidity was likely to have been closer to 100% increasing the risk of carburettor icing.

While there is a possibility that carburettor icing might have caused the initial rough running of the engine, the aircraft owner stated that he felt this was unlikely based on his previous experience of flying the aircraft. Additionally, the pilot's routine in-flight checks should have cleared any light icing that might have formed; therefore it was unlikely that carburettor icing caused the engine failure.

Damage assessment

As a result of the heavy landing the aircraft suffered severe damage and was beyond economic repair. Consequently the engine was not inspected to establish whether there had been any mechanical failure.

Discussion

Given the circumstances, the design of the fuel selector and the pilot's statement, it is conceivable that an inexperienced pilot lacking in currency could make an incorrect selection. As a result, it is possible that the engine failure could be attributed to a selection error, although, it could also be attributable to carburettor icing. Moreover, the possibility that some other unidentified problem caused the engine failure cannot be excluded.

ACCIDENT

Aircraft Type and Registration:	SAN Jodel DR1050 Ambassadeur, D-EAKM
No & type of Engines:	1 Continental Motors Corp O-200-A piston engine
Year of Manufacture:	1960
Date & Time (UTC):	17 August 2006 at 1533 hrs
Location:	Kemble Airfield, near Cirencester
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - None Passengers - None
Nature of Damage:	Main landing gear legs collapsed; damage to left wing, underfuselage fairing and propeller
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	35 years
Commander's Flying Experience:	3,770 hours (of which 1,001 were on type) Last 90 days - 46 hours Last 28 days - 13 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

During the landing roll the aircraft turned into wind and the pilot was unable to arrest the turn. The main landing gear legs collapsed causing additional damage to the wing and propeller.

History of the flight

The Jodel DR1050 is a low-wing aircraft with a tailwheel landing gear. The aircraft was on approach to Runway 08 at Kemble with a direct crosswind from the right of 15 kt. The pilot reported that the approach was normal and that he was using a 'right wing low' sideslip technique to correct for the wind drift. The aircraft touched down on all three wheels simultaneously and rolled normally for a distance of 200 to 250 metres. During the deceleration the pilot felt the tailwheel starting to vibrate and shimmy, then the aircraft began to turn right into the wind. The pilot applied full left rudder and brakes but was not able to arrest the turn. Prior to reaching the runway edge both main landing gear legs collapsed.

Pilot's assessment of the cause

In an open and frank report the pilot stated that he applied the rudder too late to stop the turn and he should have tried to stop the tailwheel shimmy. Contributory factors were the strong crosswind and weak brakes, which were out of adjustment.

ACCIDENT

Aircraft Type and Registration:	Tipsy Nipper T.66 Series 2, G-ARBP
No & type of Engines:	1 Volkswagen 1834 piston engine
Year of Manufacture:	1960
Date & Time (UTC):	7 October 2006 at 1555 hrs
Location:	Seighford Airfield, Staffordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to wing leading edges and propeller
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	79 years
Commander's Flying Experience:	7,322 hours (of which 1,269 were on type) Last 90 days - 15 hours Last 28 days - 8 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

After engine start, accomplished by hand-swinging the propeller, the aircraft moved forward, displacing the main wheel chocks. It finally came to rest against a tree and fence post having damaged the wing leading edges and propeller. The pilot was uninjured.

History of the flight

Following some maintenance on the engine, the pilot moved the aircraft to a disused part of the airfield with the intention of carrying out an engine run. The aircraft was parked with the brakes applied and the main wheels chocked. Due to heavy rain the previous evening, the pan was wet and contaminated with mud, and several clumps of moss.

Engine start, on this aircraft, required the hand-swinging of the propeller so, as a safety measure, the pilot had set the engine throttle by inserting a 'peg', which limited the throttle movement and thus restricted the engine to about 1,200 rpm. After inserting the peg, the pilot placed a map in a stowage located close to the throttle, and he then hand-swung the propeller to start the engine. Once the engine fired, the aircraft started to move forward, displacing the wheel chocks. The aircraft continued to move forward, striking tree branches and a fence post, before finally coming to rest. The damage was limited to the leading edges of both wings and propeller. The pilot was not injured.

The pilot thought that it was possible that when he stowed his map he may have knocked the throttle; despite the 'peg' being installed the throttle lever could still move forward and attain about 1,800 rpm. Due to the wet ground, the wheels and brakes had become 'wetted', reducing the effectiveness of the brakes. This, in combination with the possible higher throttle setting, allowed the aircraft to move forward once the engine started. The other factor was the wet and muddy ground and the moss, which allowed the chocks to slip and move away from the main wheels once the aircraft started to move.

ACCIDENT

Aircraft Type and Registration:	Van's RV-6A, G-EDRV
No & type of Engines:	1 Lycoming O-360-A4A piston engine
Year of Manufacture:	2004
Date & Time (UTC):	29 October 2006 at 1234 hrs
Location:	Northampton (Sywell) Aerodrome
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to nose landing gear, propeller and wing tip
Commander's Licence:	Private Pilot's Licence
Commander's Age:	48 years
Commander's Flying Experience:	377 hours (of which 95 were on type) Last 90 days - 5 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Following a normal landing, the aircraft hit a bump on the runway surface and bounced. On the second touchdown, the nosewheel dug into the soft ground, the nose landing gear collapsed and the aircraft pitched forward to a near-vertical attitude, before falling back on to its main wheels.

History of the flight

Following an uneventful flight from North Weald, the aircraft landed on Runway 03 at Sywell. The weather was reported as CAVOK with the wind variable at 5 kt. The pilot subsequently described the touchdown, which was at 55 kt IAS, as "perfect". However the aircraft then hit a bump on the runway surface, causing it to bounce into the air again. On settling back onto the runway, the speed had decreased to approximately 25 kt when the nosewheel dug into the soft ground and the nose leg collapsed. This caused the aircraft to tip onto its nose, attaining a near-vertical attitude before falling back onto its main wheels. The pilot assessed the cause of the accident as a combination of the soft ground and the small nose wheel fitted to this aircraft type

Safety action

The Popular Flying Association (PFA) publish Type Acceptance Data Sheets (TADS) for homebuilt aircraft on their website, and advice on nosewheel problems concerning RV-6A aircraft was added in a November 2006 amendment; the salient points are reproduced below.

'With the RV-6A model, to avoid problems with the nose wheel jamming in the spat it is important to trim the nose wheel spat to ensure generous clearance between the tyre and the wheel aperture in the spat (circa half an inch), and to maintain the correct nose wheel tyre pressure. It is also important to maintain suitable preload on the nose wheel axle bearings, torquing up the axle nut gently as required in the absence of a conventional spacer between the bearings. Note that the wheel spats may be used as part of the locking system for the axle nuts, so if the aircraft is operated with spats removed, alternative means of locking the axle nuts is required. Later type nose wheel forks provided by Vans seek to improve this issue by raising the ground clearance of the nose leg.

Problems have been experienced with the RV-6A nose leg, especially when operating off grass, with instances of the nose wheel bending back and the strut digging into the ground, causing a rapid stop and further damage. .....It is also important to maintain suitable preload on the nose wheel axle bearings, torquing up the axle nut gently as required in the absence of a conventional spacer between the bearings. It is also important to land the aircraft on the main wheels first and hold the nose wheel off the ground during the initial part of the landing roll, rather than landing on all three wheels together which encourages wheel-barrowing and overloading the nose wheel.'

ACCIDENT

Aircraft Type and Registration:	Zenair CH 250, G-BIRZ
No & type of Engines:	1 Lycoming O-290-G conversion piston engine
Year of Manufacture:	1982
Date & Time (UTC):	9 September 2006 at 1340 hrs
Location:	Glenforsa Airstrip, Isle of Mull, Argyll and Bute, Scotland
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Severe damage to airframe, engine propeller, port wing and landing gear
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	74 years
Commander's Flying Experience:	810 hours (of which 169 were on type) Last 90 days - 7 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

While attempting to take off from Runway 07 at Glenforsa Airstrip in southerly cross-wind conditions, the pilot lost control of the aircraft which collided with the airfield's perimeter fence before coming to rest on the beach. Both occupants vacated the aircraft uninjured.

Airfield information

Glenforsa Airfield is an unlicensed grass airfield located on the north-eastern side of the Isle of Mull, on the coast, at the end of a valley that is orientated north-west/south-east. When the wind is from a southerly direction, downdraughts, gusts and funnel winds can be a feature at the airfield.

It has one runway orientated 07/25 measuring 730 m long and 18 m wide. The runway has a transverse slope down towards the beach and it has windsocks on the northern side of each runway threshold adjacent to the perimeter fence.

History of the flight

The pilot reported that he had flown with a friend from Perth to Glenforsa for lunch, a journey he had flown on approximately 12 previous occasions in various aircraft types. Runway 07 was in use and its grass surface was dry. The flight was uneventful but at the time G-BIRZ landed, the surface wind observed by the airfield manager was from 140º to 160º at 8 kt gusting to 12 kt. This wind was described by several pilots who were at Glenforsa at the time as "reasonably demanding." The pilot added that his personal crosswind limit, for this aircraft type, was "12 to 15 kt".

After a stay of approximately two hours the pilot prepared the aircraft for the return flight. He reported that there was no weather, unlimited visibility, no cloud and the surface wind was from 140º at 12 kt. He added that he was aware of the conditions likely to be experienced with this wind but while he prepared the aircraft, the wind conditions appeared very benign.

After engine start the pilot taxied the aircraft to the holding point for Runway 07 where he completed the engine and pre-takeoff checks; he then commenced the takeoff. The airfield manager reported the weather conditions were the same as when G-BIRZ landed.

The pilot stated that during the takeoff run, despite having applied full right rudder and into wind aileron, he had difficulty keeping the aircraft straight. After approximately 300 m ground run the aircraft started to veer uncontrollably to the left. As he approached the takeoff speed of 50 mph the aircraft continued to veer left and its right wing lifted "slightly". The left wing then struck the perimeter fence before penetrating it. The aircraft then slid down onto the beach before coming to rest on the foreshore above the water line. The occupants vacated the aircraft uninjured through its sliding canopy.

The pilot added that the aircraft did not become airborne at any time. He elected to continue the takeoff because he was hoping that the aircraft would become airborne in time to clear the perimeter fence.

Eyewitnesses

There were several eyewitnesses to the accident. They included a retired Chief Flying Instructor (CFI) from a UK flying club, the airfield manager and three private pilots. The CFI and the airfield manager were standing by a gate that leads from the car park to the aircraft parking area. This was opposite the point that G-BIRZ penetrated the fence and gave them an uninterrupted view of the takeoff.

They both stated that they saw the aircraft begin its takeoff run from the threshold of Runway 07. Almost immediately, it started to drift gradually towards the shore side of the runway and after approximately 300 m they saw it get airborne briefly in a very high nose-up attitude, achieving a height of approximately 10 to 15 ft agl. The aircraft then banked left, achieving nearly 90º angle of bank. The left wing struck the ground approximately 20 ft inside the perimeter fence and the aircraft bounced before it struck the perimeter fence. It then adopted a wings-level attitude just as they lost sight of it as it crashed onto the foreshore below the airstrip.

The other witnesses stated that they saw a similar series of events as previously described. One added that after the left wing hit the fence, the aircraft spun through 180º before it disappeared onto the beach travelling backwards.

On seeing the accident the airfield manager requested that the CFI drive his 'off-road' vehicle onto the beach to the accident site to offer assistance. This he did and when he arrived at the aircraft, he found that both occupants had vacated it and were visibly unharmed. At the same time, the airfield manager entered an adjacent building to telephone the local emergency services.

Photographic evidence

The local police attended the scene of the accident. They photographed the aircraft and a witness mark on the grass just inside the perimeter fence. A photograph of the aircraft is shown at Figure 1 below.

Figure 1
G-BIRZ on the beach

In addition to damage attributed to the aircraft striking the fence and crashing onto the foreshore, there was severe damage to the left wing tip.

The witness mark on the grass showed no sign of any landing gear tracks which indicates that the aircraft had become airborne after it diverged off the grass strip. The impact mark on the ground was probably made by the left wing tip just before it struck the fence.

The damage to the aircraft was beyond economic repair.

Analysis

The pilot's lack of directional control during the takeoff was probably attributable to the wind being close to, if not in excess of, his own crosswind limit. While the aircraft would normally weathercock into wind, engine slipstream effect and torque reaction would have been dominant and would have caused the aircraft to yaw to the left. Runway 07's downward slope towards the shore would have augmented this divergence.

Whilst the pilot does not think he got airborne, he might have instinctively pulled back on the control column in a bid to get airborne in time to clear the perimeter fence. The evidence indicates that the aircraft became airborne. The high nose-up attitude witnessed would have increased the aircraft's angle of attack and induced drag, thereby reducing its airspeed. The left wing drop is most likely to have been as a result of it stalling, leading to it striking the ground. Additionally, the strong crosswind or a gust from the right would have aggravated this wing drop. After the left wing struck the perimeter fence the aircraft is likely to have been rotated, as stated by one witness. Fortunately it remained upright and there was an exceptionally low tide on the day allowing the aircraft to slide to a halt on the beach above the water line.

ACCIDENT

Aircraft Type and Registration:	Robinson R44 Astro, G-ROZI
No & type of Engines:	1 Lycoming O-540-F1B5 piston engine
Year of Manufacture:	1996
Date & Time (UTC):	16 June 2006 at 1200 hrs
Location:	York Racecourse
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 3
Injuries:	Crew - None Passengers - None
Nature of Damage:	Extensive
Commander's Licence:	Private Pilot's Licence
Commander's Age:	39 years
Commander's Flying Experience:	166 hours (of which 79 were on type) Last 90 days - 15 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

On final approach to a landing site when close to maximum weight and with a light surface wind and high ambient temperature, the pilot was aware of the 'LOW RPM' warning activating and the aircraft sinking. He attempted to increase power but the helicopter touched down heavily. Once on the ground, the rpm recovered and the helicopter lifted off again; it turned through approximately 90º before the pilot regained control and landed.

History of the flight

The pilot had planned his flights to collect some friends and take them to York Racecourse. He completed his normal external and pre-flight checks and noted that G-ROZI appeared fully serviceable. Having obtained the weights of his passengers, he calculated that he could uplift some extra fuel and flew to Sandtoft Aerodrome where he refuelled and then flew onwards to a private site to collect his friends.

The weather was good with a light surface wind, no cloud below 4,000 ft amsl and an air temperature of about 20ºC. With his passengers on board, the pilot had calculated that the aircraft's weight would be 1,065 kg compared to the maximum permitted gross weight of 1,089 kg. He was seated in the right front seat and dual controls were fitted.

The flight to York was initially uneventful and the pilot selected full carburettor heat prior to his descent to the landing site. His approach was northerly with a final turn to line up on the helicopter landing site in an easterly direction. Everything appeared normal until the pilot levelled G-ROZI for the final hover before touchdown. As he did so, the 'LOW RPM' warning activated and he was aware of the helicopter sinking. He applied more power but was unable to prevent the subsequent heavy landing. On the ground, the rpm increased and the helicopter lifted off again; it turned through about 90º before the pilot regained control and touched down in an upright attitude. After the pilot had shut down the engine and switched off the fuel valve and electrics, all the occupants vacated the helicopter though their respective doors.

The helicopter's airframe suffered extensive distortion damage during the heavy landing. Regarding the cause of the accident, the pilot subsequently confirmed that his front seat passenger remained well clear of the controls during the flight. On reflection, he considered that the heavy landing was the result of a combination of a very light wind, high air temperature and being close to the maximum permitted weight.

ACCIDENT

Aircraft Type and Registration:	LS1F Glider, BGA4665
No & Type of Engines:	None
Year of Manufacture:	1976
Date & Time (UTC):	9 August 2005 at 1725 hrs
Location:	Near Husbands Bosworth Airfield, Leicestershire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A Others - 1 (Fatal)
Nature of Damage:	Extensive damage to the left wing, left aileron separated from the wing and damaged right winglet
Commander's Licence:	BGA Glider Pilot's Certificate (Gold and Three Diamonds)
Commander's Age:	24 years
Commander's Flying Experience:	692 hours (of which 317 were on type) Last 90 days - 111 hours Last 28 days - 46 hours
Information Source:	AAIB Field Investigation

Synopsis

The accident occurred during a race as part of the Junior World Gliding Championships. During the final approach to cross the finishing line a glider, flying at a height of approximately 15 ft banked at an angle of about 20 degrees to the left, passed a group of spectators who were standing on vehicles outside the airfield perimeter. The left wing of the glider struck one of the spectators, a professional photographer, causing him fatal injuries. The glider made a largely uncontrolled landing in a nearby field. It was seriously damaged but the pilot was unhurt.

The investigation concluded that gliders involved in the race had been flying unnecessarily low during the approach to the finish. The accident and other evidence suggested a problem with the safe conduct of race finishes and deficiencies in the training for and oversight of such events. Since this accident, the British Gliding Association has been proactive in trying to address some of these issues but its rules do not apply to gliding Championships conducted in the UK under the International Gliding Commission Rules. The AAIB made five safety recommendations.

Factual information

History of the flight (pilot's perspective)

The pilot was participating in the Junior World Gliding Championships, held at Husbands Bosworth Airfield in Leicestershire. He was competing as part of the British team and on the morning of Tuesday 9 August, the third day of the competition, he attended a briefing for the day's task. This was to be an assigned area task to be flown for a planned minimum duration of three hours.

The pilot was aero-tow launched at about 1200 hrs and the start was opened at 1230 hrs. He crossed the start line at about 1300 hrs, flying between 3,500 and 4,000 ft, on a southerly track towards the first task area based on Towcester. The pilot flew into the area to a point near Kidlington before changing track to the west for the second area, based on Enstone. Here he flew into the area to a point near Chedworth, a disused airfield, before changing track for the final area based on Control Point East. This was a control point situated 10 km due east of Husbands Bosworth, designed to bring the competitors back to the airfield in line with the active runway. His final point was about 15 km from Husbands Bosworth Airfield at which time his flight computer was indicating that he already had sufficient altitude for the final glide back to the finish. The pilot recalls he was at between 2,000 and 2,500 ft which he believes was about 300 ft over his calculated minimum required for the final glide.

The pilot began his descent for the finish line flying at 80 to 85 KIAS, in close proximity to another member of the British team who was about 100 to 200 m ahead. Conditions were good and the glider was not subject to any sinking air, allowing the pilot to increase his speed to 110 KIAS some 2 to 3 km from the finish. He continued his descent so that by 1 km from the airfield the glider was about 50 to 60 ft agl.

The pilot continued his approach, crossing a field close to the airfield boundary in which was a set of wires. The presence of these wires was highlighted to pilots during each race briefing because a pilot returning to the airfield late in the day could be affected by a low sun ahead making these wires difficult to see. The accident pilot described his technique for crossing such obstacles. This involved flying low enough so that the obstacle could be clearly seen above the instrument cowling in the cockpit. At low airspeeds with a relatively high pitch angle, this would require the glider to be flown at or slightly below the height of the obstacle. He would then pull up in order to clear the obstacle. The pilot estimated the wires were suspended about 30 ft above ground level and that he would have flown below this height in order to see them against the skyline. He recalls pulling up to clear them by about 10 ft and then dropping down again on the other side to a height of about 15 to 20 ft to fly over the adjoining field. The field contained a standing crop of wheat and was bounded by a hedge. The pilot stated he could see a red box shaped vehicle ahead of him at the end of the field with about three or four people standing on it taking photographs. He did not recall seeing any other people or vehicles. The pilot also stated that he was flying towards the sun which, by then, was low in the sky.

