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COMMERCIAL AIR TRANSPORT

(ALL TIMES IN THIS BULLETIN ARE UTC)

ACCIDENT

Aircraft Type and Registration:	Boeing B737-800, EI-DAI
No & Type of Engines:	2 CFM 56-7B24 turbofan engines
Year of Manufacture:	2003
Date & Time (UTC):	21 July 2005 at 1655 hrs
Location:	London Stansted Airport, Essex
Type of Flight:	Public Transport (Passenger)
Persons on Board:	Crew - 6 Passengers - 153
Injuries:	Crew - None Passengers - None
Nature of Damage:	Right wing leading edge and lower skin punctured
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	40 years
Commander's Flying Experience:	9,600 hours (of which 4,000 were on type) Last 90 days - 250 hours Last 28 days - 80 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft commander reported that loading was nearly complete when he felt the aircraft rock. On investigation he discovered that the outboard section of the starboard wing had been struck by a pair of steps being towed by a ground agent's vehicle. This resulted in damage to the leading edge and lower skin of the wing, including a section where the skin had been completely punctured. The steps were being positioned onto the rear door of an aircraft on the neighbouring stand and the vehicle had strayed into the box marked around EI-DAI's stand intended to protect against such an accident.

Investigation reports concerning this occurrence were sought from the BAA, Stansted Airport police and the handling agents but none was able to supply anything more than photographs of the aircraft damage.

Data recently made available to the Flight Safety Foundation revealed that ramp damage is costing airlines and corporate aviation nearly $10 billion a year.

INCIDENT

Aircraft Type and Registration:	Dornier 328-100, G-BYML
No & Type of Engines:	2 Pratt &Witney PW-119B series turboprop engines
Year of Manufacture:	1996
Date & Time (UTC):	15 November 2005 at 2015 hrs
Location:	London (City) Airport, London
Type of Flight:	Public Transport
Persons on Board:	Crew - 2 Passengers - 20
Injuries:	Crew - Nil Passengers - Nil
Nature of Damage:	Smoke in cabin
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	48 years
Commander's Flying Experience:	6,142 hours (of which 420 were on type) Last 90 days - 187 hours Last 28 days - 20 hours
Information Source:	AAIB Field Investigation

Summary

The aircraft was taxiing for takeoff at London (City) Airport when ATC informed the commander that their anti-collision lights were not illuminating. Shortly afterwards the flight crew identified that the associated circuit breaker 'popped' whenever the lights were selected ON. Meanwhile, the cabin attendants reported that the cabin was rapidly filling with smoke. An uneventful evacuation of the aircraft was carried out with no injuries to any of the crew or passengers. The investigation concluded that the crew experienced two unrelated faults and that the smoke in the cabin most probably resulted from leakage of oil from the left engine into the left Environmental Control System pack.

History of flight

On the day of the incident the crew had already operated three sectors between Dundee and London (City) Airport and were taxiing to holding point Charlie at London (City) for the final flight to Dundee; ATC advised them that their anti-collision lights were not illuminating. After confirming that the anti-collision lights switch in the cockpit was selected to ON the flight crew recycled the switch but the lights remained off. The aircraft held at holding point Charlie whilst the flight crew consulted the Minimum Equipment List, after which they advised ATC that they could still depart since the strobe lights were serviceable. ATC informed the crew that they were waiting to see if Terminal Control would accept them without anti-collision lights. Whilst awaiting further instructions the flight crew noticed that the circuit breaker (CB) for the anti-collision lights had 'popped'; on resetting the CB it immediately popped again and the crew selected the anti-collision lights switch to OFF.

The cabin lights had been dimmed for takeoff and the cabin attendants were positioned in their allocated seats, 11A and 12A. Approximately four to five minutes after the pilots had noticed that the CB had popped, both attendants became aware of a smell of burning plastic. The No 1 attendant immediately used the inter-phone to inform the commander that '*there was a smell of burning in the cabin*', whilst the No 2 attendant walked to the front of the aircraft in an attempt to locate the source of the smell. Whilst doing so she noticed that there was smoke, or haze, blowing across the beams from the passenger reading lights. The attendant reported that the smoke seemed to be coming from the upper ventilation ducts located along the length of the cabin. The attendant immediately reported this to her colleague who told the commander that '*the cabin was filling up with smoke*'. The commander told the cabin attendant to '*stand by*', whilst he contacted ATC and requested an immediate return to the stand. In the meantime the No 2 attendant turned the cabin lights fully on and noticed that the cabin was now full of smoke, which appeared to be getting thicker. She again reported this to the No 1 attendant who told the commander '*we need to hurry up the cabin is really filling with smoke'*. The No 2 attendant now started to experience difficulty in breathing and went to the front of the aircraft to collect her Personal Breathing Equipment (PBE). However, before she could fit the PBE the commander gave the order, over the Public Address (PA) system, to evacuate the aircraft. He then commenced shutting down the aircraft and informed ATC '*(Callsign) we have smoke in the cabin, we are shutting down and evacuating the aircraft'*, this transmission was acknowledged by ATC.

At approximately 2015 hrs ATC activated the crash alarm and passed details of the Ground Incident to the fire service. The ATC controller estimates that the first appliance reached the aircraft approximately 30 to 45 seconds after the crash alarm had been activated. On arriving at the aircraft the Fire Officer informed ATC and the airport operations controller that the fire cover was now category 0[1]. A search team equipped with breathing apparatus and a thermal camera conducted a search of the aircraft and reported to the Fire Officer that there were no signs of excessive heat or smoke inside the aircraft.

Approximately 10 minutes after the initial call from the pilot, the Fire Officer informed the operations controller that he was downgrading the incident to a local standby. At about the same time the London Fire Brigade appliances reported that they were at the agreed rendezvous point and were informed that their assistance was not required. The airport fire appliances were stood down at approximately 2045 hrs once the operator's engineer and the Fire Officer were satisfied that the aircraft was safe to be towed to a stand.

In the absence of fire cover the runway had been closed for approximately 11 minutes during which the Tower Controller instructed one aircraft on approach to execute a go-around whilst the Radar Controller vectored other aircraft into a holding pattern until the runway re-opened.

Following the incident the commander consulted with the company Chief Pilot and, since the flight crew had not been exposed to any fumes, it was decided that they would operate the spare aircraft on the flight to Dundee. It was also arranged that another cabin attendant would be allocated to this flight; she was already at the airport

Footnote

[1] Category 0 means that there is no fire cover available.

but had not been on the incident aircraft. The two cabin attendants who had been exposed to the smoke were given the option of remaining at London; however, they elected to fly back, as passengers, to Dundee where they were based. They subsequently consulted their GP who advised them to take a few days off work. Neither of the cabin crew required any further medical treatment. The spare aircraft subsequently departed London (City) Airport at 2136 hrs.

Aircraft evacuation

On hearing the command to evacuate the aircraft the cabin attendants immediately opened the front and rear doors and instructed the passengers to leave the aircraft. A few individuals initially tried to retrieve items from the lockers and one passenger started to open the emergency exit adjacent to seat 9A. Another passenger tried to push past the attendant at the front door, who was holding the passengers back until the propeller stopped rotating. Nevertheless, an orderly evacuation was carried out and the attendants escorted the passengers safely away from the aircraft. The cabin crew reported that the passengers remained calm throughout the incident and none of them required medical treatment.

CAA advice on actions following a smoke/fumes incident

Flight Operations Department Communication 21/2002 recommends:

Operators should ensure that flight and cabin crews are advised as to the post-flight actions required following a smoke/fumes incident. These actions should include:

a) A Commander's review of the in-flight incident. This should include consultation with the flight and cabin crew;

b) A determination as to whether any crew member felt unwell, or whether their performance was adversely affected; and

c) The requirement for a crew member who felt unwell, or felt their performance was affected, not to operate as a member of the crew until he/she has been assessed as fit by a medical practitioner and the crew member feels fit to operate.

The instructions to flight and cabin crews should be detailed in the Operations Manual.

Whilst the commander and Operator instinctively complied with these recommendations, at the time of the incident there were no instructions in the Operator's Operations Manual concerning the actions to be taken following a smoke/fumes incident. However, the Operator has since taken action to include appropriate instructions in their Operations Manual.

CAA advice on the operation of circuit breakers

Flight Operations Department Communication 7/1999 recommends:

In-flight operational use of CBs will usually involve the action of resetting a circuit breaker which has tripped because of an electrical overload or fault. Clearly, the re-establishment of electrical power to a circuit which is at fault does involve, however slight, an element of risk. Accordingly, flight crews should be advised not to attempt to reset CBs in flight for other than essential services and, even then, only when it is allowed by the aircraft flight manual and there is clearly no associated condition of smoke or fumes. A second reset should not be attempted.

In this instance the flight crew elected to re-set the CB since they were still on the ground, although, strictly speaking, the aircraft was classified as being 'in flight'.

Description of air conditioning system

The aircraft air conditioning system uses engine bleed air to supply conditioned air to the passenger cabin and cockpit. Bleed air from the engines is supplied to two identical Environmental Control System (ECS) packs and the bleed air from each engine can be selected on and off by a flow control and shut-off valve. The right hand (RH) pack normally receives bleed air from the right engine and supplies all the conditioned air for the cockpit with any excess flow added to the air from the left hand (LH) pack for the passenger cabin. The engine bleed airlines from each engine are also connected by a cross-bleed line equipped with a cross-bleed valve, which can be opened by the pilots to enable both ECS packs to be supplied with air from one engine. Conditioned air is supplied through ducting to floor and ceiling outlets in the passenger cabin and cockpit; additionally each passenger seat position is supplied with conditioned air through an adjustable outlet. The flight crew can control the engine bleed air via switches mounted on the ECS control panel. The operating status of the ECS is indicated by lights on the ECS control panel and messages and synoptics on the Engine Indicating and Crew Alerting System (EICAS).

The possibility of oil contamination of the ECS was first identified in 1995 and can be caused when oil leaks from the engine main bearings and contaminates the compressor air flow before it enters the ECS through the compressor bleed valves. Some of the potential causes for this include over filling the engine oil tanks, deteriorated engine seals and starting or stopping the engines with the engine bleed air selected ON. A customer information letter was issued on 8 December 2000 highlighting the possible causes of bleed air contamination and the procedures to clear the contamination once it has occurred.

Engineering investigation

Debrief

The company engineer entered the aircraft within 10 minutes of the incident and was not aware of any signs of smoke or smells. Before the crew departed on the spare aircraft the company engineer received a quick debrief from the pilot informing him of the problem with the anti-collision lights and reports of some smoke in the cabin. The engineer's understanding was that there where only wisps of smoke from the overhead ducting, accompanied by a bad smell; consequently, the investigation initially focused on the anti-collision lights electrical system. It was a further 14 hours before the engineer became fully aware of the extent of the smoke in the cabin and was informed that the cabin crew had provided statements to the company.