The pilot stated he was concentrating on the finish line and his intended landing for which he needed to identify a suitable area of the airfield. Several gliders had already landed and were clearing the landing area. He also needed to avoid his team mate and another glider, Both of which were finishing just ahead of him. The pilot remained aware of the people on the vehicle by the hedge at the edge of the field but considered he was high enough to clear them. He estimates by this point his speed had reduced to about 70 KIAS. He stated that the glider's 'clean' stall speed is about

40 KIAS and that the minimum approach speed to land safely was about 55 KIAS.

The pilot recalls easing back on the control stick slightly as he approached the hedge; but he did not recall banking. He stated that he looked out over to his right to see when he was clear of the photographers as they had disappeared from sight below the nose of the aircraft. Then suddenly there was a massive bang and the glider slewed to the left and climbed to about 100 ft. It then pitched down, yawed left and accelerated whilst he tried to regain control to raise the nose, control the yaw and bring the wings level. He then lowered the landing wheel in expectation of crashing in order to cushion the impact. The glider continued to roll right and the pilot applied full left aileron, but to little effect. He then instinctively opened the airbrakes and almost immediately the glider hit the ground, one wing low, slewing it round before coming to rest. The pilot was uninjured in the impact and was able to open the canopy, although it was slightly jammed. He climbed out and was soon met by various witnesses coming to his aid.

History of the flight (ground perspective)

As on previous days during the competition, a small group of spectators had gathered late in the afternoon under the final approach to the airfield to watch the gliders as they approached the finish line. On this particular afternoon, five vehicles had driven about 100 m off the main road, bounding the southern boundary of the airfield, along an unmade farm track which ran beside a hedgerow. This hedgerow was about 900 m east of the landing area and the position of the vehicles was under the flight path of the gliders as they came in to land (see Figures 1 and 2). Some of the occupants then climbed on to their vehicles to get a view over the hedge of the gliders coming towards them. Amongst these spectators was a small group from one of the gliding teams standing on top of their red van. Next to them was parked a large silver-coloured estate car, on the roof of which stood a professional photographer who was wearing an orange T-shirt. The photographer specialised in taking photographs of gliders and had been covering the previous days of the competition. In conversation with the group on the van, he had told them that on the previous day, he had seen gliders brushing the edge of the trees and he had been forced to jump from the roof of his car in order to avoid a low-flying glider.

The spectators by the hedge watched and took photographs as the gliders started to return to the airfield. Various witnesses commented on the low height of the gliders as they flew across the field in front of the hedge behind which the vehicles were parked. The witnesses on the van stated that they were aware of the glider involved in the accident pulling up over some wires two fields in front of them before dropping down to a very low height as it flew across the field directly beyond the hedge behind which they were parked. They commented that other gliders had also flown very low over this field; however, this particular glider had remained low beyond the point at which the other gliders had pulled up to clear the hedge. One of these witnesses stated that he shouted a warning to his friends and then saw the glider start to bank when it was about 20 m in front of them. He stated the fuselage passed just to the right of the van at a low height with the glider still banking with the left wing low at an estimated bank angle of 20º. The witness shouted a warning to the photographer and then saw the glider's left wing strike him about two thirds of the way along the wing towards its tip. The photographer fell from the roof of his car landing on the bonnet of the car parked alongside. Some of the spectators in the vicinity then began to administer first aid whilst others drove back to the airfield to summon help.

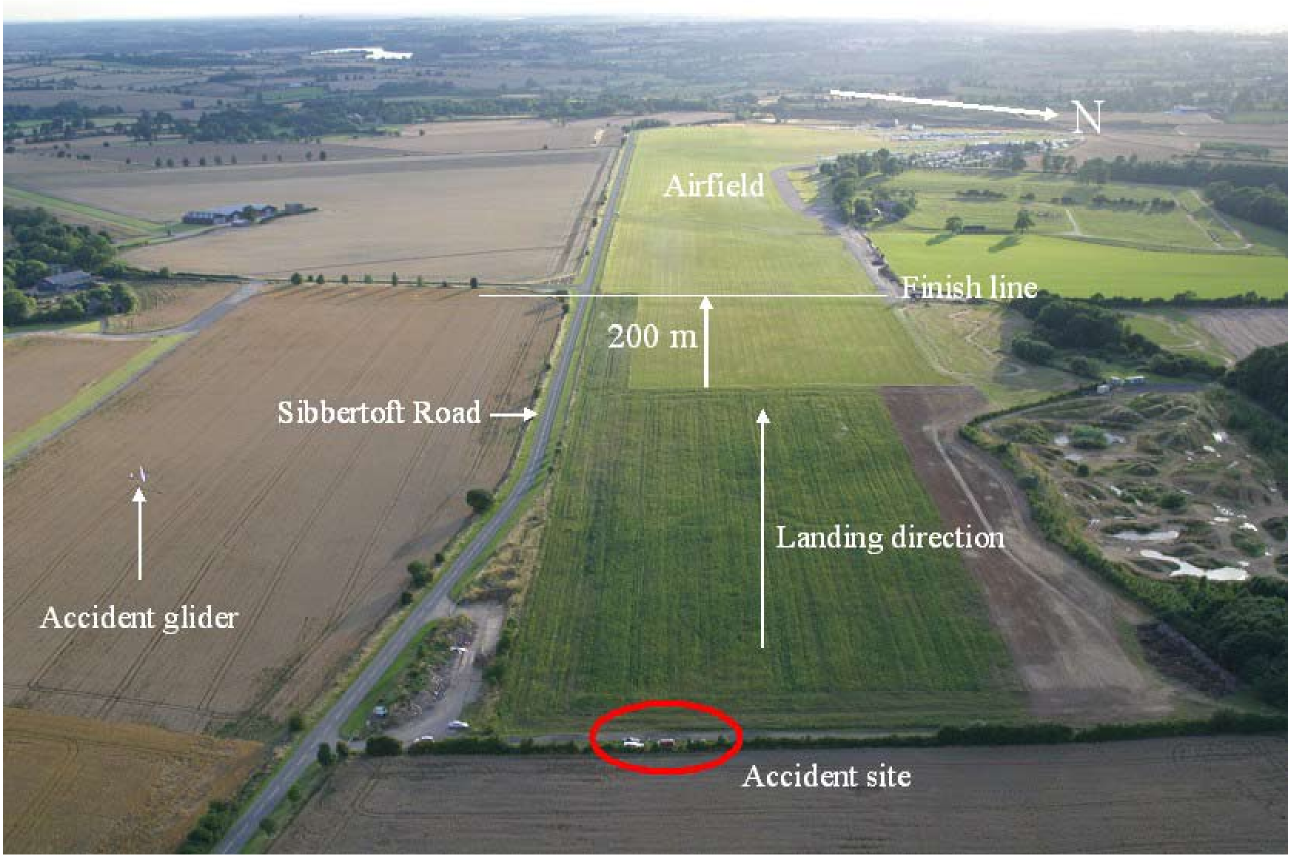


Figure 1

Accident site relative to Husbands Bosworth Airfield

Figure 2

View looking east of vehicles parked in the lane

Post impact actions

Although the race organisers were not immediately aware of the injured photographer, having seen the glider crash, they summoned the emergency services. The pilot was somewhat shaken but otherwise uninjured and on arrival, the emergency services attended to the photographer. One of the spectators estimated that an ambulance had arrived within 10 minutes, followed shortly afterwards by the fire services. The police helicopter, based only about a mile away, also responded, landing next to the accident site to offer any assistance it could. Finally, the local air ambulance, based at East Midlands Airport, was tasked to attend the scene.

When made aware of the injured photographer, the race organisers realised that his location, and that of those attending to him, was below the flight path of the finishing gliders and they made repeated radio broadcasts for competitors to finish no lower than 200 ft over the finishing line. These broadcasts were made on the radio frequency used by the competitors at the finish to inform the race organisers that they were five minutes and one minute from landing, as required by the competition rules.

The air ambulance was aware that a gliding competition was in progress at Husbands Bosworth Airfield because the competition had been notified in NOTAM H2724/05. However, the NOTAM made no mention of any new ATC frequencies being used. After takeoff, the air ambulance pilot checked with East Midlands ATC to confirm if there was an additional ATC frequency in use during the competition but ATC were unaware of any such frequency and suggested that the pilot use the gliding common frequency of 129.97 MHz. This was also the frequency published in the pilot's aeronautical guide for Husbands Bosworth Airfield. The air ambulance pilot stated that on arrival at Husbands Bosworth, he made several calls to the airfield on this frequency but without response. He was aware of numerous gliders making an approach to the airfield, describing some as being as low as 15 to 20 ft whilst still outside the airfield boundary. He instructed his crew members to keep a good lookout and switched on all the helicopter's external lights to make it as conspicuous as possible. The pilot was then marshalled to land close to the scene of the accident by one of the crew members from the police helicopter in attendance. The police helicopter departed shortly after the air ambulance's arrival.

The photographer continued to receive medical treatment at the scene for at least 20 minutes after the arrival of the air ambulance. During that time gliders continued to fly low overhead and on one occasion, so low that those at the scene were forced to dive to the ground for fear of being hit. After this protracted period of treatment, the photographer was eventually transferred to the air ambulance. As the air ambulance was preparing to depart, the police helicopter returned and was able to pass the appropriate competition frequency of 134.55 MHz to the air ambulance pilot. After making a call on this frequency, notifying its imminent departure, the air ambulance departed for the Queens Medical Centre in Nottingham where the photographer later died.

Airfield description

Husbands Bosworth is a large grass airfield on the border of Leicestershire and Northamptonshire and is home to one of the UK's largest gliding clubs. Activity at the airfield is confined to gliding and the operation of light aircraft involved in glider aero-tow launching. The takeoff and landing area is orientated east-west with Sibbertoft Road running parallel to the southern boundary of the airfield. Not far beyond the road to the south are two additional grass landing strips. These are both privately owned and are solely for the use of light aircraft operated by the respective strip owners. Further south, and in close proximity to these two airstrips, is the permanent base for a police helicopter which is jointly operated by the three adjacent police forces of Leicestershire, Northamptonshire and Warwickshire.

The approach to the airfield from the east is generally over farm land. However, there are farm buildings situated about 1,200 m from the landing area, on the northern edge of the approach path. The wires highlighted to competitors in the pre-race briefing were telegraph wires running through a field west of, and adjacent to, the access road to this farm. The telegraph poles were approximately 30 ft high and the wires dipped between them to a height of about 27 ft.

Accident site description

The accident occurred outside the eastern boundary of Husbands Bosworth Airfield. The photographer's vehicle had been parked on a grass area to the right of a farm track that ran north from Sibbertoft Road. The position of the vehicle was roughly 350 m from the airfield's eastern boundary and 900 m east of the start of the landing area. In addition to the photographer's vehicle, there were four other vehicles parked in the vicinity. A red van and a black car were both parked to the north of the photographer's car and a black car and a silver car were parked alongside each other to the west. At the time of the accident the photographer was standing on his vehicle, giving a combined height of approximately 11 ft. There were also four spectators on the red van with a maximum height (with the spectators standing) of about 12 ft. A hedge ran north-south just to the east of the vehicles.

The height of the hedge varied along its length but in the area of the cars it extended to a maximum height of about 15 ft.

Examination of the bushes and the vehicles did not reveal any contact damage from the glider. However, the black car had extensive damage to its bonnet, consistent with the photographer striking it after being hit by the gilder.

Glider examination

The glider came to rest in a standing crop of wheat, about 400 m to the south-east of Husband's Bosworth Airfield and to the left of Sibbertoft Road. Figure 3 is a picture of the glider just before it struck the ground. Inspection of the glider revealed extensive damage to the left wing, with pronounced damage about 3 ft inboard from the wing tip. The left aileron had completely detached and was found lying against the fuselage. The only other noticeable damage was to the right winglet, consistent with contact with the wheat. Detailed examination of the glider did not reveal any pre-accident defects with its structure or flying controls.

Figure 3

Glider just before ground impact

Glider's attitude and height at impact

From examination of the accident site and the glider, it was apparent that the photographer had been struck by the leading edge of the left wing. The damage to the glider's left wing indicated that the strike occurred about 3 ft inboard of the left wing tip. Using this evidence, together with video recordings (described in detail below), it was found that the manoeuvring glider was banked at least 20º to the left when it struck the photographer. The height of the glider fuselage at this point was estimated to be about 15 ft agl (see Figure 4a). Had the glider been in a wings-level attitude at a height of 15 ft agl, it would have cleared all of the obstacles and the spectators (see Figure 4b).

Flight recorders

Competition rules required all the competing gliders to be fitted with an International Gliding Commission (IGC) approved GNSS[1] flight recorder[2] programmed to record the glider's altitude (both GPS and barometric) and its geographic position at intervals of 10 seconds or less. However, most competitors voluntarily carried a second 'back-up' recorder. Competitors' recorders were analysed at the end of each race in order to determine the distance covered by each glider, the time taken to do so and to confirm that no time or altitude infringements had occurred.

Analysis of the information recorded for the race during which the accident occurred indicates that the club class gliders were all below 500 ft agl some 2 nm (3,704 m) before finishing the race, and in one case 3 nm (5,562 m). It further indicates that the majority of gliders were below 250 ft agl at least 1.5 nm (2,778 m) prior to crossing the finishing line.

Using the recorded data, a plot was created of the accident glider's track and that of the two preceding gliders as they approached the airfield (Figure 5).

Photographic and video evidence

A considerable amount of recorded video and photographic evidence was available of the period leading up to, and including, the accident. The video imagery was analysed by the National Imagery Exploitation

Figure 4a

Impact banked

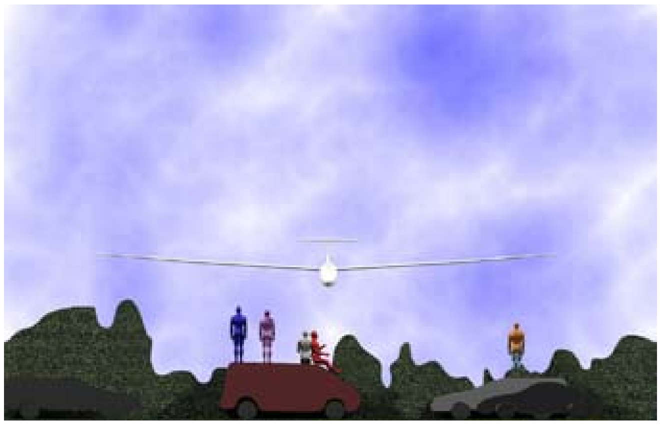


Figure 4b

Glider wings-level at 15 ft agl

Footnote

1 Global Navigation Satellite System.

2 Most IGC-approved GNSS FRs integrate the GPS and other functions such as a barograph in one sealed case.

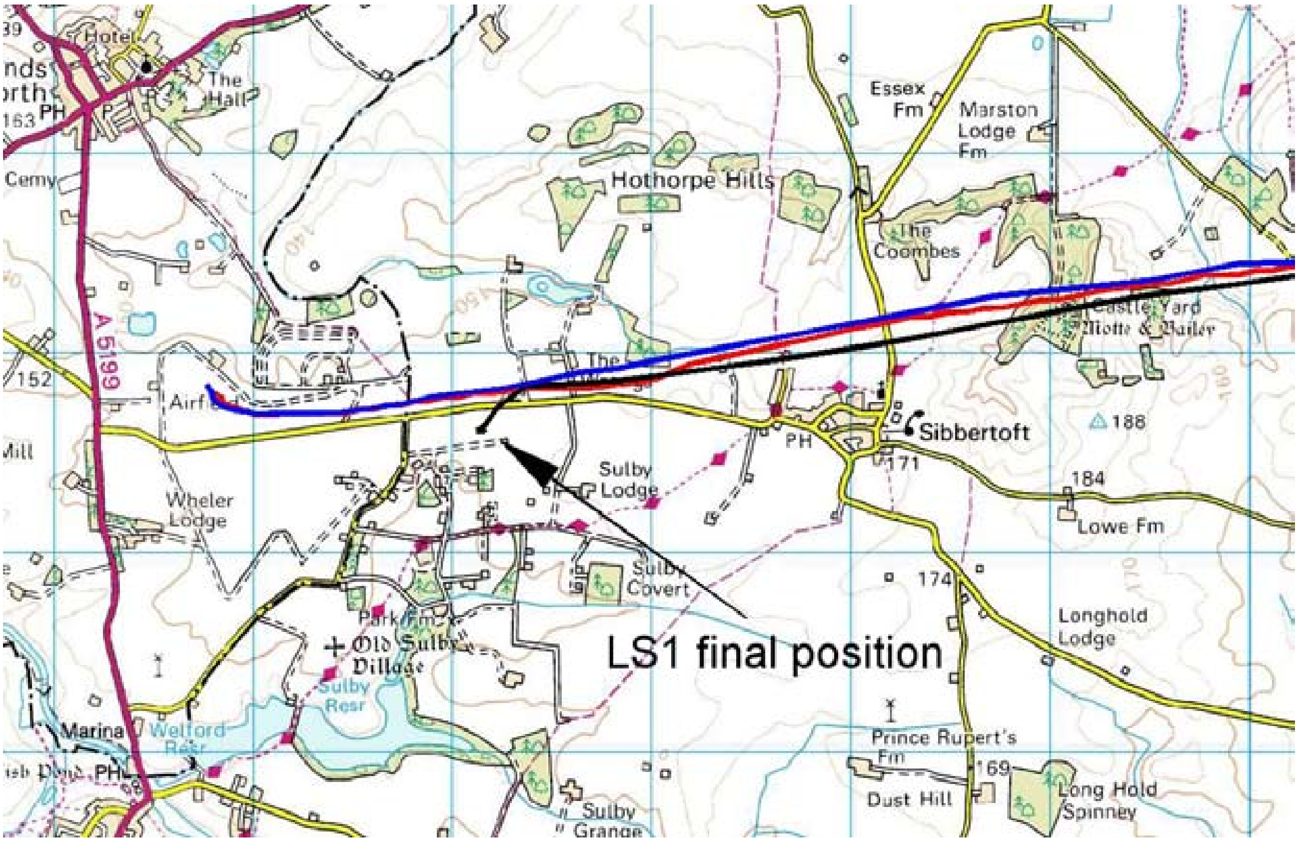


Figure 5

Ground tracks of gliders approaching the airfield

Centre. This evidence showed gliders descending on the approach to the airfield to a very low height before pulling up to clear the wires running to the farm which were at or below 30 ft agl. Gliders could then be seen descending again to below 30 ft agl to cross the field in front of the photographer. The gliders then pulled up to clear the hedge in front of the photographer before proceeding to cross the finishing line on the airfield.