Anti-collision lights

Seats 10A to 5A were removed and several of the cabin floor panels were lifted in order for a limited inspection to be carried out on the cable looms, air conditioning pipes and aircraft structure. There was no evidence of burning, over heating or signs of smoke damage. With electrical power applied to the aircraft the anti-collision lights CB 'popped' whenever the lights switch was selected ON; however there was no evidence of smoke or signs of overheating of the electrical cables and components. The anti-collision lights power supply, which is located outside the pressure cabin, was replaced and the anti-collision lights operated normally.

The engineering documentation revealed that the anti-collision lights power supply had been replaced at Edinburgh on the day prior to the incident and had been fitted on this aircraft for a total of 2.55 flying hours before the failure was noticed. The power supply had previously been removed from another aircraft on 8 August 2004 for the same fault, and following repair was reissued to the operator on 14 December 2004. It then remained in their stores until being fitted to G-BYML on 14 November 2005. The power supply unit has since been returned to the overhauler for further investigation and repair.

Engine and Air Conditioning System

There were no warning messages on the EICAS to indicate that there had been a problem with either the engine or the air conditioning system. Extensive ground runs were carried out with all the electrical equipment and the air conditioning system operating with no evidence of smoke or bad smells in the cockpit or the cabin. The ground cooling fan, recirculation fan and avionic fan were operated and found to be serviceable. The engine oil levels were checked and found to be at "ADD 1 ½" mark, which was considered to be normal. The air conditioning pipes from the air conditioning packs were removed and there was no evidence of oil having leaked out of the engines into the ECS pack. The aircraft was subsequently flown, without passengers, for 1.47 hours on a training flight and closely monitored for a further 20 flying hours with no repetition of smoke or smells in the cabin. The engine oil consumption was also closely monitored during this period and was assessed by the company as being normal. Moreover, since this incident the operator has not reported any further incidents of smoke in the cabin on any of their aircraft.

Possible causes of smoke in the cabin

Anti-collision lights

With the anti-collision lights power supply unit located outside of the pressure vessel, and no evidence of smoke or overheated cables under the cabin floor, it is unlikely that the anti-collision electrical system was the source of the smoke.

Engine

The engine manufacturer has stated that leakage across two of the four main bearing carbon seals in the engine can cause smoke and unusual smells in the cockpit. However, this would result in an increase in oil consumption and, since the problem could not fix itself, there would be repeated occurrences of smoke in the cabin. Given that the oil consumption was normal and there have been no repeated occurrences of smoke in the cockpit, it is considered unlikely that failure of a main bearing carbon seal was the cause of the smoke in the cockpit.

Environmental Conditioning System

Despite the lack of oil residue in the pipelines, the description given by the cabin attendants of the bad smell and the smoke coming out of the cabin ventilation vents strongly indicates that the ECS pack had become contaminated with oil. With the ECS cross-bleed valve selected CLOSED, its normal position, it is likely that the oil came from the left hand engine, which only feeds conditioned air to the passenger cabin. However, the engineering investigation could not identify the circumstances that led to oil entering the ECS and the operator has reported no further incidents of smoke in the cabin.

Discussion

The evidence strongly suggests that the flight crew were presented with two unrelated faults and it is most likely that the source of the smoke was leakage of oil from the left hand engine bleed system into the LH ECS. The cabin attendants' description of the amount of smoke in the cabin was at variance with the observations of the fire crew and the operator's engineer shortly after the evacuation when there was no evidence of smoke, or bad smells in the cabin. It is possible that with the lights dimmed for takeoff, and the smoke blowing across the passenger reading lights, that the smoke appeared to be much thicker than it actually was. Nevertheless, the timing of the two unrelated events, and the concerns of the cabin attendants that the cabin was rapidly filling with smoke, was sufficient for the commander to order the evacuation of the aircraft. Communication between the commander and cabin attendants was effective and the attendants took timely action in making the decision to don their PBE, and they subsequently carried out a swift and safe evacuation of the aircraft. ATC also displayed a good level of communication in bringing the pilots attention to the failed anti-collision lights and instigating the aircraft ground incident plan. The Airport Fire Service and the London Fire Brigade responded promptly with the result that the incident was down-graded quickly to local standby and the runway was closed for only 11 minutes.

INCIDENT

Aircraft Type and Registration:	HS 748 Series 2A, G-BVOU
No & Type of Engines:	2 Rolls-Royce Dart 534-2 turboprop engines
Year of Manufacture:	1973
Date & Time (UTC):	15 February 2005 at 1323 hrs
Location:	Belfast (Aldergrove) Airport, Northern Ireland
Type of Flight:	Public Transport (Cargo)
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Both left main wheel tyres deflated
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	58 years
Commander's Flying Experience:	8,500 hours (of which 4,000 were on type) Last 90 days - 180 hours Last 28 days - 60 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and extensive enquiries by the AAIB

Reported circumstances

The aircraft commander, who held the post of Deputy Chief Training Captain of the operator, reported that the aircraft had landed in calm conditions with good visibility. He was occupying the right-hand seat with the left-hand seat occupied by the handling pilot who, according to the commander, had completed his LPC/OPC to a very good standard on the previous leg.

The commander stated that the landing in question appeared normal in every respect, and he observed no excessive or heavy braking at any stage. Upon exiting the runway onto the taxiway, however, steering became difficult and the aircraft could only just be manoeuvred off the runway. ATC reported that the aircraft was moving slowly and when asked if assistance was required, the crew stated that the left engine had stopped. On leaving the aircraft the commander noted that both tyres on the left main landing gear were flat.