Video imagery showed the accident glider approaching the airfield from the east. Nine seconds before striking the photographer, it gained height to clear the 30 ft high telegraph wires by 2.5 ± 0.5 m (between about 6 and 9 ft). After clearing the wires it descended to a minimum height of 1.4 ± 0.2 m (about 4 ft) above the crop until 1.7 seconds before striking the photographer when it began rolling to its left and climbing.

Photographs recovered from the deceased photographer's camera show the two gliders finishing just ahead of the glider involved in the collision. The first glider passed just to the north of the photographer whilst the second passed just to the south. Both gliders were extremely low as they passed over the field immediately to the east of the photographer with some photographs appearing to show that the photographer was looking down on the gliders from his vantage point on the car roof (see Figure 6 in which the pilot and glider have been disidentified). Photographs recovered from the photographer's camera also showed other pilots clearly waving at him as they flew past at low height.

The last two photographs on the photographer's camera are of the glider that struck him. These, together with other video imagery, showed that he had the camera up to

Figure 6
Photograph of an approaching glider

his eye whilst the glider crossed the field in front of him. Video evidence showed the photographer was standing upright, ducking at the last moment before being struck by the glider's left wing.

Pathology

The pathologist's report indicates that the injuries sustained by the photographer were consistent with him bending down at the time of the impact.

Pilot's background

The pilot started flying paragliders in 1999 and gliders in 2000. He first flew in gliding competitions in 2002. Since then he had flown in competitions at numerous UK airfields, including several previous competitions at Husbands Bosworth. He had also flown gliders in Italy, South Africa, Australia, New Zealand and Spain, and had competed in South Africa and Spain.

In January 2004 the pilot moved to South Africa, taking his glider with him. In July 2004 he returned briefly to the UK to take part in the British Junior National Championships, at which he secured a place on the national team for the 2005 World Junior Championships. He continued to compete whilst in South Africa and came third in the country's National Championships early in 2005. He returned to the UK in March 2005, basing his glider at Husbands Bosworth, although he flew at numerous other locations for training. This included official training for the British team in Spain, culminating in a week's training at Husbands Bosworth immediately prior to the commencement of the World Junior Championships on 6 August 2005.

The pilot stated that he had never received any formal training in conducting the final glide for competitions; he had developed his technique through experience. He did, however, comment that occasionally he had been able to fly with a coach in a two-seat glider during team training events and had discussed that aspect of his race technique at these times.

BGA Junior Team training

The BGA's perspective on the training given to the Junior Team members differed from the accident pilot's recollection. Initially, the Association stated that training in the management of final glide finishes is not provided within an official BGA or Fédération Aéronautique Internationale's (FAI) syllabus. However, later, the BGA stated that the syllabus used by the British Team coaches present at the Junior Team training camp in Spain during April 2005 included final glides in its list of topics. The BGA further stated that this element of the coaching placed emphasis on achieving an efficient and safe approach to the finish line and that the accident pilot was advised on how to manage the final glide to a competition finish.

Pilot's medical

The pilot held a valid JAA Class 2 medical certificate. The certificate required that he wear corrective lenses and limited him to day VFR flights only because his red/green colour perception was deficient. At the time of the accident the pilot stated he was wearing corrective contact lenses and non-prescription sunglasses tinted medium-brown.

Photographer's background

The photographer had been a freelance professional in the aviation field for some years and was also a qualified glider pilot. He specialised in taking photographs of gliders and many of his pictures appeared in gliding magazines and associated publications. His photographs were used extensively in the programme for this competition, including that on the front cover. In the course of his work he covered many of the main gliding competitions, both in the UK and abroad. As a result, he was known to many people in the gliding world. He would normally wear an orange coloured top when photographing at such events.

Competition description

The competition, the World Junior Gliding Championships, was held between 6 and 20 August 2005. It was organised as a joint venture by the British Gliding Association and the local Soaring Centre. The competition rules were the international rules set down by the FAI's delegated gliding authority, the International Gliding Commission (IGC). Competitors were required to observe the 'Rules for World and Continental Championships' as modified or amplified by 'Local Procedures', also approved by the IGC. These Local Procedures were the method by which the competition organisers' requirements and restrictions could be notified to competitors. A list of the IGC's approved competition penalties are included at Appendix 1.

There were about 60 pilots competing from 18 different countries and they were required to be under the age of 25 years at the time of the competition. Details of the event and the pilots competing were included in the competition programme. The programme featured, on its cover, a photograph of a glider flying low over a field prior to landing. The photograph had been taken at a previous competition at Husbands Bosworth Airfield (see Figure 7), by the photographer who was fatally injured in this accident. The official language for the competition, as with all IGC races, was English. Gliders were divided between two different classes: standard class and club class. Standard class was for gliders with a maximum wing span of 15 m and no wing flaps, but with no other limitations. Club class was for older gliders which had previously been in the standard class, but which had now been superseded. The club class aircraft flew under a handicapping system based on the type of glider.

Competition took the form of both racing tasks and area tasks. A racing task consisted of gliders flying round a set course, generally of 100 to 300 km in total length. The results were determined by ranking the pilots in order of the time taken to complete the course, the winner being the pilot who finished in the quickest time.

An area task also involved flying around a set course. In this case, however, turning points were replaced by designated areas. Pilots determined how far they would fly into each of these areas before heading for

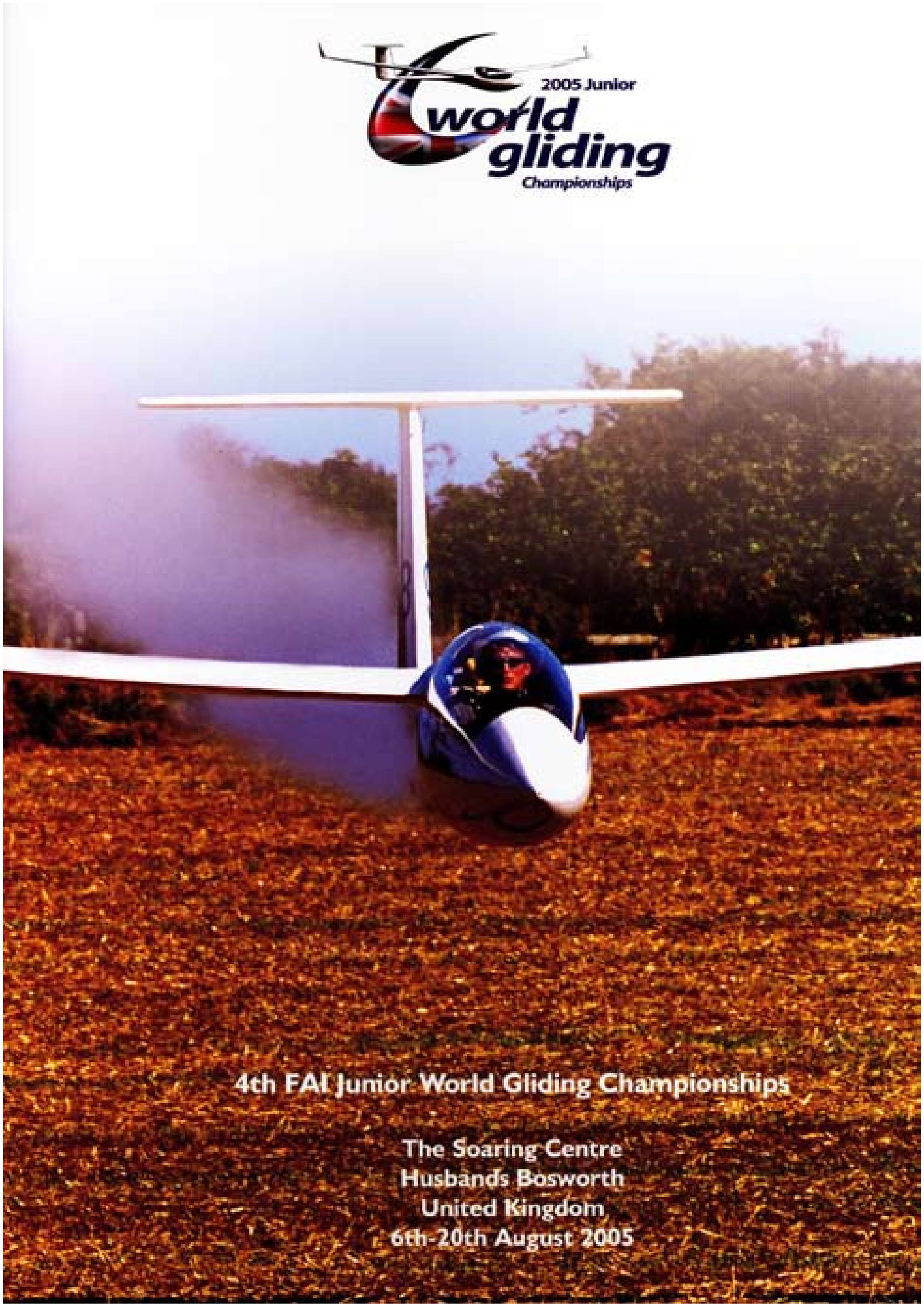


Figure 7

2005 competition cover photograph

the next one, aiming to remain airborne over the course for a specified time, generally three hours. The total distance achieved after crossing the start line was then compared against the time taken, in order to calculate the average speed.

The finish was the same for both types of race. For this competition, the finishing line was 1,000 m long extending perpendicular to the landing direction, running south from the northern edge of the airfield. Its position was marked by the presence of a scaffolding tower on which stood the competition officials. The line was positioned about a quarter of the way into the airfield, in the direction of landing. Its location was such that, once crossed, gliders would either have sufficient energy remaining to complete a circuit before landing or, if not, have sufficient distance ahead to be able to land. The competition rules stated that the minimum height for crossing the finish line was 100 ft agl, except when landing straight ahead.

Each day the race organisers chose the type of competition and the route to be flown depending mainly on the prevailing weather conditions.

Race technique

Having completed the required course, pilots attempt to set course direct for the finishing line as soon as they reach a point where they consider they have gained sufficient height to be able to do so under the prevailing conditions. This portion of the flight, known as the final glide, is critical in achieving a good result. If the glider is too high when starting the final glide, it will cross the line with surplus energy remaining and the pilot will have wasted time in achieving the unnecessary height. If, however, the glider is too low when starting the final glide, there is a danger that the glider will have insufficient energy to cross the finishing line resulting in it landing short. Consequently, the final glide forms an important part of the race.

Glider pilots have different methods of calculating the point at which to commence their final glide. The accident pilot used a final glide computation employing the McCready theory[3]. He used a small computer which compared the glider's current position with that of the finish, taking into account any remaining part of the course still required to be completed. The computation then monitored the climb rate achieved in the final thermal and took into account the wind and thermal conditions to determine the best glide speed and the altitude required to achieve the fastest return to the finish. The pilot would then continue to climb higher, generally by about 200 to 300 ft, adding a margin to insure against any sinking air that might exist on the final leg.

Once the pilot sets out on his final glide, should there be no adverse thermal conditions, then any margin added in the final climb equates to additional potential energy that can be usefully converted into speed. Thus, once he is assured of crossing the finishing line, the pilot seeks to increase his speed such that he crosses the finishing line with minimum safe energy remaining.

In order to maximise the use of any excess energy during the latter stages of the final glide, pilots in a race may descend to a low level some distance from the finish line. Sinking air is not encountered at this level and if low enough, the glider may also benefit from being in ground effect. Ground effect is encountered below a height equal to about half the glider's wingspan.

Footnote

3 In the 1950s McCready devised a means of calculating the optimum speeds to fly between thermals based on the performance of the glider, the sink rate between thermals and the rate of climb in the next thermal.

Flying in ground effect minimises induced drag but has no effect on profile drag. Therefore, flying in ground effect is most beneficial when the glider is flying at low airspeeds. If the altitude at the start of the final glide is insufficient for the conditions subsequently encountered, then flying low may be the only way to conserve enough energy for the glider to reach the finish line.

Control of spectators at gliding competitions

On the day of the accident, no attempt was made to control or influence the presence of spectators beneath the final approach path. Moreover, evidence was found of low flying in close proximity to people during the final approach phase of other international competitions. For instance, photographs published on the Internet of the 2005 FAI European Championships held overseas show spectators close to gliders in the late stages of the final glide to the finishing line. Two examples are shown in Figures 8 and 9 below; the gliders and their pilots in these examples have been deliberately disidentified.

It is not possible to determine from the photographs the distance of these spectators from the finish line but the gliders were reportedly crossing the airfield boundary shortly before finishing. There are several spectators within a few metres of the low-flying gliders and neither glider appears to have extended its landing gear. The alignment of the shadows indicates that the pilots were looking 'into sun' which could have made it more difficult for them to see the spectators. Some spectators appear to have resorted to crouching down to increase their separation from the gliders.

NOTAMS

In order to allow penetration of specified areas of controlled airspace during the competition, the organisers applied for a temporary exemption from Rule 21 of the Rules of the Air Regulations 1996. This application was made to the Terminal Airspace Section of the CAA. The competition was also notified to the CAA's Airspace Utilisation Section (AUS). Although no specific request was made for a NOTAM to be published advising of the competition, there was an expectation that one would be published because this had occurred under similar circumstances in the past.

Figure 8

Glider and spectators

Figure 9

Glider and spectators

Information provided to the AUS was forwarded by them to the Aeronautical Information Section (AIS), the unit responsible for publishing NOTAMs and which is managed by National Air Traffic Services (NATS). The AIS duly published a NOTAM advising details about the scope and duration of the competition. However, no frequency information had been provided to the AUS by the competition organisers. This may have been because the competition organisers did not apply to the spectrum management section of the CAA's Directorate of Airspace Policy in time for the competition frequencies to be allocated and then notified to the AUS. Consequently, the NOTAM did not contain information about the communication frequencies allocated for use during the competition.

CAA Aeronautical Information Circular (AIC) number 86/2004 advises that organisers of unusual aerial activities should notify the AUS by means of the standard notification Form SRG 1304 (Special Events and Unusual Aerial Activity Application Form). The AIC states that this information is used to ensure that:

> *'the Activity is notified to other airspace users through the NOTAM system'.*

Form SRG 1304 does not request information on the radio frequencies to be used.

Traditionally, the BGA had not used Form SRG 1304 to notify the AUS of competitions it intended to hold. AUS staff stated they were happy with the unofficial means of notification used and that any information they required which was not provided under this system was obtained by the AUS contacting the BGA. The original information provided by the BGA about this and other competitions in 2005 made no reference to frequencies to be used at the events. Similarly, the AUS Airspace Co-ordination Notice produced by the AUS for the World Junior Gliding Championships made no reference to radio frequencies used during the competition.

After the accident, the race organisers tried to get the competition frequency for the airfield published by NOTAM. To do this they contacted the AIS who informed them that because Husbands Bosworth was not a licensed airfield, they would be unable to publish a NOTAM of that nature relating to the airfield.

Radio carriage

In order to compete, each glider was required to carry a radio transceiver capable of operating on the competition frequencies. RTF messages were used by the race organisers to announce the start line opening time to competitors and for competitors to inform the race organisers that they were approaching the finish line. Calls on the main competition frequency of 134.55 MHz were required five minutes and one minute before crossing the finish line. This frequency was also used as the safety frequency.

Rules of the Air Regulations

New low-flying regulations came into force on 1 April 2005, four months before the accident. This amended legislation (Rule 5) is reproduced in its entirety at Appendix 2. All aircraft, including the participants in any gliding competition held in the UK, should comply with the Air Navigation Order and Rules of the Air Regulations.

BGA Rated Competition Rules

The BGA's Competition Rules did not apply to this IGC sanctioned competition. However, the majority of gliding competitions in the UK are conducted under BGA Competition Rules and the Association modified its rules after this accident. The changes to the penalties sections of the rules are evident in the differences between the Association's 2005 Competition Rules (see Appendix 3) and its 2006 Competition Rules (see Appendix 4).

Analysis

Causal factors

The glider that struck the photographer was manoeuvring at about 15 ft agl as it popped up to avoid the hedge. Had it not been rolling, it would have passed over the people standing on their vehicles to watch the gliders, but only by a few feet at most. There were several people standing on vehicles beneath the final approach path so a small error of height judgement by the pilot as he flew the pop-up manoeuvre could have resulted in more than one person receiving fatal injuries, even if he had maintained wings level. The pilot was aware of the spectators on the van but he (and perhaps others) did not regard them as a hazard that they should clear by a substantial margin.

Whilst the accident pilot was aware of the spectators on the van, he stated that he did not see the photographer prior to the impact. The photographer purposely wore an orange top at gliding events to make himself more conspicuous but he may have been partially obscured behind the hedge and it is likely that the accident pilot's attention was drawn to the group standing on the red van as the largest object in the vicinity. Consideration was given to the colour of the photographer's orange shirt and the pilot's imperfect red/green colour perception but it was concluded that this was unlikely to have contributed to the accident. Indeed, the low position of the sun was more likely to have restricted the pilot's vision, a fact he had commented upon when interviewed. However, because the pilot seemed to have no problem in seeing the group on the van, it seems unlikely that his colour perception was really a contributory factor.

The photographer had a distorted view of the glider's relative position as he was viewing it through the lens of his camera and this, combined with the rapid onset of the rolling manoeuvre, meant he had insufficient time to drop clear of the wing or jump off his vehicle (as he had done the day before) and he received fatal injuries.

The spectators under the final approach placed themselves in an area where they knew the gliders would be low, and furthermore, they chose to sit or stand on their vehicles to get a better view. These spectators were all involved in the competition and should have appreciated the risks involved. The photographer had positioned himself in comparable positions before so he must have been aware of the risks involved but perhaps he chose to accept those risks in order to obtain some unusual and exciting photographs of gliders.

Before the race, the photographer may have actively made pilots aware of his location. This possibility cannot be substantiated but he was not the only person who chose to be in that area on the day of the accident and others were also taking photographs. Moreover, it seems improbable that all the pilots who were flying very low were doing so in the hope of creating a good photographic opportunity.

The nature and extent of the low flying, and the speeds of the gliders finishing the race, suggest that the flying witnessed during this race was not due to the gliders being low on energy. It is likely that the majority of the pilots believed it was an acceptable racing tactic.

Low flying risks

The glider that struck the photographer may have been flying lower than others finishing the same race, but being a competitive event, if one pilot used this tactic and it was thought by others to offer an advantage, then all of them were likely to adopt a similar technique. Consequently, many of the gliders were finishing the race at heights which placed them in ground effect (ie less than half a wingspan). They were flying at such heights for as much as 1,000 m before they reached the airfield boundary.

Flight at very low height did not present a particular risk to people within the confines of the airfield because the race organisers had control of activities on the airfield and spectators were positioned to the side of the flight line rather than under it. However, some pilots' racing tactics did present a significant risk to people under the flight path, whether they were spectators or not, and for several hundred metres outside the airfield boundary.

The vehicles parked in the lane where the accident occurred were largely hidden by the trees of the hedgerow from the view of the low-flying glider pilots crossing the field leading up to the lane (as shown in Figure 2). However, the spectators standing on the vehicles should have been visible to the glider pilots although they would not necessarily have been particularly conspicuous. On the other hand, as some video recordings showed, the spectators standing on their vehicles could be seen clearly by people on the airfield standing close to the finishing line. The white clothing of one spectator made that person very conspicuous. The lane was a place where, at the time of the accident, the race organisers attempted no control or influence over the presence of people. It would seem that those in authority were either unaware of these people or were content to tolerate their presence. Nevertheless, during subsequent race days at Husbands Bosworth, the competition officials wisely positioned a member of staff at the entrance to the lane to discourage people from standing there.