Photographs of the aircraft taken by the airport authorities after the incident indicate that both tyres on the left side had deflated, and their treads and carcass structures had completely worn through locally to 'flat spots'. The left propeller was in a coarse pitch position, at or approaching the feathered setting.

The aircraft technical log was annotated 'Left-hand fire indication on landing; both (undecipherable word) fired'. Subsequent maintenance actions included the replacement of both fire bottles. Analysis of further entries in the technical log show that no significant internal damage had occurred in the left engine and subsequent ground running was carried out successfully. No problems were reported with wheel braking after the aircraft returned to service.

Subsequent operating problems and component changes

The aircraft subsequently experienced a series of engine flame-outs during landing, as well as occurrences of RPM hunting in flight. A micro-switch within the control console, operated by the flight fine pitch-stop (FFPS) lever and intended to cancel the auto-coarsening function once the pitch stops were withdrawn during landing, was noted as being slightly damaged. It was suspected of incorrect operation and was replaced. The plug to the solenoid in the left propeller control unit (PCU) was also replaced and ultimately the PCU was changed.

Relevant aircraft features

Propeller control and interlocking

The landing procedure on the HS 748 requires the FFPS lever to be moved upwards and aft to the 'stops-removed' position soon after touch down. This can only be done if the throttles are both in the fully aft position. Operation of the FFPS lever causes micro-switches to function, resulting in an electrical signal being supplied to each PCU. Consequent operation of a solenoid valve in the PCU allows hydraulic pressure to pass, via a dedicated 'third' oil line in each propeller hub, causing each FFPS to be extracted. This allows each propeller to reduce in pitch to an angle below the FFPS setting, towards a figure ultimately limited by the ground fine pitch stop (GFPS).

Circuitry in the aircraft forms an auto-coarsen facility which operates if the FFPS fails to function. Auto-coarsening takes place if the propeller pitch becomes significantly below the FFPS setting in flight. The system utilises the feathering pump and causes the propeller pitch to increase until the operation is cancelled by action of a hub-switch; pitch will then decrease until the cycle is repeated. Movement of the FFPS withdrawal lever to the aft position during the landing, in addition to its primary function, operates micro-switches in the auto-coarsening circuits. These microswitches inhibit the auto-coarsening function permitting the pitch of each propeller to decrease below the FFPS setting.

It is possible on the 748 to remove the FFPS regardless of whether or not the main landing gear oleos are compressed.

At high runway speeds, early in the landing run, FFPS removal increases drag and assists retardation. It also reduces lift as a result of affecting airflow over the wing immediately aft of each propeller. FFPS removal, in allowing the propeller to fine off below the FFPS pitch angle, permits engine/propeller rpm to rise if the throttles are subsequently moved forward, thus safeguarding the turbine against rapid over-temperature and failure.

Engagement of the flying control gust-lock lever, positioned on the control console, normally takes place as speed reduces. The lever is mechanically interconnected with the FFPS lever, preventing the latter moving away from the 'Stops-Out' position once the gust locks are engaged. Locks engagement is achieved by upwards, aft and downward movement of the telescopic lock lever.

A theoretical evaluation of the functioning of the PCU was carried out by the manufacturer using archived data together with experience of development engineers involved with the unit during its development process and previous service use. It was determined that normal control of the delivery pressure from the oil pump within the unit was achieved by axial movement of a sleeve allowing progressive exposure of bleed ports to take place. A ball valve incorporated in the system had been designed to operate in conditions of very low oil temperature when the normal regulating system was not able to bleed sufficient flow rate to prevent excessively high pressure levels being produced by the pump.

Braking system

The 748 is equipped with 'Maxaret' anti-skid units. These detect changes of wheel rotational speed and release brake pressure to prevent locking of the relevant wheel. They do not, however, prevent locking should a stationary wheel come into ground contact with the brake already applied.

Engine nacelles

Examination of a similar aircraft, in the company of an HS 748 engineering specialist, indicated that small amounts of a grease, used to lubricate universal joints on the drive shaft between the engine and the accessory gearbox, tend to be centrifuged away from the joint by shaft rotation. This material then frequently coats adjacent areas in the region of the combustion system. These surfaces are cooled by the normal ventilation airflow through the engine nacelle. If, however, during a landing, the aircraft is brought to a halt and the throttles remain in the fully aft position with low engine and propeller rpm, normal ventilation through the nacelle reportedly becomes greatly reduced and in extreme cases a flow reversal can take place. Without normal nacelle ventilation flow, temperature in the region of the deposited grease becomes much higher than normal and combustion of the deposits can take place. The high temperature characteristics of the materials in this area are such that no fire damage normally results from the brief period of combustion required to destroy the grease deposit. The fire detection loop, however, passes directly above the position at which the grease deposit usually occurs and is thus easily activated.

Recorded data

Considerable difficulty was experienced in decoding the flight data recorder (FDR), and the limited set of parameters recorded were of no value in this investigation. In addition, the recorded data was of poor quality and the pitch attitude, one of the required parameters, had not been recorded. The engineering organisation that supports the operator has been advised of these observations and has initiated actions to resolve the issues.

The cockpit voice recorder, however, indicated that operations were normal during touch-down and initial deceleration. Verbal reference can be heard to the propeller pitch stop withdrawal and the application of the gust-lock lever, both normal procedures during the landing run of an HS 748. Subsequently a crew member exclaims that an engine has stopped and it appears that attempts are being made to taxi the aircraft. During crew discussions about the difficulty of taxiing the aircraft the audio fire warning is heard followed by the commander questioning the handling pilot as to the point of origin of the smoke.