The pilot's described technique for clearing obstacles such as low wires, tree lines and hedges was flawed because if a pilot is not to leave the pull-up too late, he or she has to concentrate their gaze on the obstacle, which is above the horizon. This narrow focus of concentration is exacerbated if the glider is racing in close proximity to other gliders, for the pilot may also have to monitor other pilots' manoeuvres to minimise the risk of an aerial collision. Consequently, the pilot is less likely to see people or obstacles at a similar height to the glider and might have to make sudden rolling manoeuvres to avoid other gliders or re-position towards a clear area for landing. As in this case, unexpected manoeuvres may compromise a spectator's ability to avoid a glider they are watching.

This accident and the photographs at Figures 8 and 9 demonstrate that there is a tendency for spectators to position themselves deliberately outside the confines of the airfield, where the competition organisers may have no effective authority to exclude them. These people may accept or underestimate the personal risks they take. However, there is also a risk to other people who might not be spectators or not involved in gliding and who happen to pass beneath the final approach path, even though they may be hundreds of metres from the finishing line. To ensure a safe margin of clearance between gliders and people during a competition finish, there appear to be only two options: exclude people from the area beneath the final glide or ensure that gliders to do not fly so low that they risk colliding with a person.

Low-flying regulations

The Local Procedures specified '*the minimum for crossing the finishing line, except when landing straight ahead, is 100 feet AGL'*. These Local Procedures did not mention any requirement to observe the UK statutory low-flying regulations, nor did they specify any minimum height before crossing the finishing line or any clearance height by which spectators were to be avoided.

Most competitors landed straight ahead. By landing immediately after crossing the finishing line, the pilots were in effect carrying out two tasks in quick succession but treating them as concurrent manoeuvres. In doing so, some may have thought that because ultimately they were landing, they were absolved from the obligation to observe Rule 5 whilst they were racing towards the finishing line. However, gliders do not normally approach a glider site at high speed and very low height requiring pop-up manoeuvres to avoid obstacles outside the airfield boundary. Usually, they land from an approach involving a gradual descent at moderate airspeed, crossing the airfield boundary at a height that does not normally present a risk to spectators or passers-by. Therefore, it is clear that the finishing technique used in this race by many of the competitors did not constitute '*landing in accordance with normal aviation practice*' (see Rule 5 para (3)(a)(ii)) which automatically exempts pilots from having to observe the '500 feet rule' stipulated in para (2)(b)).

A further exemption from the '500 feet rule' exists for aircraft taking part in flying displays, including air races, (see Rule 5 para (3)(f)) when '*within a horizontal distance of 1,000 metres of the gathering of persons assembled to witness the event*'. In discussing the implications of this regulation with the CAA, their representative believed that this exemption was intended to apply only where a specific permission for the event has been received from the CAA. Such permission would be specific and would include the area and lowest height over which the low-flying exemption would extend. In the representative's opinion, the Authority would be unlikely to approve heights below 100 ft outside an airfield boundary.

Section 8.9 of the IGC rules in force at the same time stated the penalties in force for dangerous or hazardous flying and gave a list of specific examples and penalties. Included in these were '*Finish: crossing below height or altitude limit*' and '*Finish: hazardous manoeuvre*.' The penalties applicable varied from a warning for the first offence through losing 25 points to disqualification from the competition.

By examining these rules it might be considered that sufficient regulations existed at the time which would actively have prohibited the nature of the low flying witnessed. The fact that they didn't suggests that neither the competitors nor the race officials believed it constituted dangerous flying. Indeed, one competition official stated:

> *"Most had been flying the same pattern, arriving at the last hazard, the power lines in the distance, then diving down. This converts the safety margin of height they had at the lines to speed in order to finish quickly, and is a common and sound competitive tactic."*

The fact that, after the accident, race officials thought it appropriate to brief pilots that they should not fly unnecessarily low when approaching the finish is therefore of note. Equally of note is the fact that when racing re-started, there appeared to be no repetition of the very low flying and 'pop-up' manoeuvres previously witnessed, yet the competition seemed unaffected.

IGC response to the accident

The accident was discussed at an IGC Bureau meeting held in Paris in October 2005 but before the full details of the accident were available to the Committee. At that time the Bureau believed that the most positive step to reduce the chances of a similar accident was to revisit the way in which the IGC gives advice to contest organisers regarding control of the public and advice to pilots when finishing a race. The IGC stated that they were in the process of changing the way in which they ensure the quality of their events. Part of that process was to include advice on the handling of spectators and how to organise the final glide route to minimise the risk to both pilots and spectators.

BGA response to the accident

After this accident, the BGA clarified and expanded their race competition rules relating to dangerous flying, specifically at the finish. These changes were included in their competition rules for 2006. Regarding dangerous flying during the finishing of a race, the changes applicable to competing pilots were:

Finish and approach to finish – hazardous manoeuvre, including:

1) *any sudden change of attitude other than for the purposes of avoidance of other aircraft, airfield objects or people.*
2) *Proximity to ground and obstacles of less than 30 ft. except when landing (characterised specifically by cracked airbrakes and wheel down or low energy <70 knots IAS).*

Changes applicable to the organisers and race officials were:

'The event Director must now appoint an additional specific safety officer, who may if required also be the Deputy Director, to ensure that flying conduct relating to finishing is continually monitored by one or both.'

Compliance with Rule 5 of the Rules of the Air

The BGA oversees most gliding activities in the UK, including the conduct of the majority of gliding competitions. The CAA does not regulate gliding but glider pilots are still required to comply with the Rules of the Air. Specifically, the wording of Rule 5 does not absolve glider pilots from observing the low-flying restrictions except when hill soaring.

Rule 5 permits an element of low flying closer than 500 ft to people and obstacles so long as an aircraft is landing or taking off in accordance with normal aviation practice. However, manoeuvring a glider at heights less than half a wing span can place a wing tip so close to the ground that, if the glider is not within a cleared or protected area, it presents a significant risk of collision with unseen persons or obstacles. Consequently, flying at heights below half a wing span outside an airfield boundary places other people at real risk, particularly in circumstances where a person blends into the background or is not looking in the direction of the glider. The risk described may be infrequent but, as this accident demonstrated, the consequences are likely to be fatal for the bystander or walker who does not hear or see the glider.

The changes to the BGA's competition rules that arose from this accident are evident in the differences between the Associations's 2005 competition rules (Appendix 3) and its 2006 competition rules (Appendix 4). These changes should be welcomed. However, although the outcome might well be beneficial, a minimum height of 30 ft does not necessarily ensure the safety of spectators underneath the final approach path, particularly since 'persons' are not mentioned in the revised competition rules. Consequently, to control the hazards to spectators and competitors, the BGA competition rules may need further refinement, particularly since they appear to be in conflict with the provisions of Rule 5. Therefore, it was recommended that:

Safety Recommendation 2006-119

The British Gliding Association should seek approval from the Civil Aviation Authority for the wording of the Association's competition rules in respect of the minimum height for finishing a race.

Furthermore, if the BGA considers that a competition finish cannot comply with Rule 5, a dispensation in accordance with Rule 5 (3)(f) (flying displays or air races) might be required from the CAA. Since the wording of Rule 5(3)(f) does not specify that prior permission from the CAA is required before holding *'a flying display, air race or contest'*, the Authority's policy would benefit from clarification and publication. Therefore it was recommended that:

Safety Recommendation 2006-120

The Civil Aviation Authority should clarify and publicise whether permission from the Authority is required before exemption from the 500 feet low-flying rule in accordance with Rule 5 (3)(f) is applicable.

Training and qualifications

No specific training is required to take part in gliding competitions but the IGC specifies minimum qualifications and experience for international championships. Competitors are expected to familiarise themselves with the FAI Sporting Codes as well as the Rules and Procedures issued for the event. They are also required to sign a declaration that they have read these documents but no other mechanism is in place to ensure they have either done so or, more importantly, understood them. This is particularly relevant to events where English is not every competitor's native language.

The pilot stated that he had received little training or coaching in how to perform the final glide manoeuvre. It was a technique he had learned through experience gained during previous races, both in the UK and overseas. Such experience was shaped by witnessing the technique used by others and by the way the regulations were commonly interpreted by competition organisers.

The accident pilot believed that sinking air was unlikely to be encountered at low height. He also believed that although manoeuvring was inefficient, the penalty was small compared to the potential benefit of avoiding sinking air. By flying in ground effect where there was no prospect of encountering sinking air, he believed he was likely to obtain a net benefit from this tactic. However, his theory took no account of the prospect of low-level wind shears that might exist in the lee of line-elevated features and obstacles.

The role of team coaches

According to the BGA:

'manoeuvring unnecessarily at height or close to the ground is neither demonstrating good airmanship or efficient.'

Moreover, the BGA stated that had the 'pop-up' technique for clearing obstacles been observed during the British Team training events, the Team coaches would have criticised it for being 'unacceptably dangerous'. However, only the larger and better organised teams had coaches present at the competition and not every British Team coach was able to be present on every competition day. Also, the British Team coaches would have been unable to monitor their team pilots' individual final glides on a daily basis because, typically, they had other duties to perform in the coaching role. However, on the competition days following the accident, the British Team coach advised the Team pilots to finish 'high' and there was no repetition of the pop-up manoeuvres prevalent on the day of the accident.

Not every team had the benefit of a coach on the day of the accident but it is likely that some of the team coaches and competition officials were aware of the low-flying techniques used by many pilots during the finish. It seems that the final glide element of the race was neither being effectively trained nor properly monitored. This problem was more 'international' than 'national' and so it was recommended that:

Safety Recommendation 2006-121

The International Gliding Commission should, through national gliding associations, require, competition team coaches to include techniques for the safe conduct of race finishes within their coaching sessions.

Emergency response

The race organisers were able to respond quickly to the accident and the emergency services also provided a rapid response. However, the operator of the air ambulance reported that the lack of a notified frequency for the airfield during the competition had serious implications for the safety of their response to the incident. Another major problem was low flying by gliders over the emergency services in attendance.

The BGA notified the AUS of the event. However, they had not included, nor were they asked for, details of the frequencies used by the competition. The BGA did not traditionally use Form SRG 1304 to notify the AUS of their competitions and the AUS were content with this arrangement because they felt that they had all the information they required. It is unlikely that had the BGA used the Form SRG 1304, they would have supplied the frequencies and there was no prompt on the form for them to do so.

Had the competition organisers ensured that the normal airfield frequency for Husbands Bosworth remained monitored and answered, omitting to notify the competition frequencies to other agencies would have been of little significance. However, the consequences of aircraft being unable to contact the airfield had been overlooked. The police helicopter based nearby had been notified of the frequencies in use but only because of its proximity to the competition base.

Having become aware of the problem, there appeared to be no mechanism by which the race organisers were able to have the frequency change notified. The AUS have since informed the AAIB that they would have been able to amend the NOTAM relating to the competition to include the change of frequency had they been contacted. A method therefore existed to have the information published, albeit in a somewhat circuitous manner, which the race organisers could not have been expected to have known.

An immediate solution to the problem would have been to ensure the normal airfield frequency remained monitored for the duration of the competition. A future solution, perhaps, relies on the AUS and the AIS reviewing their procedures in light of this event. Although the BGA had not specifically requested a NOTAM be published advising of the competition, there was an expectation that one would be published, simply because this had occurred under similar circumstances in the past. Formal action to notify other airspace users about intensive gliding operations is both a courtesy and a safety measure which should always be carried out. Therefore, it was recommended that:

Safety Recommendation 2006-122

The British Gliding Association should comply with Civil Aviation Authority Aeronautical information Circular 86/2004 and include, in their notifications to the Authority, the frequencies to be used for the competition.

Safety Recommendation 2006-123

The Civil Aviation Authority should instruct National Air Traffic Services Ltd, the organisation that manages the UK's Aeronautical Information Section, to endeavour to include any non-standard radio frequencies in NOTAMs about gliding competitions.

Low flying after the accident

The emergency services were particularly concerned by continued low flying over their position as they attended the critically injured photographer. One overflight had been so low that they were forced to throw themselves flat on the ground for their own safety. The race organisers had made repeated transmissions on the finishing frequency that the competitors should not finish below 200 ft. The response by some pilots to these instructions suggests that perhaps they did not receive the message, did not understand it, could not comply with it due to a lack of aircraft energy or ignored it. The competitors were all required to transmit on the finishing frequency, both at five minutes and one minute prior to landing, so there should have been ample opportunity for them to have received the message. The language used during international gliding championships is English and so all competitors should be able to understand such an instruction.

Because the video evidence suggests that the gliders were not flying low due to a lack of energy, this raises the question as to whether the instruction was simply ignored, if not by all, then by at least some of the competitors. Certainly some were flying so close to the helicopter that the emergency services personnel felt threatened. This suggests that when flying so low, some pilots were unable to see well-lit obstacles directly ahead in time to avoid them.

This situation persuaded the race organisers to publish additional instructions to competitors before racing resumed. These instructions advised them of the announcements that would be made and the correct response to them, should there be an incident, either on the final approach or on the airfield. Logically, such instructions should form part of a normal competition brief and be included in Local Procedures.

Conclusion

A contributory cause of the accident was spectators deliberately positioning themselves too close to the finishing zone. However, the root cause was the practice of flying too low outside the confines of the airfield and resorting to pop-up manoeuvres to clear obstacles. This racing tactic, which was employed by many competitors, was unnecessary and it deprived them of a good view of obstacles ahead.

Pragmatic changes to the BGA competition rules should reduce the risk to spectators and competitors for competitions held under BGA rules. Some of these rules could usefully be incorporated into Local procedures for future competitions held in the UK under FAI Rules. Organisers of all gliding competitions should be encouraged to consider the public in their risk assessments. However, the BGA rule changes concerning low flying appear to be inconsistent with the Rules of the Air Regulations and these inconsistencies should be resolved. Omitting competition frequencies from the published NOTAM created additional and unneccesary risks for the emergency services attending the accident.

Safety Recommendations

During the course of the investigation, the AAIB made the following safety recommendations:

The British Gliding Association should seek approval from the Civil Aviation Authority for the wording of the Association's competition rules in respect of the minimum height for finishing a race. (Safety Recommendation 2006-119)

The Civil Aviation Authority should clarify and publicise whether permission from the Authority is required before exemption from the 500 feet low-flying rule in accordance with Rule 5 (3)(f) is applicable. (Safety Recommendation 2006-120)

The International Gliding Commission should, through national gliding associations, require, competition team coaches to include techniques for the safe conduct of race finishes within their coaching sessions. (Safety Recommendation 2006-121)

The British Gliding Association should comply with Civil Aviation Authority Aeronautical Information Circular (AIC) 86/2004 and include, in their notifications to the Authority, the frequencies to be used for the competition. (Safety Recommendation 2006-122)

The Civil Aviation Authority should instruct National Air Traffic Services Ltd, the organisation that manages the UK's Aeronautical Information Section, to endeavour to include any non-standard radio frequencies in NOTAMs about gliding competitions. (Safety Recommendation 2006-123).

Appendix 1

Extract from IGC Competition Rules

8.9 LIST OF APPROVED PENALTIES

Type of Offence	First Offence	Subsequent Offence	Max Penalty
Overweight/Underweight of W kilograms	W x 2 pts	n x W x 2 pts	n x W x 2 pts
Wrong, late or missing information			
Documentation not complete	No launch	No launch	No launch
Configuration check not complete	No launch	No launch	No launch
Notification of start time > 30 min after start	Warning	10 pts	25 pts
Declared start time differing from the real time	Warning	10 pts	25 pts
Changing FR without advising the Organisers	10 pts	20 pts	25 pts
Incorrect FR adjustment (Time interval between fixes > 10 sec)	Warning	10 pts	25 pts
Late delivery of documentation (FR, outlanding certificate) > 30 minutes	Warning	10 pts	25 pts
Late delivery of backup documentation > 60 min.	Warning	10 pts	25 pts
Incomplete outlanding report	Warning	10 pts	25 pts
Incorrect Start			
Between 0 and 0.50 Km from the start line	50 pts	50pts	50pts
More than 0.50 km from the start line	No valid start	No valid start	No valid start
Valid Start at Incorrect Start Point	100 pts	100 pts	100 pts
Incorrect Rounding of Turn Points or Areas			
More than 0.50 km from the boundary of the Turn Point or Area	50 pts	50 pts	50 pts
More than 1.00 km from the boundary of the Turn Point or Area	No Control	No Control	No Control
Dangerous or hazardous flying			
Cloud flying	100 pts	Day Disqual.	Disqualification
Circling in wrong direction in the local zone	Warning	(n-1) x 25 pts	Disqualification
Circling in the start zone	Warning	(n-1) x 25 pts	Disqualification
Towing: early or late release	Warning	(n-1) x 25 pts	Disqualification
Towing: pull-up before release	Warning	Day Disqual.	Disqualification
Finish: crossing below height or altitude limit	Warning	(n-1) x 25 pts	Disqualification
Finish: hazardous manoeuvre	Warning	(n-1) x 25 pts	Disqualification
Landing: incorrect landing lane	Warning	(n-1) x 25 pts	Disqualification
Flying above the absolute altitude limit (defined at briefing) if excess altitude < 100m	1 pt/m	n pts/m.	Day Disqual.
Flying above the absolute altitude limit (defined at briefing) if excess altitude > 100m	Outlanded at the point of airspace entry	Day Disqual.	Disqualification
Starting above the altitude limit	1 pts/m	n pts/m	Day Disqual.
Entering restricted or closed airspace	Outlanded at the point of airspace entry	Day Disqual.	Disqualification
Landing after legal daylight	10 pts/min	Day Disqual.	Disqualification
Cheating or falsifying documents			
Falsifying documents	Disqualification	Disqualification	Disqualification
Attempt to obtain external help for finding lift from non competing glider or airplane	Day Disqual.	Disqualification	Disqualification
Other Violations			
Flying under influence of alcohol	Day Disqual.	Disqualification	Disqualification
Positive doping control	See FAI policy	See FAI policy	
Wing Span Penalty in 15m & STD Class (#)	1 pt/cm	1 pt/cm	1 pt/cm

(#) If the span of a glider in the 15 m Class or in the Standard Class exceeds 15,000 mm, a penalty of a fixed number of points shall be subtracted from the daily score. The number of daily penalty points is obtained by subtracting 0.3 cm from the measured overspan, then rounding this number to the nearest whole cm.

Examples:

(i) A 2.7 cm overspan will give daily penalty points of 2.7 - 0.3 = 2.4 which is then rounded down to 2 points.

(ii) A 3.9 cm overspan will give daily penalty points of 3.9 - 0.3 = 3.6 which is then rounded up to 4 points.

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Appendix 2

Rule 5 of the Rules of the Air (Amendment) Regulations 2005

Low Flying

5. (1) The prohibitions to be observed are -

(a) an aircraft shall comply with the low flying prohibitions set out in paragraph (2) subject to the low flying exemptions set out in paragraph (3).