Component testing

No fault could be reproduced in the micro-switch removed from the auto-coarsen circuit. The problems with the engine, however, ceased after the micro-switch had been changed.

Rig testing of the PCU initially revealed no functional problems with that unit. A strip examination was then carried out which revealed no internal defects. Following re-assembly, however, a functional problem was experienced during a rig test. This was initially attributed to pre-existing damage to the ball of a pressure relief valve within the unit, which acted as a peak pressure governor to the oil pump. Subsequent microscopic examination of the ball and assessment of its operating mode by the component manufacturer did not, however, substantiate the theory advanced for the effect of a sticking ball on the functioning of the propeller.

Although the reason for the incorrect functioning of the PCU during the subsequent rig test was not established, its behaviour was consistent with the possibility that a solid contaminant in the rig oil supply had become lodged in one of the ports in the sleeve of the pressure relief valve. Such an obstruction, if capable of temporarily jamming the sleeve, could leave it in an open port condition allowing excessive spilling of oil and loss of system pressure, the phenomenon noted during the rig test. Since the test was carried out after strip examination and re-assembly of the PCU, it is considered unlikely that any contamination of the engine/PCU oil supply present during flight operation would have remained present in the region of the pressure controlling sleeve at the time of the rig test. It is also not clear how a loss of system oil pressure could lead to an unexpected increase in blade pitch angle during the landing.

Further information

Information supplied by the propeller manufacturer revealed that occasional service problems had been experienced in the past with corrosion of contacts in the PCU socket into which the airframe cable connector is plugged. Although the airframe plug was changed during part of the diagnostic process, the part of the connection within the PCU remained present with potential for retaining problems of bad contact until the PCU was changed.

Analysis

The precise sequence of events during this landing is not clear. The anti-skid units normally prevent wheel locking, unless there is a system defect or brake pressure is being applied by a crew member as the aircraft or relevant wheel touches down. Since each wheel brake is safeguarded by an individual anti-skid unit, the damage inflicted to both left tyres, together with the absence of corresponding damage on the right units, cannot readily be accounted for by a system failure.

No mechanical reason for the stoppage of the left engine is evident from the technical log entries covering rectification during the operating period immediately after the flight in question.

The problem of occasional left engine flame-out on landing and periodic rpm fluctuation in flight continued, however, until the left auto-coarsen system micro-switch was replaced. Thereafter, the problems appear to have ceased. Although testing of the removed micro-switch failed to reproduce a failure condition, it should be recognised that such testing does not necessarily fully reproduce the varying temperature and vibration levels experienced in service. Such electrical components are often susceptible to 'dormant' faults, which can be exploited by vibration and temperature changes.

If the micro-switch was not operating correctly as the aircraft landed, auto coarsening of the left propeller could commence once the throttles were fully retarded, the airspeed had decayed and the pitch stop withdrawal lever had been operated. Progressively increased airflow would then be briefly created by the left propeller with an increase in propeller thrust and local lift. When the FFPS was selected 'out' the right propeller alone would fully enter the ground-fine range, significantly reducing local airflow and hence reducing both thrust and lift, but solely on that side of the aircraft. Thus if the FFPS selection was made during the flare, fractionally before the aircraft touched down, considerable and unexpected lift asymmetry would occur. If not immediately identified and successfully counteracted with lateral control this could have caused the left wheels to remain clear of the ground during the round-out whilst the right wheels made positive ground contact. Thus the aircraft may have alighted initially on the right wheels only, without this situation being entirely evident to the crew.

Depending on any float, and the precise points at which the FFPS lever was withdrawn and wheel braking was initiated, the possibility exists that brake pressure was applied to the left units whilst the corresponding wheels unexpectedly remained clear of the runway. Such a sequence would explain the locking and subsequent flattening of both tyres on the left and the undamaged state of those on the right. Although sliding contact of the locked wheels with the runway would produce considerable retardation, this is unlikely to have been more effective than a rolling wheel with firm braking and correctly operating Maxaret units on the right hand side. Thus with appropriate modulation of pressure on the right brake pedal, directional control could have remained effective. The low sampling rate of the FDR heading parameter would mask any rapidly corrected short period heading change brought about by asymmetric retardation resulting from any difference between the performance of the locked and rolling wheels.

Under these circumstances, the left engine would have suffered progressive reduction of rpm as the blade pitch increased and the airspeed decayed; with the fuel flow remaining at or below the idle figure it is possible that reduced compressor delivery pressure and flow rate would have lead to flame out. Although the hub switch would have normally limited auto-coarsening of the blades once a pitch figure slightly above the FFPS setting was reached, with reducing air-speed, coupled with engine flame-out, the propeller rpm would have decayed. The centrifugal twisting moment (CTM), normally tending to drive the blades towards fine pitch, would have progressively reduced, permitting any residual hydraulic pressure to drive the blades, without the usual CTM restraint, towards the high pitch position.

The engine fire warning that took place is consistent with the effect of a sudden loss of nacelle ventilation on the ground occurring as a result of engine stoppage, immediately after the engines had been operating at approach power. In such circumstances, the area contaminated with grease could be expected to reach a higher temperature than would occur during a normal shut-down following a period of low power operation during taxiing with consequent nacelle ventilation present. Although implementation of the in-flight engine fire drill involves propeller feathering, the bottles alone can be discharged in isolation, an appropriate action on the ground if the fire warning occurred some time after it had been identified that the engine had flamed-out. The fact that the engine flamed out during the landing run appears to have been a consequence of the increasing propeller blade pitch without a corresponding rise in fuel-flow, further suggesting that the final coarse propeller pitch setting was achieved before the fire warning and subsequent crew actions took place.