(b) where an aircraft is flying in circumstances such that more than one of the low flying prohibitions apply it must fly at the greatest height required by any of the applicable prohibitions.

(2) The low flying prohibitions

(a) Failure of power unit

An aircraft shall not be flown below such height as would enable it, in the event of a power unit failure, to make an emergency landing without causing danger to persons or property on the surface.

(b) The 500 feet rule

Except with the permission in writing of the CAA, an aircraft shall not be flown closer than 500 feet to any person, vessel, vehicle or structure.

(c) The 1,000 feet rule

Except with the permission in writing of the CAA, an aircraft flying over a congested area of a city town or settlement shall not fly below a height of 1,000 feet above the highest fixed obstacle within a horizontal radius of 600 metres of the aircraft.

(d) The land clear rule

An aircraft flying over a congested area of a city town or settlement shall not fly below such height as will permit, in the event of a power unit failure, the aircraft to land clear of the congested area.

(e) Flying over open air assemblies

Except with the permission in writing of the CAA, an aircraft shall not fly over an organised open-air assembly of more than 1,000 persons below -

(i) a height of 1,000 feet, or

(ii) such height as will permit, in the event of a power unit failure, the aircraft to alight clear of the assembly,

whichever is the higher.

Appendix 2 cont

(f) Landing and taking off near open air assemblies

An aircraft shall not land or take-off within 1,000 metres of an organised open-air assembly of more than 1,000 persons, except -

(i) at an aerodrome, in accordance with procedures notified by the CAA, or

(ii) at a landing site other than an aerodrome, in accordance with procedures notified by the CAA and with the written permission of the organiser of the assembly.

(3) Exemptions from the low flying prohibitions

(a) Landing and taking off

(i) Any aircraft shall be exempt from any low flying prohibition in so far as it is flying in accordance with normal aviation practice for the purpose of taking off from, landing at or practising approaches to landing at or checking navigational aids or procedures at a Government or licensed aerodrome.

(ii) Any aircraft shall be exempt from the 500 feet rule when landing and taking-off in accordance with normal aviation practice.

(b) Captive balloons and kites

None of the low flying prohibitions shall apply to any captive balloon or kite.

(c) Special VFR flight and notified routes

Any aircraft shall be exempt from the 1,000 feet rule when flying on a special VFR flight, or when operating in accordance with the procedures notified for the route being flown; provided that when flying in accordance with this exemption landings may not be made other than at a licensed or Government aerodrome, unless the permission of the CAA has been obtained.

(d) Balloons and helicopters over congested areas

(i) A balloon shall be exempt from the 1,000 feet rule when landing because it is becalmed.

(ii) Any helicopter flying over a congested area shall be exempt from the land clear rule.

(e) Police air operator's certificate

Any aircraft flying in accordance with the terms of a police air operator's certificate shall be exempt from the 500 feet rule, the 1,000 feet rule, the prohibition on flying over open air assemblies and the prohibition on landing and taking off near open air assemblies.

Appendix 2 cont

(f) Flying displays etc

An aircraft taking part in a flying display, air race or contest shall be exempt from the 500 feet rule when within a horizontal distance of 1,000 metres of the gathering of persons assembled to witness the event.

(g) Glider hill soaring

A glider when hill-soaring shall be exempt from the 500 feet rule.

(h) Picking up and dropping at an aerodrome

Any aircraft picking up or dropping tow ropes, banners or similar articles at an aerodrome shall be exempt from the 500 feet rule.

(i) Manoeuvring helicopters

A helicopter shall be exempt from the 500 feet rule when conducting manoeuvres in accordance with normal aviation practice, within the boundaries of a licensed or Government aerodrome, or at other sites with the permission of the CAA: provided that when flying in accordance with this exemption the helicopter must not be operated closer than 60 metres to persons, vessels vehicles or structures located outside the aerodrome or site.

(j) Dropping articles with CAA permission

(i) Any aircraft shall be exempt from the 500 feet rule when flying in accordance with article 56(3)(f) of the Order, and

(ii) Any aircraft shall be exempt from the 500 feet rule when flying in accordance with an aerial application certificate issued by the CAA under article 58 of the Order."

Appendix 3

Extract from BGA Competiton Rules 2005

34.7. Excess span. Up to 50 mm: 1 point per mm per day. Greater than 50 mm: disqualification. Measurement to be made with the wings supported to allow the glider to match its unloaded shape. This depends on the design of the glider, but will generally mean that the trailing edge is straight along the length of the wing.

34.8. Airspace. Each infringement is assessed vertically and horizontally and the lower figure applied. The vertical penalty is 1 point for every 5 feet or part thereof.

Horizontally the penalty is 1 point per 10 metres or part thereof measured to the nearest edge of the Airspace. For an active parachute zone specified by the competition organisation the penalty is 2 points per 5 metres or part thereof for the first 500 metres plus a further 300 points if the infringement exceeds 500 metres.

The Airspace penalty applied will be the sum of all offences during the day. For a second day of infringement the penalty will be doubled with further days being quadrupled.

Any glider incurring 200 or more airspace penalty points on more than two days will be disqualified from the competition.

34.9. Dangerous Flying. 100 points. Included in this is exceeding the gliders limitations.

34.10.Cheating. Day disqualification.

All other penalties are applied after scores have been calculated and, except for Airspace infringements, will not result in a negative score.

The following Penalties should be applied.

34.1. Loss of flight recorder evidence. Periods exceeding 60 seconds during which it cannot be established that airspace was not infringed and an engine not operated: Landed out at that point.

34.2. Self-sustainer engine running. Exceeding the 30 second testing limit: 1 point per second

34.3. Start. Starting from within the Horizontal Penalty Area: 50 points. Starting within the Vertical Penalty Volume: 2 points per 10 feet, or part thereof, above Start Height. Exceeding Start Height by more than 100 feet in the 2 minutes prior to Starting: 1 point per 10 feet or part thereof above Start Height. In cases where more than one infringement has been committed, only the greater Penalty will be applied.

34.4. Procedural rules. Failure to comply: 20 points.

34.5. Turnpoint error. Controlled within the Turnpoint Penalty Area without having entered the Turnpoint zone: 50 points.

34.6. Weight. Glider overweight: 2 points per kg above their permitted weight times the number of similar offences.

Appendix 4

Extract from BGA Competition Rules 2006

34. LIST OF APPROVED PENALTIES

Type of offence	First offence	Second offence	Further offence
Wrong, late or missing information			
Notification of start time > 30 minutes after start	Warning	10 points	25 points
Declared start time differs from real time >2 minutes	Warning	10 points	25 points
Changing FR without advising the Organisers	10 points	20 points	25 points
FR fix interval set greater than required	Warning	10 points	25 points
Late delivery of FR or other docs. > 60 minutes	Warning	10 points	25 points
Late delivery of back-up FR or docs. >60 minutes from receipt of request	Warning	10 points	25 points
Missing FR evidence – exceeding 60 seconds, where it cannot be reasonably established that airspace was not infringed or engine not operated	Outlanded at that point	Outlanded at that point	Outlanded at that point
Incorrect start or rounding of TP or Areas			
Starting from within Horizontal Penalty Area	50 points	50 points	50 points
Starting from within Vertical Penalty Volume	1 point /5ft. or part	1 point /5ft. or part	1point /5ft. or part
Exceeding start height by more than 100 feet in the 2 minutes prior to Starting	1 point /10ft. or part, above start height	1 point /10ft. or part, above start height	1 point /10ft. or part, above start height
Controlled only within Turnpoint Penalty Area	50 points	50 points	50 points
Dangerous or hazardous flying			
Cloud flying – incorrect radio protocol	Warning	100 points	Day Disqualification
Cloud flying – within 10km. of airfield centre or any start zone of any class	100 points	Day Disqualification	Disqualification
Flying outside glider's C of A limits	100 points	Day Disqualification	Disqualification
Airspace – each infringement is assessed vertically and horizontally and the lower penalty applied. Horizontal distance is measured to the nearest edge of the airspace. The penalty applied will be the sum of all infringements in a day. Multiple infringements on any day are classed as one offence.	1 point per 5 ft. vertically 1 point per 10m.horizontally	2 points per 5 ft. vertically 2 points per 10m.horizontally	4 points per 5ft. vertically 4 points per 10m.horizontally
Briefed Parachute zone infringement	2 points/5m if <500m. If >=500m, 500 points.	4 points/5m if <500m. If >=500m, 1000 points.	8 points/5m if <500m. If >=500m, 2000 points.
Persistent infringement of airspace and/or briefed parachute zones of more than 200 points per day on more than two days	Disqualification		
Finish – crossing below height limit for go around - if specified	Warning	100 points	Disqualification

Appendix 4 cont

Type of offence	First offence	Second offence	Further offence
Finish – incorrect landing pattern - if specified	Warning	100 points	Day Disqualification
Finish and approach to finish – hazardous manoeuvre, including :- 1) any sudden change of attitude other than for the purpose of avoidance of other aircraft, airfield objects or people. 2) proximity to ground and obstacles of less than 30ft. except when landing (characterised specifically by cracked airbrakes and wheel down or low energy < 70 knots IAS).	Warning	100 points	Disqualification
Hazardous/dangerous flying recommended by PSC for penalty, if not covered by other penalty	100 points	Day Disqualification	Disqualification
Cheating or falsifying documents			
Falsifying electronic files or paper documents	Disqualification		
Attempt to obtain help for finding lift from non competing glider or aircraft	Day Disqualification	Disqualification	
Use of any non-approved radio frequency for communication of any sort whilst airborne except with Air Traffic Services, or in emergency	Day Disqualification	Disqualification	
Non-approved data transmission	Day Disqualification	Disqualification	
Other violations			
Glider overweight to class and/or C of A limit	W x 2 points	n x W x 2 points	n x W x 2 points
Positive doping control	see FAI policy	see FAI policy	see FAI policy
Excess wing span when measured with wings supported to match unloaded shape with 0.3cm. allowance. The excess is rounded to the nearest cm.	1 point per cm.	1 point per cm.	1 point per cm.
Self-sustainer engine test running >30 seconds	1point per second	1 point per second	1 point per second
Failure to comply with specific single procedure not covered elsewhere.	25 points	100 points	Day Disqualification

For scoring purposes disqualified competitors will be deemed not to have flown on the day(s).

All other penalties are applied after scores have been calculated and, except for Dangerous/Hazardous flying infringements, will not result in a negative score.

ACCIDENT

Aircraft Type and Registration:	Medway Microlights Raven X, G-MYVW
No & Type of Engines:	1 Rotax 447 piston engine
Year of Manufacture:	1995
Date & Time (UTC):	9 June 2006, between 1332 hrs and 1412 hrs
Location:	North of Cliffe, Kent
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Fatal) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Student Pilot
Commander's Age:	41 years
Commander's Flying Experience:	40 hours (of which 18 were on type) Last 90 days - 7 hours Last 28 days - 7 hours
Information Source:	AAIB Field Investigation

Synopsis

The student pilot was briefed to fly a solo general handling exercise over marshland on the south side of the Thames Estuary. He had not returned to the airfield by the time the aircraft's fuel was known to be exhausted and a search and rescue operation was initiated. Approximately 24 hours later the crew of the Police Air Support Unit helicopter located the aircraft and the fatally injured pilot. There were no eye-witnesses and no recorded evidence. The investigation was unable to determine the cause of the accident.

History of the flight

The student pilot, who was also the owner of the microlight, arrived at Rochester Airport expecting to conduct a solo cross-country flight. He was near to completing the microlight private pilot's licence syllabus and this was one of the few outstanding requirements. However, the crosswind was outside his limits for the cross-country destination airfields, so the flying school's chief instructor briefed him to fly a general handling flight in the local area. His brief was to fly north to an area of marshland on the south side of the Thames Estuary where he would practise stalls, tight turns and simulated engine failures. This was the flying school's normal area for general handling and an area with which the pilot would have been familiar. During the briefing the instructor also confirmed with the student that he intended to depart with a full fuel tank; this was 25 litres, which was equivalent to about 2 hours' flying time. On completion of the briefing, the student self-rigged the aircraft; his instructor reported that he was entirely proficient in this procedure. The student informed the Aerodrome Flight Information Service Officer (FISO) that he was departing for a local flight and at 1244 hrs he took off from Runway 02L and climbed away to the north. The radar heads at Pease Pottage and Debden recorded that element of the flight where the aircraft was higher than approximately 2,000 ft agl, but were unable to record any other vertical profile information. The aircraft was first recorded at 1255 hrs, just to the north of Rochester, routing directly towards the marsh area and then flying a series of manoeuvres in the pre-briefed area. The manoeuvres were all over land and the recording finished at 1332 hrs. At this time the aircraft was approximately 5 km east of the accident site and heading in a westerly direction. There were no other confirmed sightings of the aircraft airborne after this time. The crew of a Police Air Support Unit helicopter located the aircraft and the fatally injured pilot the following afternoon. The accident site was on a sand and pebble beach that was mostly overgrown with weeds, just above the high tide mark of the estuary and below a sea wall.

Search and recovery

The aircraft departed Rochester Airport at 1244 hrs and was known to have an endurance of about 2 hours. When this endurance had been exceeded, the flying school instructors decided to commence a search of the area in which the student pilot had been briefed to fly. This search commenced at 1525 hrs, with the pilot's instructor and the chief instructor using a microlight to search the area whilst maintaining radio contact with the FISO at Rochester Airport. After they had searched the area for 80 minutes without success, the FISO informed the Distress and Diversion (D&D) cell at West Drayton that the aircraft was overdue and had exceeded its endurance limit.

The D&D cell began tracing action and information gathering in an attempt to locate the aircraft. This included contacting the Kent police force and informing the Aeronautical Rescue Co-Ordination Centre (ARCC) at RAF Kinloss that the microlight was missing. This action was unsuccessful in locating the aircraft and the ARCC launched a search and rescue helicopter from RAF Wattisham in Suffolk. The helicopter was flown to Rochester Airport to collect the microlight pilot's instructor and the search commenced at 1935 hrs. The search of the area continued until 2230 hrs, using thermal imaging equipment and a possible trace from the pilot's mobile telephone signal, without success. The local coastguard teams and lifeboats conducted a search of the rivers and marshland, again without success.

The following morning, the Police liaised with the ARCC with regard to the continued search and decided to use the Sussex Police Air Support Unit based at Shoreham. Their helicopter commenced the search at 1200 hrs and the crew located the accident site at 1245 hrs. The pilot, who had been fatally injured, was found next to the aircraft wreckage.

Overdue Action

CAP 410B '*Manual of Flight Information Services*' (MFIS), Chapter 11 entitled 'Overdue Aircraft' states in its introduction that:

> *'Overdue action is not related solely to the filing of a flight plan. If at any stage of a flight, the pilot has made his intentions clear and subsequently does not arrive or report when expected, FISO's should seriously consider taking overdue action'.*

The Manual also states that, with regard to radio-equipped aircraft, such as the aircraft involved in this accident:

> *if the fuel carried by the aircraft is considered to be exhausted…the FISO shall inform the Area Supervisor that the aircraft is fully overdue'.*

In practice, at this airfield, this would mean informing the Distress and Diversion (D&D) cell at West Drayton.

Meteorology

An aftercast from the Met Office showed a high pressure system situated over the North Sea with a light to moderate south-easterly flow covering Kent. There was no cloud below 5,000 ft agl and the visibility was between 15 and 25 km, reducing to between 3 and 5 km in coastal mist over the Thames Estuary. The microlight school's chief flying instructor was flying in the same area and at about the same time that the accident occurred. He reported that there was light turbulence in the area and believed that at very low level close to the sea wall, there could have been significantly more turbulence, due to the effect of the wall disrupting an otherwise smooth airflow.

Pathology

The post mortem report concluded that the pilot died as a result of the multiple injuries sustained in the accident. The nature and pattern of the injuries indicated a relatively low energy impact and there was evidence at the accident site which suggested that the pilot had been able to undo his harness and remove his helmet following the impact.

Toxicological examination suggested that the pilot may have been using cannabis within hours of the accident. The post mortem report stated that:

> *'Experimental studies have demonstrated a wide range of effects of cannabis on cognitive functions and psychomotor skills, including impairment of information acquisition, working memory, divided and sustained attention, reaction time, tracking and motor control. While it is impossible to say whether the pilot would have been impaired by the presence of cannabis metabolites at the time of the accident, the possibility that he may have been certainly exists.'*

The report also commented that:

> *'complex tasks such as flying are particularly sensitive to the performance impairing effects of cannabis and impairment may continue for many hours after the subjective effects (those felt by the user) have worn off. In fact decrements on performance have been demonstrated on pilots for up to 24 hours following the use of cannabis.'*

The Air Navigation Order (ANO), Article 65, states that:

> *'A person shall not, when acting as a member of the crew of any aircraft or being carried in any aircraft for the purpose of so acting, be under the influence of drink or a drug to such an extent as to impair his capacity so to act.'*

Description of the aircraft

The Raven X is a two-seat, weight-shift microlight aircraft of conventional layout and structure. The aerofoil shape of the wings is maintained by tubular battens inserted into channels sewn into the upper and lower fabric. The upper battens are cambered and retained in the channels by pockets at either end. When the wing is tensioned they are securely located in the channel such that only failure of the fabric or of the batten itself, or a loss of wing tension could allow it to spring out of position. The lower battens are straight and the majority are retained in the channels simply by friction when the wing is tensioned. In other words, they can slide out rearwards when the wing is slack but are reportedly immovable when it is tensioned. The outermost lower battens are, however, provided with an elastic cord device which provides positive retention.

G-MYVW was not fitted with the more usual fibreglass 'pod' around the lower parts of the trike, so that the pilot was fully exposed to the slipstream and his feet would merely have rested on the ground steering pedals or hung beneath the aircraft.

On-site examination of the aircraft

The aircraft and its pilot lay on a sand and pebble beach just above the high tide mark of the estuary. The right wing was standing leading edge down whilst the left wing lay flat on the ground and partially folded across the right wing root. The trike, still attached to the wing, lay in an almost inverted attitude with the two mainwheels in the air and the nose landing gear separated from the rest of the trike, lying on the beach. It was evident that the pilot had undone his lap-belt and appeared to have rolled out of his seat, removing his gloves and helmet and seemingly extracting his mobile telephone from (presumably) a pocket in his flying suit: the mobile phone was switched on. His injuries would have precluded any attempt at walking. It was noted that a nearly-full, 20-litre jerry can of fuel had occupied the rear seat, and had been secured by tying the rear seat harness around it.

The wooden 2-bladed propeller had broken tips which, in both cases, had led to a breaking-away of the trailing edge, leaving the leading edge undamaged. In one case, the trailing edge was missing and not found but on the other blade the trailing edge remained loosely attached at the root. Also not recovered, despite extensive searching, was the pilot's right shoe.

The only items not present at the main accident site, apart from the propeller pieces and the pilot's shoe, were two right wing lower battens, one from the tip and the other from about third span from the root. The latter was found about 30 metres south of the wreckage, stuck into the earth at the top of the sea wall whilst the former was lying on the ground to the south-west, on the landward side of the base of the wall.

Examination of the various structural cables showed that the two rear flying cables running from the 'A' frame aft to attach to the wing keel had failed, as well as the cross-tube tension cable and its backup cable. In addition, one of the luff lines[1] and the right wing landing wire had failed, but apart from these all the other cables were intact (see Figure 1). Further information and discussion of the cables is contained later in this report.

Subsequent examination of the aircraft

The microlight was transported to the AAIB facility for further examination. This did not reveal any pre-impact anomalies but the failed rear flying cables were selected for detailed examination, since the failure mode of the swaged fittings did not appear to be that of a properly-made swage. Essentially, the terminations of the cables are constructed by doubling the cable back on itself around a looped fitting known as a 'thimble' (see Figure 2). Two copper ferrules are then crimped around the two strands of cable, normally using a hand tool which squeezes the ferrules down to a smaller dimension. This dimension is checked using a simple 'go / no-go' gauge – if the joint has been properly swaged, and using the

Footnote

[1] Luff lines are small-diameter cables which run from the king post to attach to the wing fabric at various points along the trailing edge. Their purpose is to prevent distortion of the trailing edge during certain flight manoeuvres. In-flight failure of one of these cables should not prove catastrophic.

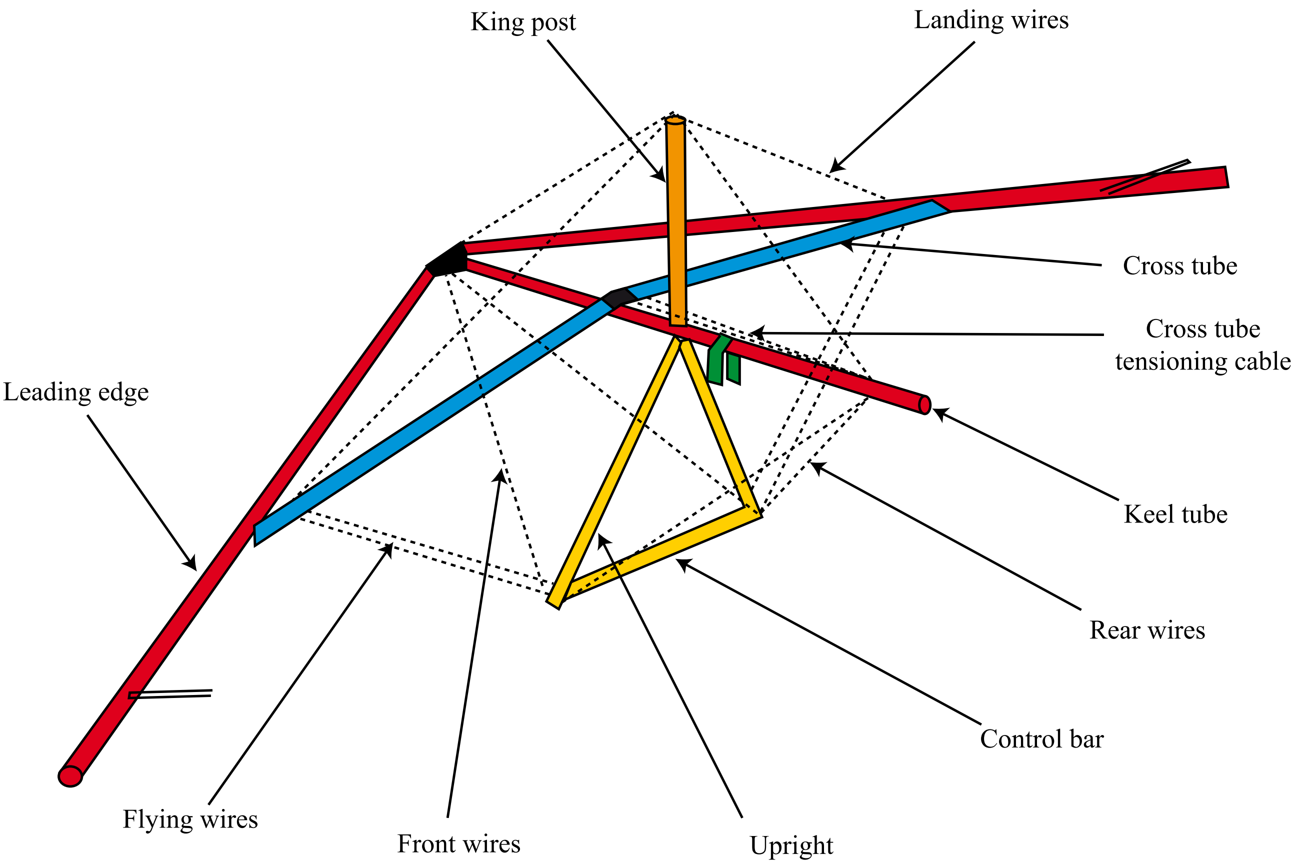


Figure 1

Sketch of generic weight-shift microlight wing to illustrate some of the nomenclature referred-to in the text

appropriate ferrule, it will fit into the gauge and should guarantee that the copper fitting has flowed closely up against the cable strands and gripped them tightly. A correctly formed joint should be stronger than the cable itself and thus a tensile overload force applied to the cable typically causes failure of the cable adjacent to the joint and not at the joint itself.

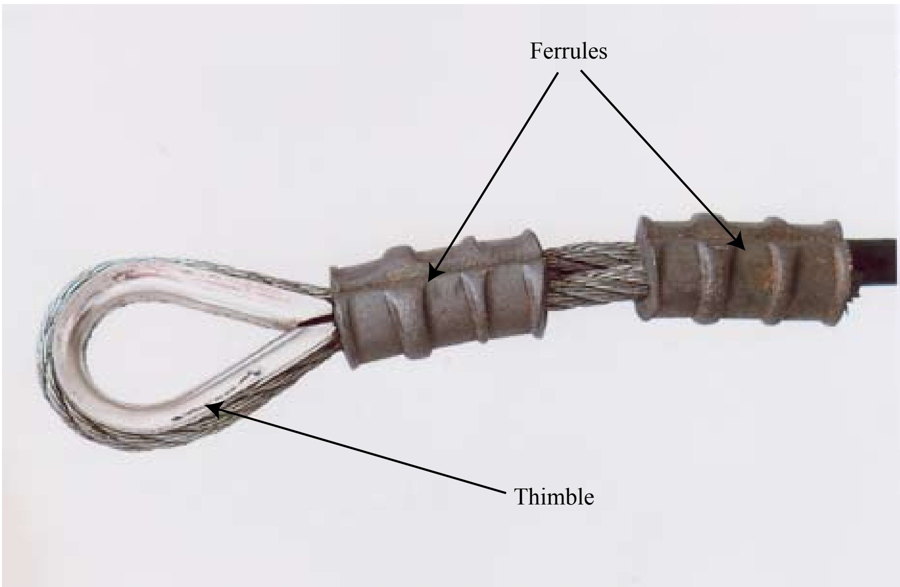


Figure 2

Intact swaged joint

In the case of G-MYVW, the rear flying cables had pulled through the swage fittings at one end (see Figure 3), leaving just a thimble attached to each side of the 'A' frame.

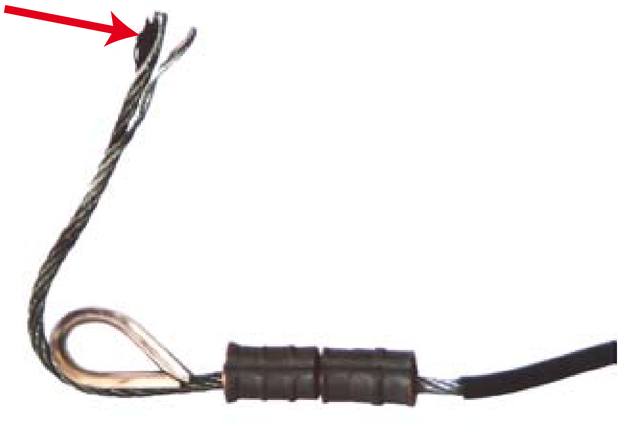


Figure 3

Broken rear cable from G-MYVW
Note that the cable has pulled through the ferrules and the fibre core (arrowed)

If these cables were to fail in flight, the aircraft would almost certainly be uncontrollable, since any attempt to put forward pressure on the control bar to raise the nose would have little or no effect. A recent case of failure of these cables on a different model of microlight, but of a similar layout, resulted in an accident. In that case, the free ends of the cables had also trailed backwards and struck the propeller.

There was absolutely no evidence that this had happened to G-MYVW, but the anomalous failure mode warranted further investigation. It was noticed that the cables themselves were of unusual construction. Most aeronautical wire cables are constructed of mild or stainless steel throughout: the failed cables clearly had the centre core strands made from a black, non-metallic material, probably polypropylene. Such cables are usually called 'fibre-cored' and do not appear to have found many applications in the aviation industry. In this case, the cables were of the specified 3 mm diameter, but the design assumes that 7 x 7 steel-cored cables will be used. This terminology indicates that the cable is made from seven groupings each containing seven strands, thus there are 49 metal strands in each cable. Fibre-cored cable of the same diameter would be termed '6 x 7', indicating that there are only 42 metal strands.

Consultation of the cable-makers' data for steel and fibre-cored cables of the same diameter indicated that there is not, surprisingly, much difference in the Ultimate Tensile Strength (UTS) of either variety; the fibre-cored type having about 7% less UTS. However, the manufacturer of the hand press tool, Nicopress, which was used to make the swages, confirmed that it was never intended for use on fibre-cored cable because the tool compresses the fitting down to a pre-determined dimension. The greater compressibility of the fibre core would mean that the copper fitting does not form itself around the outer strands as was intended. This was confirmed when several unbroken swages from G-MYVW were sectioned (see Figure 4).

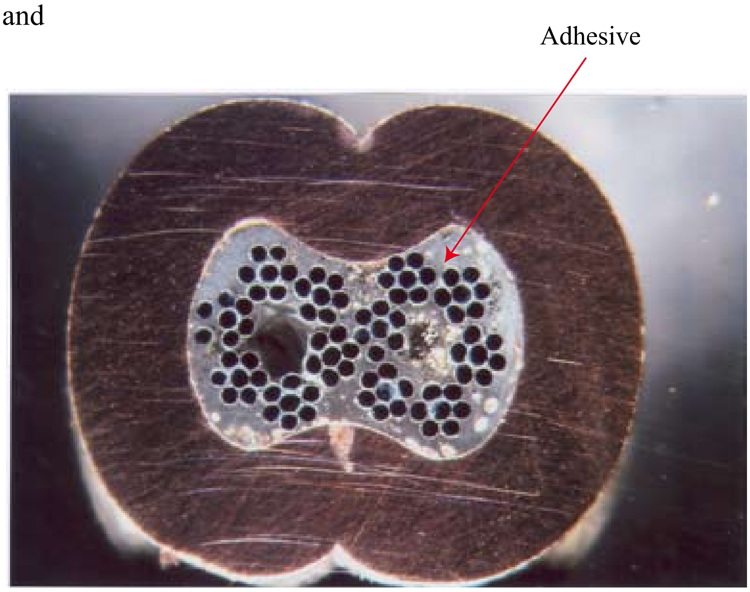


Figure 4

Section through an unfailed swage, showing poor grip of the cable strands by the ferrule. Note that the fibre core is not readily apparent (although present) and that the grey material filling the voids is cyanoacrylate adhesive, applied to stabilise the assembly during sectioning

All of the 3 mm cables on G-MYVW were fibre-cored, so it was decided that these cables, including the unbroken ends of the failed cables, would be subjected to a destructive 'pull' test to explore their UTS. Of the six swages subjected to the test, the highest value recorded was 5.5 kilonewtons (kN) and the lowest value was 3.67 kN before failure, all of which resulted in pulling of the cable through the swage. It was noted, however, that in all cases the cable was starting to pull through the swage at values considerably lower than the ultimate – one as low as 2.5 kN. The value at which correctly assembled steel cables failed was nominally in excess of 6 kN.

Detailed examination concluded that the swaged joints were of poor quality, probably as a result of the use of fibre-cored cable. In comparison, some original cables supplied by the manufacturer, and of about the same age as those fitted to G-MYVW, were significantly stronger and the swaged joints were satisfactory. Considerably greater strength would have been achieved if the correct cable had been used.

Tracing the origin of the errant cables proved inconclusive. The original manufacturer of G-MYVW produced documentation to show that he had purchased a bulk supply of the correct specification at the time the aircraft was made. The first owner of G-MYVW confirmed that he had not had to change any cables during his period of ownership (1995-2006) and there was no mention in the aircraft log book of any replacement of cables. All cables on the aircraft appeared to be of similar age, suggesting that the deceased owner-pilot had not changed any.

Analysis

Conclusions from on-site observations

Determining the precise attitude of the aircraft at impact was difficult because the nature of the ground meant that no clear ground marks had been left. However, the right wing was much more damaged than the left, with signs of ground contact along most of the span of the leading edge. It was therefore judged that this wing had struck the ground first. The 'snoot' at the extreme front of the trike had also made hard nose-first contact with the ground, causing failure of the keel further aft. It therefore appears that the aircraft's attitude at impact was about 30º nose-down but banked to the right.

The aircraft's speed must have been relatively low, since crashes at such extreme attitudes, whilst at normal flying speeds, would usually result in immediate fatality. Consideration was given to the possibility that the two battens found some distance away from the rest of the wreckage indicated that there had been a mid-air failure and loss of wing tension, allowing them to be released. However, they both showed damage consistent with the wing striking the ground (the inboard batten was bent when it should have been straight) and it was concluded that they were somehow ejected on impact and propelled through the air for a considerable distance. Failure of the cross-tube tension cables would be expected in this kind of impact and later examination confirmed that they had failed in overload.

The condition of the propeller blades was difficult to explain, since they both indicated a strike on the tips only, the leading edges otherwise being devoid of damage. If they had struck the ground during the impact sequence, then more leading edge damage (and possibly failures at the root as well) would be expected. A search was conducted for any evidence that the aircraft had first struck the ground or an object somewhere other than where it came to rest but no such evidence was found, although the nature of the terrain made this search extremely difficult. However, it is possible that the broken propeller pieces were thrown into the river estuary. There was no obvious explanation for the pilot's missing shoe.

Conclusions from examination of the cables

Despite the use of non-standard fibre-cored cable, several factors suggest that in-flight failure of the rear cables was not responsible for the accident:

- The nature of the impact and the momentum of the pilot's weight on the control bar could produce enough force to fail even cables made to the correct specification; in other words one would expect these particular cables to fail on impact.
- Although the strength of some of the cables was degraded, it appears that the lowest values measured were still higher than the calculated loads experienced by them, even in high 'g' manoeuvres.
- There was no sign of contact with the propeller which might be expected bearing in mind previous accidents where the rear cables had failed.
- Although it is possible that the cable may have been progressively pulling through the swages over a period of time without being noticed, this was not borne out by microscopic examination, which suggested that the pull-through occurred as a single event.

Nevertheless, the possibility of in-flight failure of the cables could not be completely eliminated and the fact remains that use of the type of tool employed to make the swages was inappropriate for fibre-cored cables and so the following Safety Recommendation is made:

Safety Recommendation 2006-126

The British Microlight Aircraft Association should promulgate the information that fibre-cored cables should not be used on aircraft, unless specified by the manufacturer, and that the Nicopress swaging tool was not designed for fibre-cored cables and will therefore not produce a correctly swaged joint.

Operational issues

The investigation into the cause of this accident was hampered by the lack of available evidence. Once the aircraft had departed from the airfield boundary there were no eyewitness accounts of its movements. This was not surprising, however, since the flight was probably over sparsely populated marshland. The pilot was not carrying Global Positioning (GPS) equipment so the only trace of the aircraft's routing came from the primary radar returns from radar heads located at Pease Pottage and Debden. Analysis of the recorded data did not reveal anything unusual; it was all within the pre-briefed manoeuvring area, all over land and consistent with the pre-briefed general handling exercises. The radar recording terminated 48 minutes after the aircraft took off from Rochester when it must be assumed that it descended below the height of radar coverage which is approximately 2,000 ft agl in this area. At this point, the aircraft was approximately 5 km east of the accident site and heading towards it. The actual time of the accident is not known but, based on the amount of fuel retrieved from the wreckage, it must have occurred within about 40 minutes of the last radar recording. In reality, it was probably much less than this since it is likely that there was leakage of fuel after the accident.

During this period the aircraft probably remained below 2,000 ft agl where it is possible that the pilot was carrying out simulated engine failures. It is also possible that he may have practised low flying along or close to the sea wall. This is a fairly common practice for microlights flying in this area and the student pilot had flown along the sea wall with his instructor on several occasions to practise low flying techniques. It is of note that he was heading towards the sea wall in the direction of the accident site when radar contact was lost. The broken propeller blade and pilot's missing shoe suggest that there may have been some ground contact prior to the final accident site but the initiating event for this accident cannot be determined.

The presence of cannabis in the pilot's body compounds the difficulty in understanding the circumstances regarding this accident. Although it is not possible to say whether Article 65 of the ANO was contravened, the possibility that cannabis may have impaired his judgement and/or handling of complex tasks cannot be excluded.

It is also evident from the pathologist's report that the accident was potentially survivable; indeed it appears the pilot attempted unsuccessfully to make a mobile telephone call after the accident. Thus it is worth considering why the pilot was not located earlier and ways in which survivability could have been improved.

If the crew of an aircraft are unable to provide any notification of an accident and there are no eyewitnesses (as in this accident), tracing action does not normally commence until the aircraft is identified as being overdue. Identifying an aircraft as overdue relies on a flight plan or knowledge of takeoff time and endurance. In this case the pilot was a student on a pre-briefed exercise for there was no flight plan and so only the flying school would have known when his endurance had been exceeded. In order that the FISO can fulfil the CAP 410B requirement to inform the area supervisor as soon as '*the aircraft's fuel is considered to be exhausted',* the aircraft's endurance must be made available.

The microlight school instructors knew the area in which the student pilot had been briefed to fly and their reconnaissance of the area allowed the search to commence at the earliest opportunity. The FISO, when made aware that the aircraft's endurance was exceeded, began tracing action and then contacted D&D when the instructors' initial search proved fruitless. It would have been possible to save time by contacting D&D as soon as the fuel was known to have been exhausted because the first actions of D&D are also to begin tracing action and there is likely to have been duplication of effort at this point. There is a degree of reluctance for some airfields to involve D&D immediately after an aircraft has exceeded its endurance as aircraft, particularly those that have the ability to land on unlicensed fields, occasionally land elsewhere without informing ATC. However, informing D&D initiates a chain of events that, due to their resources and experience, are likely to resolve an overdue aircraft incident in the most expeditious manner.

It transpired that the microlight school's chief instructor had almost certainly flown over the accident site during his initial search but the black and yellow upper wing surface and pilot's dark green flying suit made the site relatively inconspicuous from the air (see Figure 5). Manufacturers now use white as the default colour for the upper wing surface but bright clothing and reflective strips would also improve visual conspicuity. Some microlight flying schools advocate the carrying of a switched-on mobile telephone in order to provide a signal for rescue services to use should incapacitation prevent a call being made. This accident demonstrated that a mobile telephone signal alone cannot be relied

Figure 5

upon to guide rescue services directly to the accident site. An alternative and more accurate method would be to use a personal locator beacon. However, their use does depend on positive initiation of the beacon which may not be possible if the occupant is incapacitated.