Conclusion

An intermittent defect in a micro-switch in the control console could account for the engine flame-out and the eventual coarse pitch position of the left propeller. This defect is broadly consistent with the reported events, the recorded data, the final position of the propeller blades and the damage known to have occurred to the tyres. The limited data available, however, together with the lengthy and progressive nature of trouble-shooting and component replacement carried out, make it unclear as to the precise sequence of events and any potential aircraft defect which led to the incident.

ACCIDENT

Aircraft Type and Registration:	Avid Aerobat (Modified), G-LAPN
No & Type of Engines:	1 Jabiru 2200A piston engine
Year of Manufacture:	1995
Date & Time (UTC):	2 January 2006 at 1205 hrs
Location:	Otherton, Staffordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Propeller and both wingtips damaged. Mud in engine cooling air intakes
Commander's Licence:	Private Pilot's Licence
Commander's Age:	42 years
Commander's Flying Experience:	106 hours (of which 1 was on type) Last 90 days - 1 hour Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot and data from the Met Office

History of flight

The pilot/owner, having rigged the aircraft, carried out the normal external checks which included taking a fuel sample from the fuel tank drain and checking for contamination; none was observed. Following engine start the pilot taxied the aircraft to the holding point for Runway 25L where power checks were carried out satisfactorily. The aircraft was then taxied onto the runway, the throttle opened, full power rpm observed and the take-off roll started. Approximately three-quarters of the way down the runway the pilot noticed a change in the engine sound and upon checking the engine rpm gauge saw that it had reduced by about 250 rpm. The throttle and choke controls were checked and found to be in their correct positions which led the pilot to abandon the takeoff. At this point there was very little runway remaining in which to stop the aircraft. The aircraft overran the runway and hit a single track road that consisted of two ruts either side of a raised grassy ridge. At this point the aircraft was launched into the air to a height of between 5 and 10 ft from which it fell back to the ground in a nose-down attitude. Later inspection of the aircraft by the pilot showed damage which he thinks indicated that, during the impact with the ground, the aircraft 'cart-wheeled' around its wingtips.

In the pilot's assessment the engine lost power due to either fuel or air starvation, possibly due to carburettor icing. No detailed examination of the aircraft's fuel system has been undertaken.

Meteorology

The Met Office provided an aftercast. At 1200 hrs on 2 January 2006 the synoptic situation showed a ridge of high pressure extending north-east over England and Wales with a light westerly flow covering the area. The weather was hazy, with a surface visibility of 7 to 10 km and a cloud base of around 4,000 ft. The air temperatures and humidity were:

Height agl	Temp	Dewpoint	Humidity
Surface	PS 05	PS 04	90%
500 ft	PS 04	PS 01	80%
1,000 ft	PS 06	PS 01	60%
2,000 ft	PS 03	PS 03	65%

The surface temperature and humidity figures were plotted on the carburettor icing probability chart (Figure 1) as shown in the CAA General Aviation Safety Sense Leaflet 3A titled '*Winter Flying*' and Leaflet 14 titled '*Piston Engine Icing*'. The chart showed a probability of serious carburettor icing at any engine power setting.