Follow-up action

As a result of this incident the Rochester Airport Airfield Director issued a memo on 22 August 2006 which requires the airport FISO's:

> *'to record the expected time of duration of the 'local' flights from Rochester. This information is to be recorded on all relevant flight strips enabling us to initiate prompt overdue action if required. Whenever possible a call should be made when a flight is longer than briefed in order to confirm everything is well. A revised ETA should be obtained'.*

Conclusion

The lack of available evidence and witness information meant that the cause of this accident could not be identified, although it did appear to be potentially survivable. Despite the use of non-standard fibre-cored cable, the evidence suggests that an in-flight failure of the rear cables was not responsible for the accident. Nevertheless, the possibility could not be completely eliminated. A number of factors delayed the discovery of the accident site and the airfield has put in place a procedure to reduce one of these. The lack of visual conspicuity and on-board location equipment also contributed to the difficulties of accident site detection. However, it is the Distress and Diversion cell in conjunction with the Aeronautical Rescue Co-Ordination Centre that have pre-eminence in search and rescue operations and their inclusion at the earliest stage gives the greatest likelihood of a successful outcome.

ACCIDENT

Aircraft Type and Registration:	Pegasus Quantum 15-912, G-BYNO
No & Type of Engines:	1 Rotax 912 piston engine
Year of Manufacture:	1999
Date & Time (UTC):	5 April 2006 at 1225 hrs
Location:	Clench Common Airfield, near Marlborough, Wiltshire
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Serious) Passengers - 1 (Serious)
Nature of Damage:	Aircraft destroyed; damage to other aircraft and barn roof
Commander's Licence:	Private Pilot's Licence
Commander's Age:	49 years
Commander's Flying Experience:	14,000 hours approximately (of which about 600 were on type) Last 90 days - 22 hours Last 28 days - 8 hours
Information Source:	AAIB Field Investigation, with the participation of the British Microlight Aircraft Association

Synopsis

After an uneventful flight and while on the approach to land, the wing pitched up and the aircraft turned to the right. It subsequently crashed into the roof of a barn close to the landing threshold of the airstrip. Ferrules[1] had failed in four rigging cable assemblies causing structural failure of the aircraft. These four cable assemblies had been recently fitted. The cable assemblies were made locally; they were not approved by the manufacturer, nor were they approved by the BMAA.

History of the flight

The flight was an air experience lesson bought for the passenger as a gift. The flight progressed uneventfully until the aircraft returned to the airstrip. Runway 34 was in use and the surface wind was estimated to be from approximately 350º at 10 to 15 kt. The aircraft joined the circuit and all appeared normal until it was at approximately 80 ft agl on its approach to land. At this point the aircraft encountered some turbulence. This is a known phenomenon with the wind from this direction due to the presence of a wood situated very close to the eastern edge of Runway 34. The pilot was seen to make appropriate control inputs to correct the disturbance. Shortly afterwards an unusual noise was

Footnote

[1] Ferrule – a sleeve of metal which is crimped onto the wire rope to allow a loop in the rope to be formed.

heard by the passenger and also by several eyewitnesses. One eyewitness saw a cable trailing to the rear of the aircraft. The wing then pitched up and the aircraft turned to the right, before descending towards a barn that was close to the landing threshold of the airstrip. The aircraft struck and penetrated the roof of the barn; the pilot and the passenger sustained serious injuries.

Three flights earlier, about two weeks previously, the aircraft had been fitted with four replacement rigging cable assemblies, which had been locally made. Soon after the accident the AAIB published Special Bulletin S4/2006 which gave preliminary details of the accident and drew attention to the requirement to use approved parts in critical applications. No safety recommendations were made in the Special Bulletin.

Pilot's comments

The pilot suffered very serious injuries to his legs and back. When he regained consciousness three weeks later he had no recollection of the accident flight. He had completed a flight in G-BYNO on the morning of the accident but his recollection of this flight was patchy. He did recall that he did a thorough pre-flight inspection of G-BYNO, during which he noticed nothing untoward. He stated he was not aware that cables had been replaced on G-BYNO two weeks previously.

Passenger's comments

The passenger suffered serious injuries to his legs and left arm. He stated that before the flight the pilot of G-BYNO gave him a general description of the air experience lesson. It was emphasised that all items of clothing were to be secure and his camera, which he took on the flight, was to be around his neck on a lanyard. When not being used it was to be stowed in a pocket on the front of the flying suit that was secured with Velcro. He was subsequently given a flying helmet with an intercom, a thermal flying suit and gloves; these all fitted correctly.

After being securely strapped into the aircraft the pilot started the aircraft's engine and then taxied out to the runway. After a check of the intercom the pilot proceeded to line up on the runway and take off. Once airborne the pilot said to the passenger that if he felt uneasy at any time then they would return to Clench Common "without delay".

The flight progressed uneventfully until the aircraft was on final approach to land. At this stage the passenger could feel the aircraft being buffeted by the wind. As they came abeam the farm buildings on the right, he heard a 'twang'. The passenger did not say anything and he did not hear the pilot say anything. The wing then suddenly pitched up and the aircraft turned to the right. He became aware that the aircraft was descending rapidly towards the roof of a barn and he then heard two loud bangs. He believed these were the aircraft hitting the barn roof and then the ground.

Witnesses' comments

There were numerous witnesses to the accident. The majority were outside the flying club house which was situated to the north of the barn. They observed G-BYNO on final approach, and all reported that the aircraft was disturbed by some turbulence; shortly afterwards there was a loud bang. Then they saw the wing pitch up and the aircraft turn right. They subsequently lost sight of the aircraft just before it impacted the barn roof.

One eyewitness was standing by the signals square on the edge of the airstrip on the north-western side of the barn. He stated that he was preparing his aircraft to go flying, and was interested in observing G-BYNO as it made its approach to land as he wanted to get an idea of the flying conditions. All appeared normal until the aircraft was at approximately 80 ft agl when it was disturbed by a gust of wind. He saw the pilot putting large inputs into the control frame as he corrected this disturbance. He subsequently heard "something peculiar" and thought something had hit the propeller but he did not see any loose article come out of the cockpit and felt everything was still normal at this point. G-BYNO then pitched up slightly.

He then heard a second noise similar to the first, followed by an unusual noise from the engine. He subsequently saw a wire trailing from the aircraft's control frame, to the right side of the aircraft, beneath the propeller; this wire then went into the propeller. The wing then pitched up and the aircraft turned right towards the barn. It crashed into the roof of the barn in a nose down and right wing down attitude.

Aircraft information

The Pegasus Quantum 15 is a two-seat, weight-shift controlled, flexwing microlight which consists of a tricycle unit or 'trike' suspended beneath a flexible wing assembly. The trike incorporates the engine, landing gear, seats and cockpit, and has a front strut and monopole. The latter provides an attachment point for the wing. Attached to the wing is the control frame which is triangular and consists of a left frame, a right frame and a base bar; this is commonly called the 'A' frame.

Four rigging cables brace the control frame relative to the wing. Two cables run from the bottom of the left control frame, one forward and one rearwards, and similarly, two cables run from the bottom of the right control frame, one forward and one rearwards (see Figures 1a and 1b). These cable assemblies consist of

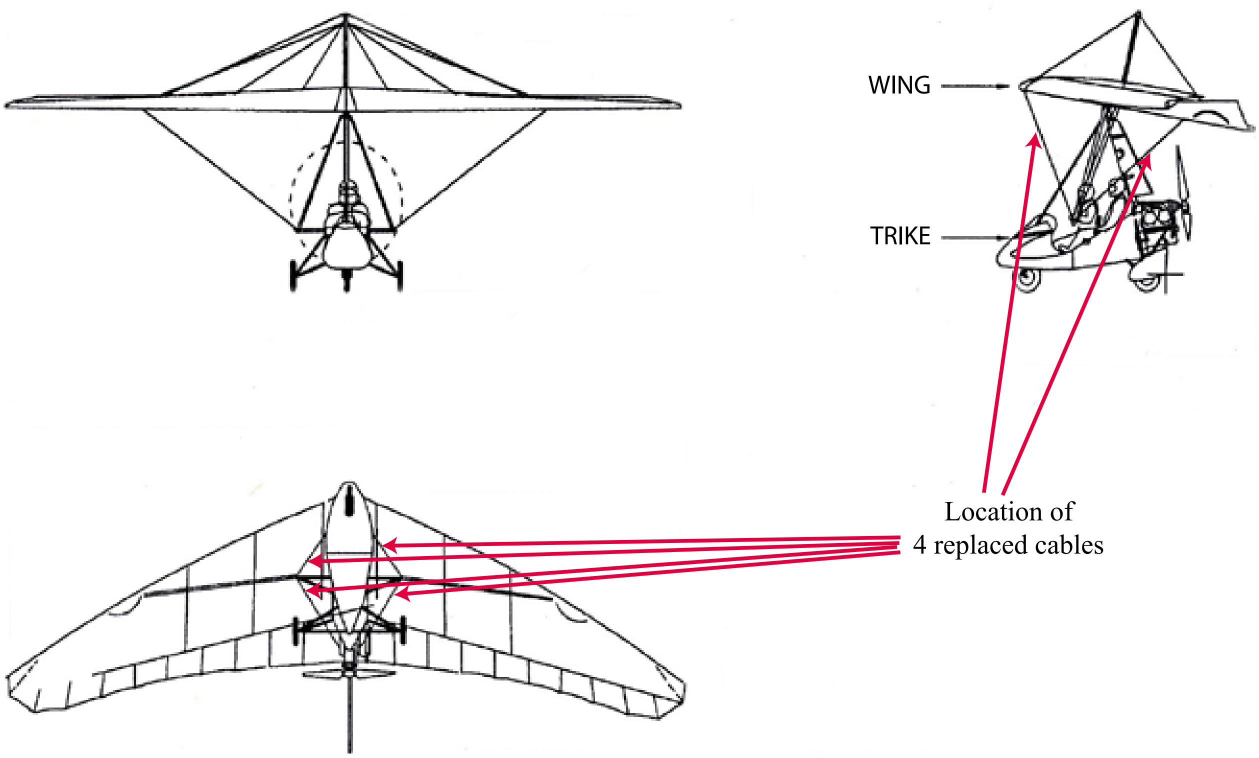


Figure 1a

Aircraft layout and location of replaced cables

Figure 1b

Location of the failures in the cable assemblies
(Note: generic microlight model shown)

a length of 3mm diameter, 7 x 7 strand wire rope, with a loop at each end. The loops are formed by the cable passing around a teardrop shaped eyelet, often called a thimble, through which bolts are fitted. The loop is held in place by two ferrules which are crimped onto the wire rope using a crimping tool. Each ferrule is crimped in two places forming two 'necks' in each ferrule. As part of the manufacturing process a simple gauge is used to test that the dimensions of the necks are sufficiently small to ensure that the cables are adequately gripped. It is common practice for protective plastic shrouds to be fitted to cover the ferrules.

On the Pegasus Quantum there are also flying wires that extend from the base of the control frame outboard to the wing spar, rather like a bracing strut found on many high wing light aircraft. These flying wires are swept slightly aft, which has the effect that the maximum loads in the forward pair of rigging cables are higher than those in the rear rigging cables.

G-BYNO was built in 1999 and had logged over 1,700 hours. The aircraft operated on a Permit-to-Fly, for which its last inspection and check flight were on 25 August 2005.

Meteorological information

The Met Office provided an aftercast for the time of the accident. The synoptic situation at 1200 hrs indicated that there was a ridge of high pressure covering the British Isles with a light northerly flow affecting the Marlborough area.

The METARs for RAF Lyneham, 11 nm north-west of Clench Common, issued 30 minutes before and after the accident, showed that the wind was from 350º at 10 kt and there were FEW clouds at 4,500 ft agl. Although RAF Lyneham is 138 ft below Clench Common in elevation, it is believed that the wind at the airstrip would have been comparable.

Airstrip information

Clench Common is an airstrip two nautical miles south of Marlborough, Wiltshire, which is predominately used by microlight aircraft. It is 650 ft amsl and consists of two grass runways, orientated 34/16 and 05/23. Runway 34/16 is 390 m in length and Runway 05/23 is 330 m in length. There is an Air-Ground radio frequency for aircraft operations.

To the east of the threshold of Runway 34 there is a barn and a collection of small buildings. The barn is used for aircraft storage and the buildings are used as offices and a club house. Behind these buildings is a small wood of 60 ft high trees.

Wreckage information

The aircraft had penetrated the roof of the barn. As a result the internal wing structure had failed causing both the wings to fold upwards, and most of the aircraft wreckage was contained within the barn.

During the initial examination, failure of the ferrules to grip the wire rope at one end of each of the four rigging cable assemblies was evident. See Figure 2 for an example of failed ferrules (note the wire rope has pulled through the ferrules) and Figures 1a and 1b for a diagram showing the location of the four cables. No ferrules or plastic shrouds were found on the rear ends of the two

Figure 2

rear cables and these cable ends had damage consistent with having been struck by the propeller.

A search of the ground under the aircraft's likely final approach path revealed several pieces of propeller and two blue plastic shrouds. These two shrouds had damage consistent with having been struck by the propeller, and ferrules were present inside both of them. Photographs of the aircraft taken as it was taxiing prior to the accident flight confirmed that blue plastic shrouds were present on the rear end of both the rear cables. The wreckage trail was therefore consistent with the cable ends pulling through the ferrules of the two rear rigging cable assemblies, whilst in flight.

The ferrules on G-BYNO were compared with those on another aircraft of a similar type at the site and the G-BYNO ferrules were found to have a substantially smaller wall thickness.

Previous maintenance activity

The owner of the aircraft was a qualified microlight instructor with over 7,000 flying hours. He had noticed that there were signs of corrosion in all four rigging cables and on 22 March 2006 all four rigging cable assemblies were replaced. The owner of the aircraft stated that, due to many days of poor weather, there was a lot of flying training planned. He was also concerned that new cable assemblies supplied from the manufacturer might take over a week to arrive since a recent order of parts had been lost in transit. He therefore asked an acquaintance, known to have significant experience in cable making, to make a set of cable assemblies for the aircraft using tools and parts available at the airfield workshop.

The acquaintance was retired but had over 35 years experience with hang-gliders and microlights, including working for an organisation that manufactured microlight aircraft. He was also interviewed and he recalled agreeing with the owner that the cables needed replacing. He felt comfortable with assisting since he was experienced in making cables, and he was confident that he had the correct wire rope (material type and size), the correct tools and the correct gauge with which to check the compression of the ferrules.

A representative from the aircraft manufacturer attended the accident site. He confirmed that the replacement rigging cables assemblies had been made using a correct type of wire rope and the correct tools; however, the ferrules used were of a different type from those used by the manufacturer.

The aircraft had flown for a total of 1 hour and 50 minutes on three flights, not including the accident flight, since the cables were replaced.

British Microlight Aircraft Association (BMAA) Guide to Airworthiness Procedures

The BMAA Guide to Airworthiness Procedures covers a wide range of aircraft types and includes sections covering both modifications and maintenance.

The Modifications section starts with the following words:

> *'It is not legal to fly any modified aircraft, including a microlight, without first obtaining appropriate approval for the modification….'.*

Modifications are classified as Major or Minor, and both need to be approved by the BMAA. The definition of a Major modification is as follows:

> *'A major modification is a change to the state of the aircraft that affects the primary aircraft structure, flying controls, aerodynamic surfaces, powerplant design and operation, flight or ground handling. It may also sometimes comprise a collection of minor modifications that in combination are of sufficient complexity to justify this definition. Minor modifications are those that do not meet the above classification.'*

It is noted that repairs are classified and treated in the same way as modifications.

The Maintenance section starts with the following words:

> *'General maintenance tasks, such as replacing hoses, engine components and other such consumable items need not be submitted to the BMAA for approval. In general, this holds true where 'form, fit and function' is not altered and components are replaced with fully interchangeable parts approved by the manufacturer'.*

There is no explicit warning in the maintenance section that the fitting of non-manufacturer-approved parts in safety-critical areas requires a major modification application form to be submitted to the BMAA for approval.

The BMAA were contacted and confirmed that had a major modification application form been submitted for the cables in G-BYNO the application would have been rejected on the grounds that only parts approved by the manufacturer should be used.

Operator's Manual

The Operator's Manual contains a section on the maintenance of rigging cables as follows:

> *'WARNING. Kinked, corroded or damaged cables should be changed at once with new factory supplied items. Flying with damaged cables could cause structural failure, resulting in injury or death.'*

Comparison of the G-BYNO cables with factory supplied items

A comparison was made between the cable assemblies fitted to G-BYNO and a new set supplied from the manufacturers. The only discernable difference was the type of ferrule used; see Figure 3 for a comparison of uncrimped ferrules, and Figures 4a and 4b for a comparison of the end of cable assemblies. The following comparisons were made:

Physical properties of the ferrules

The mass, wall thickness, internal diameter, hardness and chemical composition were determined using metallurgists where appropriate. One end of each of the

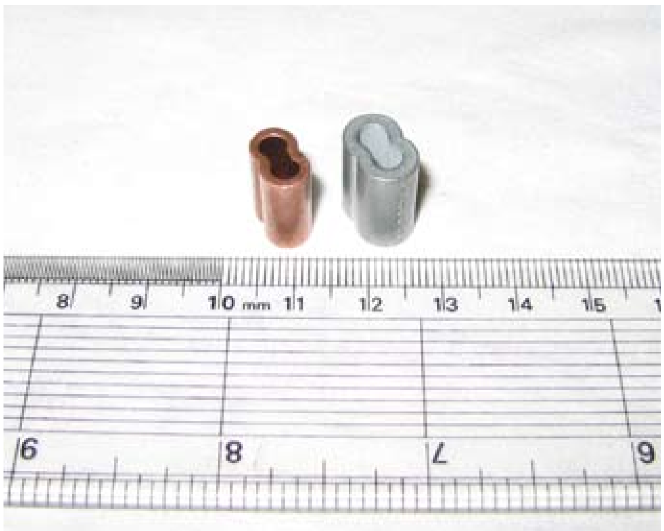


Figure 3

Photo: QinetiQ

Figure 4a

End of cable assembly (factory-supplied)

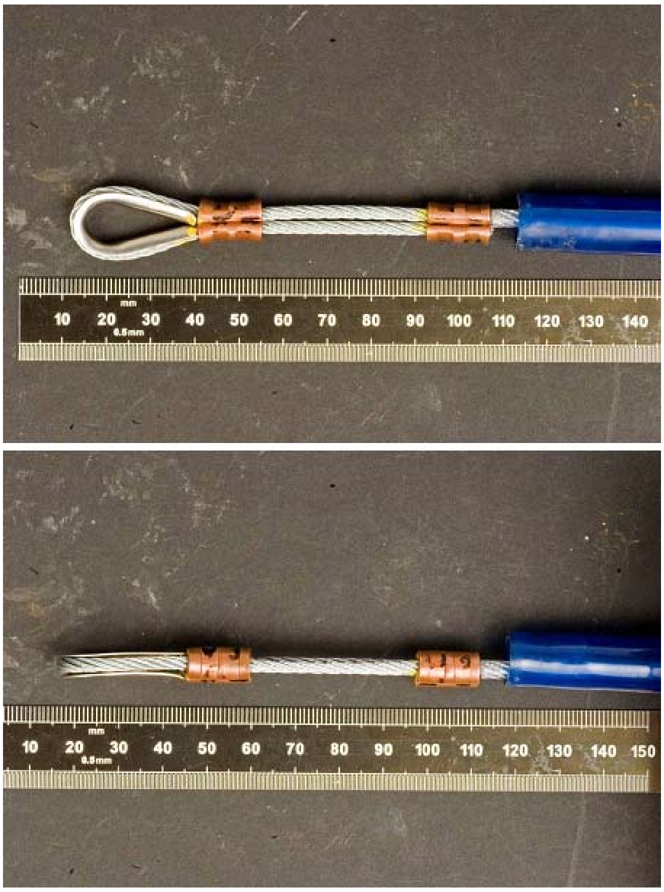


Photo: QinetiQ

Figure 4b

End of cable assembly (G-BYNO)

four cables had failed and the physical properties of all the ferrules from G-BYNO's cable assemblies that had failed are tabulated below. Two ferrules are used at each end of the four cables, making a total of eight ferrules. However, only seven ferrules were recovered from the accident site as one of the ferrules from the rear end of the rear cables was not found.