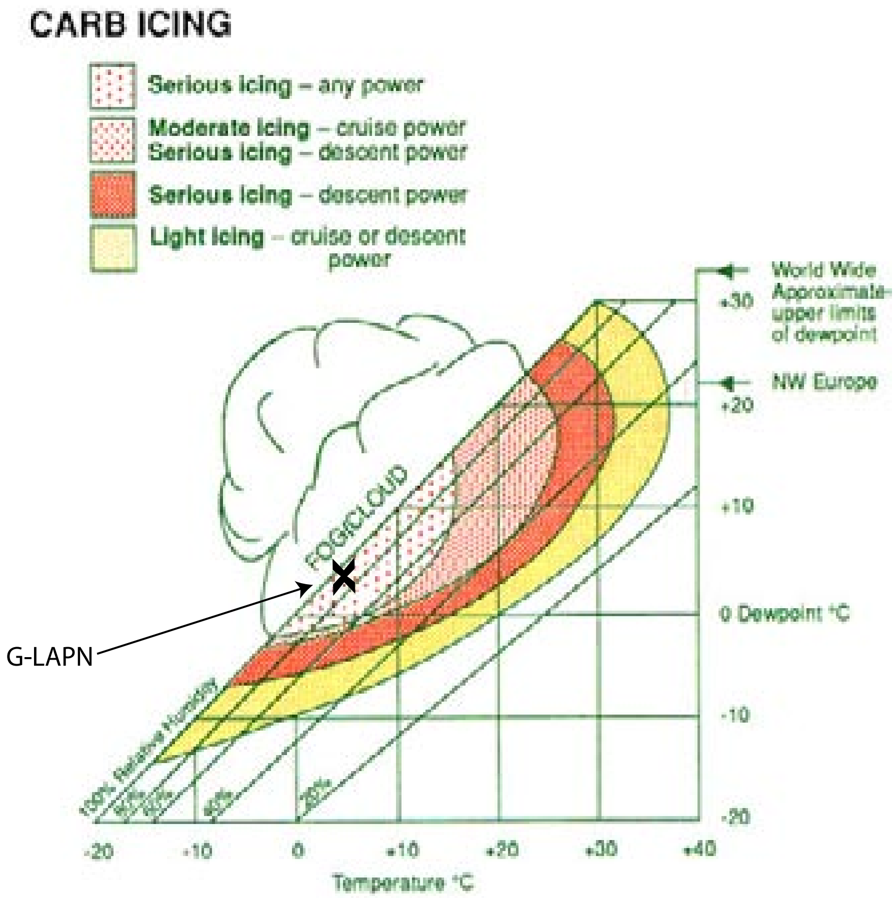


Figure 1

Carburettor icing probability chart

INCIDENT

Aircraft Type and Registration:	Beech C23 Sundowner, G-BASN
No & Type of Engines:	1 Lycoming O-360-A4J piston engine
Year of Manufacture:	1973
Date & Time (UTC):	26 December 2005 at 1415 hrs
Location:	Aldergrove Airport, Northern Ireland
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	None
Commander's Licence:	Private Pilot's Licence
Commander's Age:	38 years
Commander's Flying Experience:	315 hours (all on type) Last 90 days - 0 hours Last 28 days - 0 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

As the aircraft took off from Runway 25, the tower Air Traffic Control Officer observed an object dangling from the tail. The object was subsequently identified as a car tyre filled with concrete, which had been used to tie down the aircraft on the ground. The pilot was informed and he landed the aircraft safely after completing a normal circuit. After landing the aircraft was taxied clear of the runway and shut down before the tie-down weight was removed. A runway inspection was carried out before further use. The pilot reported that during the aircraft's pre-flight inspection he had removed the tie down weights attached to the wings but had failed to notice the tie down weight attached to the tail.

ACCIDENT

Aircraft Type and Registration:	Bolkow Bo 209 Monsun, G-AZRA
No & Type of Engines:	1 Lycoming O-320-E2F piston engine
Year of Manufacture:	1972
Date & Time (UTC):	20 October 2005 at 1150 hrs
Location:	Private airstrip, near Miserden, Gloucester
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Dented spinner, fibre glass cowling cracked, wing leading edge dented
Commander's Licence:	Private Pilot's Licence with IMC rating
Commander's Age:	29 years
Commander's Flying Experience:	264 hours (of which 149 were on type) Last 90 days - 19 hours Last 28 days - 6 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot was returning to his private airstrip, having previously flown from High Wycombe to nearby Rendcombe, a grass strip 550 m in length. The airstrip has two landing areas, 04/22 which is 450 m long and has a downslope of 1:18 (5.5%) in the 22 direction and 13/31,which is 390 m long, is level and has a 15 ft high fence close to its 13 threshold. There is no windsock at the airstrip.

When he arrived overhead, the pilot listened to the Kemble radio frequency which was reporting a wind of 230º/11 kt; Kemble is approximately 6nm from the airstrip. The pilot concluded that he would have a tailwind of approximately 11 kt if he landed down the slope of the longer runway and an 11 kt crosswind using the shorter runway. He had used both landing directions several times before and, on this occasion, selected landing direction 13 for his landing. Passing over the hedge, the aircraft touched down approximately 80 m beyond the threshold, which left approximately 300 m for the landing roll in which to stop.

The pilot initiated firm braking, but the wheels locked and slid on the wet grass, which resulted in little deceleration. He then pumped the brakes on and off, with little effect and, with 100 m of runway remaining and the aircraft still travelling at 40 to 45 mph, he applied full left rudder to prevent a collision with a stone wall at the end of the runway. The aircraft deviated to the left, whilst sliding to its right, before it hit a post and wire fence in the corner of the field. The pilot pulled the mixture control to idle cut-off before the collision.

Many light aircraft are in performance group E, and certificated with unfactored data[1]. The owners manual for this aircraft type indicates that a landing distance of approximately 440 m is required from a height of 50 ft on approach, which includes a ground roll of approximately 240 m. These figures assume that the landing is being made on a dry hard surface, at an elevation of approximately 500 ft amsl, at standard atmospheric temperature and pressure and with a zero headwind component. They are derived from measured data, and are usually produced using a new aircraft, in ideal conditions and flown by a highly experienced pilot. The manual states that the landing distance should be increased by 10% on a grass surfaces, but it also states that the landing roll can be much greater on grass runways, especially when wet.

The UK CAA publishes a very useful guide for light aircraft short field operations. The incorporated data, derived from practical testing, is published as an Aeronautical Information Circular (AIC) and is currently also available as Safety-Sense Leaflet (SSL) No. 7c, titled A*eroplane Performance* dated June 2005. This provides factors to be applied to (unfactored) data in the manual for non-standard runway conditions, ie, grass surfaces, slopes, tailwind component, etc. With reference to page 6 of SSL 7C, Figure 1, where dry grass of up to 20 cm (8 in)[2] height on firm soil constitutes the surface, the required landing distance (from 50 ft) should be increased by 15%. If the grass is wet the relevant increase is 35% and should the grass be very short and wet, 60% is indicated. SSL 7c also advises that an additional overall safety factor of 1.43 should be applied to unfactored data, once the landing distance has been derived by applying individual factors to data in the manual, and that all factors are cumulative and should be multiplied together.

The effect of variables of pilot technique, the uncertainty of the value of headwind or tailwind component (because the only data available to the pilot was an estimated cross-wind based on a measured figure of strength and direction broadcast from a location some distance away) and the state of the landing surface (wet grass) conspired, on this occasion, to render landing direction 13 unsuitable for the aircraft to perform a successful landing.