Two unused ferrules, one of the type used on G-BYNO and one of the type used in factory-supplied cables, were obtained. The widths, before crimping, were 11.0 mm and 13.2 mm respectively. Thus the effect of crimping the ferrules in G-BYNO was to reduce the width of the ferrule, ie produce a neck, in two places, typically from 11.0 mm to 8.5 mm; a compression of 2.5 mm. For the

	Ferrules from G-BYNO cables (mean value of seven ferrules that failed)	Ferrules from factory-supplied cables
Mass (g)	4.7	7.4
Diameter of hole for wire rope (mm) before crimping	3.7	4.0
Wall Thickness (mm)	1.5	2.2
Width (mm) – dimension of "neck" in ferrule after crimping	8.5	9.2

manufacturer's supplied cables the reduction was from 13.2 to 9.2 mm; a compression of 4.0 mm.

The chemical composition of the seven ferrules that failed on G-BYNO and a ferrule from a factory-supplied cable were determined using Energy Dispersive X-ray (EDX) analysis in a scanning electron microscope. The analysis concluded that all seven ferrules from G-BYNO that failed were pure copper. The ferrule from a factory-supplied cable was also determined to be, apart from the thin anti-corrosion coating, pure copper. There remains the possibility that beryllium, which cannot be detected using EDX analysis, could be present in the ferrules tested although this is considered unlikely.

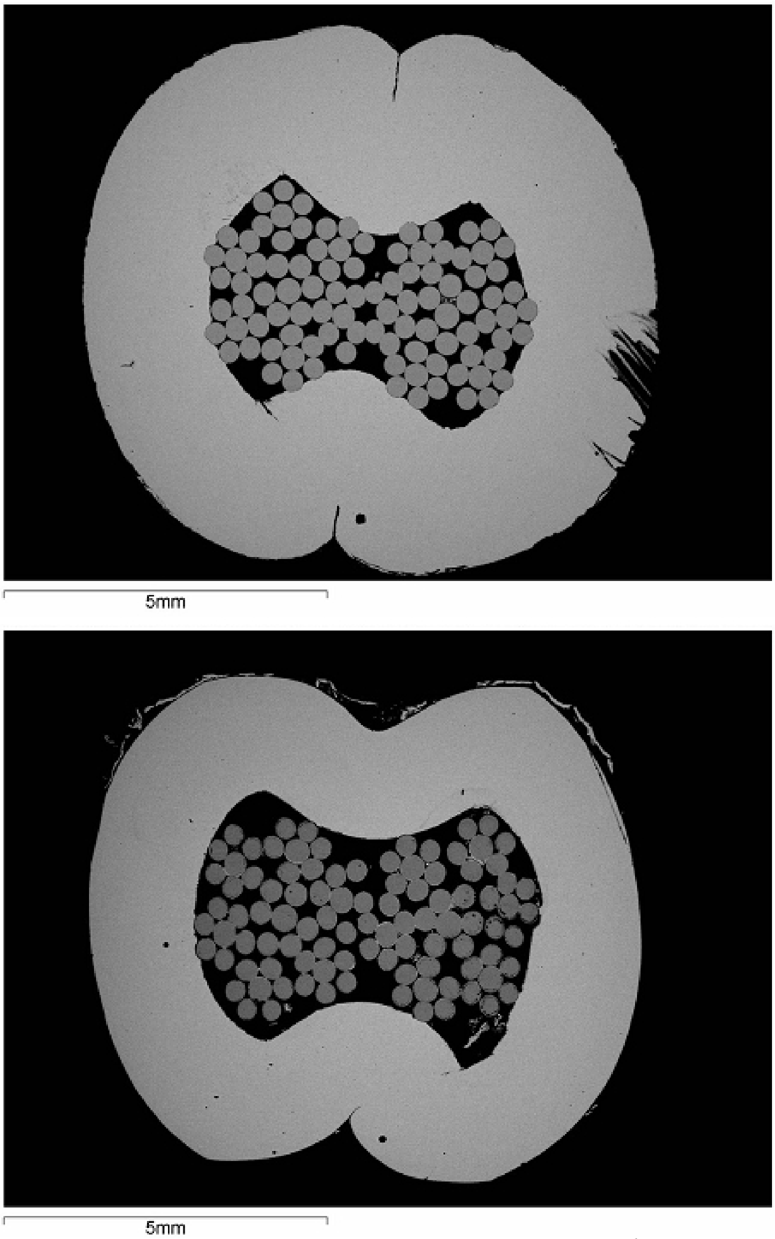
Vickers hardness tests were also carried out on crimped and uncrimped ferrules for both G-BYNO and factory-supplied parts. Such is the size of the ferrules that the crimping process has the effect of significantly hardening the material. The tests concluded that the copper used in the G-BYNO ferrules was significantly harder than that used for factory-supplied parts. This probably resulted in the G-BYNO ferrules having inherently less friction between the internal ferrule surfaces and the wire rope compared to the factory-supplied ferrules.

The end of one cable assembly from G-BYNO that did not fail, and a comparable factory-supplied item were sectioned and polished. The sections were made through the ferrules and wire rope in the region of the neck produced by crimping. Figure 5a and Figure 5b show the sections from the factory-supplied cables and G-BYNO respectively. Comparing the two sections it is evident that for the factory-supplied items there is:

a) more contact between strands of the wire rope and the ferrule;

b) more contact between the strands and other strands of wire rope;

c) less void space.



Photos: QinetiQ

Figures 5a (top) and 5b (bottom)

Sections through crimped ferrules

Length of cable assemblies

Cables that are over-length can be subject to 'snatching' and therefore become more highly loaded. Therefore the cable assemblies fitted to G-BYNO were measured and compared to the dimensions on the manufacturer's drawings. The accuracy of the measurements was compromised since one end of each of the four cables had failed causing the thimble (the key component that defines the length) to become detached, and both the rear cables were damaged by the propeller. As a result of the measurements it was concluded that it was likely that the G-BYNO cable assemblies were of the correct length.

Cable loading

For this aircraft, at an all-up weight of 409 kg, the load in these cables at the +4g design case is 1.66 kN. The manufacturer estimated that during the approach to land +2g loads could be expected and, with control forces added the loads in the cables would be about 1.0 kN.

The manufacturer estimated that the minimum load required to cause these cables to fail is 5.4 kN.

Destructive testing

One end of each of the four cable assemblies on G-BYNO had failed. Such cables carry tensile loads only and therefore the magnitude of the load at the end that did not fail was the same as that at the end that did fail. Therefore destructive testing of the cable ends that did not fail indicates the likely upper maximum of the load of the failed end of the cable; the load at failure may well have been much less. Two cables from G-BYNO, namely the forward end of the left forward cable and the forward end of the left rear cable, were tested using tensile load testing equipment. The applied strain rate was 5 mm/minute, until failure. Three ends of manufacturer supplied cables were similarly tested. The results are contained in the table below.

The cables supplied by the manufacturer failed in overload at the base of the ferrule, as was expected. It is usual in such tests to achieve a maximum load in excess of the nominal load for the wire rope alone. As noted above the manufacturer uses a minimum failure load for this stainless steel wire rope of 5.4 kN.

The G-BYNO cables pulled through the ferrules, indicative of insufficient purchase by the ferrules, without the wire rope failing. The two results for G-BYNO cables show significant variation and, importantly, it should be noted that the other ends of the cables tested must have failed on the aircraft at lower loads than those achieved during the tests. The destructive tests on the G-BYNO cables resulted in the appearance of the cable ends being similar to that found on the failed cables ends at the wreckage site - see Figure 2.

Cable	**Maximum load (kN)**
Manufacturer's cable – A	6.98
Manufacturer's cable – B	7.03
Manufacturer's cable – C	6.69
G-BYNO - forward end of left forward cable	3.45
G-BYNO - forward end of left rear cable	2.39

Analysis

All four rigging cable assemblies were found failed at the wreckage site. All four had been fabricated using a correct type of wire rope, the correct tools and of lengths which appeared to be correct. However, all four cable assemblies were made using incorrect ferrules and therefore did not conform to either the BMAA's Guide to Airworthiness Procedures or the Operator's Manual.

The two test results for cables from G-BYNO (2.39 kN and 3.45 kN) showed significant variation and were most probably higher than the loads which caused the cables to fail in the accident. It is possible that the lowest load to fail the cables at the other end was considerably less than these values. However the tested loads are higher than the loads that the manufacturer estimated for the aircraft on approach and thus it cannot be stated with certainty that the cables failed because they could not sustain the normal in-flight load conditions. It remains possible that some load case was experienced which was outside the +4g design case. There is, however, no direct evidence for this. Also there might have been some slippage and progressive failure of the cables during flight prior to the final failure of the cables at the time of the accident.

These tests also confirmed that the tested cables from G-BYNO failed as a result of the wire rope pulling through the ferrules. This resulted in the cable ends having a similar appearance to those found at the wreckage site. The lower wall thickness of the ferrules used for the G-BYNO rigging cables appears to have resulted in reduced grip on the wire rope and this conclusion is supported by the comparative photographs of the sections through the cable assemblies. The copper used in the ferrules for G-BYNO was harder than that used for factory-supplied cable assemblies and this is also likely to have reduced the grip inside the ferrule.

The eyewitness evidence indicated that at least two cables failed with the aircraft on approach and that at least one cable struck the propeller. The two blue shrouds from the rear two rigging cables were found on the airfield under the likely flight path of the aircraft and these provided very strong evidence that the two rear rigging cables failed prior to impact with the barn. It was not possible to be certain if the front cables, which typically carry higher loads than the rear cables, failed before the rear cables, or indeed failed before impact with the barn. However, the description of the aircraft's trajectory from the eyewitnesses would suggest that the front left cable failed first, causing the wing to pitch up and the aircraft to turn right, followed very shortly afterwards by the front right cable failing. The fact that the two forward cables carry higher loads than the rear two cables makes it more likely that the forward cables failed first. This would have allowed the rear cables to be struck by the propeller.

Whilst the decision to replace the four rigging cable assemblies appears to have been correct and timely, an important link in the chain of causes of this accident was the decision not to purchase factory-supplied parts. The Operator's Manual clearly states that factory-supplied cables should be used as replacements. The section entitled 'Maintenance' in the BMAA Guide to Airworthiness Procedures could be more explicit in stating that when replacing safety-critical items, either fully interchangeable parts approved by the manufacturer must be used, or a modification needs to be submitted for BMAA approval. Therefore the following safety recommendation is made aimed at ensuring that approved parts are used for safety-critical items:

Safety Recommendation 2007-007

It is recommended that the BMAA update their Guide to Airworthiness to state clearly that only parts approved either by the manufacturer or in a BMAA approved modification, should be used for the replacement of all safety critical items.

ACCIDENT

Aircraft Type and Registration:	Pegasus Quik, G-CCYE
No & type of Engines:	1 Rotax 912ULS piston engine
Year of Manufacture:	2004
Date & Time (UTC):	10 November 2006 at 1401 hrs
Location:	Manton Pegasus strip, near Marlborough, Wiltshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Wing segment torn, battens, tubes and bodywork damaged. 'A' frame and pylon bent
Commander's Licence:	Private Pilot's Licence
Commander's Age:	69 years
Commander's Flying Experience:	234 hours (of which 191 were on type) Last 90 days - 12 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

During rotation a gust of wind caused the aircraft to veer to the right and leave the runway, before entering a field and rolling onto its right side.

History of the flight

The pilot lined the aircraft up for takeoff on the grass Runway 26 at Manton Pegasus strip. The wind was reported as from the south-west at seven knots. The pilot began the takeoff roll and rotated the aircraft by applying forward pressure to the base bar of the control frame; when the front wheel lifted off the ground the aircraft veered to the right. The pilot reduced engine power to idle and applied the brakes gently. Due to the front wheel being off the ground, the pilot had no means of steering the aircraft as it continued to veer to the right before it left the runway and entered a field. The wind was now under the wing, causing the aircraft to roll over onto its right side before coming to rest. The pilot was uninjured and was able to exit the aircraft unaided. He had been wearing a lap strap and diagonal harness and a helmet.

The pilot attributed the initial veer to the right to a gust of wind at the point of rotation.

ACCIDENT

Aircraft Type and Registration:	Rans S6-ESA, G-BSUT
No & type of Engines:	1 Rotax 582 piston engine
Year of Manufacture:	1990
Date & Time (UTC):	7 August 2006 at 1552 hrs
Location:	Near Woolston Moss, Cheshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to propeller, cowlings, nose landing gear, main landing gear, cockpit cage, engine bearers, gearbox and fuselage skin
Commander's Licence:	Private Pilot's Licence
Commander's Age:	49 years
Commander's Flying Experience:	402 hours (of which 123 were on type) Last 90 days - 32 hours Last 28 days - 10 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft was damaged during a precautionary landing, following a loss of engine power.

History of the flight

The aircraft had departed from a farm strip near Nantwich, heading for Barton Aerodrome, Manchester. It had flown up the Manchester low level route at about 1,100 feet with no problems and, having passed the Thelwall viaduct, the pilot turned north-east for Barton. She contacted Barton for joining instructions and was told of a helicopter leaving their traffic zone heading towards her. Accordingly, she elected to cruise-climb to circuit joining height.

However, at approximately 1,300 feet the engine lost power – an estimated drop of about 1,000 rpm – but it recovered and the pilot at first thought she may have nudged the throttle with her left leg. Another loss of power and recovery occurred and she realised that there was now a genuine problem. The aircraft was passing a private strip near Warrington, so the pilot radioed a PAN call to Barton, announcing that she was making a precautionary landing at the private strip. Turning to land in a south-westerly direction, she now realised that this probably meant that there was at least a crosswind, and possibly also a tailwind component, but she found this difficult to estimate under the circumstances. The aircraft was ‘high and fast’ on the final approach and was running out of runway length when it bounced once, heavily. Despite an unsuccessful attempt to apply power, it landed again this time on its nosewheel, which collapsed. The occupants evacuated the aircraft normally via the left door and were uninjured.

The pilot candidly admits that she had turned too early towards the runway and that her attempts to sideslip the aircraft to lose height were not successful. She recalls that she was very tense and nervous since this was the first time she had experienced such an emergency for real.

Despite a thorough strip examination of the engine and fuel system, no reason for the power fluctuations has been found. It is intended that, when the aircraft has been repaired, the engine will be subjected to protracted ground and flight testing before being released back to the owner.

ACCIDENT

Aircraft Type and Registration:	X'Air 700(1A), G-CBCM
No & type of Engines:	1 HKS 700E V3 piston engine
Year of Manufacture:	2001
Date & Time (UTC):	4 December 2006 at 1435 hrs
Location:	Sandtoft Airfield, Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to nose and right main landing gear, nose fairing and propeller
Commander's Licence:	Private Pilot's Licence
Commander's Age:	33 years
Commander's Flying Experience:	2,880 hours (of which 5 were on type) Last 90 days - 101 hours Last 28 days - 29 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft suffered a partial power loss after takeoff. During the subsequent forced landing on soft terrain, the aircraft sustained damage. The pilot attributed the cause of the power loss to carburettor icing.

History of the flight

The flight was planned as part of the annual Permit-to-Fly renewal for the aircraft. The pilot had carried out a detailed inspection that day prior to the flight. At the runway threshold he ran the engine at full power to assure himself of the engine performance and the aircraft then took off and climbed satisfactorily. However, at approximately 250 ft, the engine suffered a partial loss of power leaving what the pilot estimated to be approximately 60% of the normal maximum power. He selected a field into which he planned to carry out a forced landing and transmitted a PAN call. At around 150 ft the engine lost more power, to around 20-30% of full power, and the pilot realised he would not be able to reach his selected field. He landed in the centre of a soft field and the right wheel detached. The nose landing gear then contacted the soft ground and collapsed, allowing the aircraft to tip onto its nose, breaking the propeller. Both occupants were uninjured.

Discussion

The pilot initially considered that fuel starvation could have been the cause of the power loss and he therefore checked the fuel filter and carburettor float bowl, which were found to be clean. Once an investigation of the engine has been carried out any further findings will be published in a later bulletin.

The pilot assessed that carburettor icing was a possible cause of the loss of engine power. The HKS 700E V3 is a two-cylinder four-stoke engine, which, not unusually for a microlight engine, does not have any carburettor heat facility.

Metrological aftercasts from the area around the airfield showed the temperature and dew point were 11ºC and 6ºC respectively, with 71% humidity. Reference to the carburettor icing chart in the CAA General Aviation Safety Sense Leaflet 14A showed that these conditions are conducive to serious icing at any power.

FORMAL AIRCRAFT ACCIDENT REPORTS ISSUED BY THE AIR ACCIDENTS INVESTIGATION BRANCH

2005

1/2005 Sikorsky S-76A+, G-BJVX near the Leman 49/26 Foxtrot Platform in the North Sea on 16 July 2002.

Published February 2005.

2/2005 Pegasus Quik, G-STYX at Eastchurch, Isle of Sheppey, Kent on 21 August 2004.

Published November 2005.

3/2005 Boeing 757-236, G-CPER on 7 September 2003.

Published December 2005.

2006

1/2006 Fairey Britten Norman BN2A Mk III-2 Trislander, G-BEVT at Guernsey Airport, Channel Islands on 23 July 2004.

Published January 2006.

2/2006 Pilatus Britten-Norman BN2B-26 Islander, G-BOMG, West-north-west of Campbeltown Airport, Scotland on 15 March 2005.

Published November 2006.

3/2006 Boeing 737-86N, G-XLAG at Manchester Airport on 16 July 2003

Published December 2006.

2007

1/2007 British Aerospace ATP, G-JEMC 10 nm southeast of Isle of Man (Ronaldsway) Airport on 23 May 2005.

Published January 2007.

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