When planning to land at an airfield under limiting conditions, it is vital to ascertain the weather conditions, the state of the runways and apply the factors as described in SSL 7c.

Footnote

[1] Unfactored data relates to the actual performance of an aircraft when flown and measured under ideal conditions.

Footnote

[2] The length of the grass on Runway 13 was reported as three to four inches.

10 SUMMARY:

FACTORS MUST BE MULTIPLIED i.e. 1.20 x 1.35

	TAKE-OFF		LANDING	
CONDITION	INCREASE IN TAKE -OFF DISTANCE TO HEIGHT 50 FEET	FACTOR	INCREASE IN LANDING DISTANCE FROM 50 FEET	FACTOR
A 10% increase in aeroplane weight, e.g. another passenger	20%	1.20	10%	1.10
An increase of 1,000 ft in aerodrome elevation	10%	1.10	5%	1.05
An increase of 10°C in ambient temperature	10%	1.10	5%	1.05
Dry grass* - Up to 20 cm (8 in) (on firm soil)	20%	1.20	15%[+]	1.15
Wet grass* - Up to 20 cm (8 in) (on firm soil)	30%	1.3	35%[+] Very short grass may be slippery, distances may increase by up to 60%	1.35
Wet paved surface	-	-	15%	1.15
A 2% slope*	Uphill 10%	1.10	Downhill 10%	1.10
A tailwind component of 10% of lift-off speed	20%	1.20	20%	1.20
Soft ground or snow*	25% or more	1.25 +	25%[+] or more	1.25 +
NOW USE ADDITIONAL SAFETY FACTORS (if data is unfactored)		**1.33**		**1.43**

Notes: 1. * Effect on Ground Run/ Roll will be greater.

2. [+] For a few types of aeroplane e. g. those without brakes, grass surfaces may decrease the landing roll. However, to be on the safe side, assume the INCREASE shown until you are thoroughly conversant with the aeroplane type.

3. Any deviation from normal operating techniques is likely to result in an increased distance.

If the distance required exceeds the distance available, changes will HAVE to be made.

SSL 7c 6 June 2005

Figure 1

Extract from Safety Sense Leaflet 7c (June 2005)

ACCIDENT

Aircraft Type and Registration:	Cessna U206F, G-BMHC
No & Type of Engines:	1 Continental Motors Corp IO-520-F piston engine
Year of Manufacture:	1976
Date & Time (UTC):	20 October 2005 at 1855 hrs
Location:	Tilstock Airfield, Preesheath, Whitchurch, Shropshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Extensive; aircraft damaged beyond economic repair
Commander's Licence:	Private Pilot's Licence
Commander's Age:	33 years
Commander's Flying Experience:	824 hours (of which 400 were on type) Last 90 days - 140 hours Last 28 days - 49 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Summary

The aircraft struck a rut or mound while landing on a rough grass strip in failing light. The nose wheel fork fractured and dug in, overturning the aircraft.

History of the flight

The pilot reported that he flew from Draycott Farm to Blackpool for a business meeting in Blackburn. Owing to the meeting over-running, followed by heavy traffic encountered on the return drive to Blackpool Airport, the departure was later than intended and the pilot considered that he could not reach Draycott Farm before nightfall. He therefore decided to fly to Tilstock, an airfield well known to him, from which he had operated extensively in the past and with which he was very familiar.

On arrival at Tilstock the approach was normal but just after touch-down the nose-wheel hit either a rut or a small mound on the runway. The aircraft then became airborne again. The fork holding the nose-wheel axle fractured and as the aircraft touched down for the second time the remains of the fork dug into the ground and the aircraft overturned. The pilot switched off the fuel and electrics and both occupants exited the aircraft without injury.

Pilot's comment

The pilot subsequently considered that he had been unwise to use a comparatively rough grass strip in fading light conditions, when adverse surface features were less easily seen and avoided.

ACCIDENT

Aircraft Type and Registration:	DH 82A Tiger Moth, G-ANMO
No & Type of Engines:	1 De Havilland Gipsy Major 1C piston engine
Year of Manufacture:	1935
Date & Time (UTC):	2 October 2005 at 1450 hrs
Location:	Andrewsfield, Essex
Type of Flight:	Private/Instructional
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Broken propeller and damage to nose
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	59 years
Commander's Flying Experience:	2,020 hours (of which 100 were on type) Last 90 days - 14 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The aircraft was carrying out an instructional flight. During the latter part of the landing roll, on a grass surface, the aircraft began to pitch forward and, despite application of full aft stick, the aircraft's tail continued to rise until the propeller struck the ground. The aircraft then slid some 10 to 15 m with its nose on the ground.

The pilot reported that this flight was the seventh of the day in similar wind conditions (340º/5-10 kt, gusting 15 kt). These conditions were accommodated on each landing by approaching slightly across the runway, Runway 27, to reduce the cross-wind component and by using an 'into-wind, wing-down' technique. In each case, alighting took place with the right main-wheel first, directional control being initially maintained with the aircraft's tail up, and then by moving the stick aft as the aircraft slowed to a stop.

The pilot noted that it had rained overnight which he considered may have created a soft patch of grass, causing the wheels to dig in, pitching the aircraft forward. He also considered that the wind may have veered and gusted, creating a brief tail-wind component which, at a low forward speed, would have reversed the effect of the up elevator input, creating a nose down rather than a tail-down effect.

ACCIDENT

Aircraft Type and Registration:	Europa (Tri-gear), G-BWZA
No & Type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	1997
Date & Time (UTC):	5 November 2005 at 1420 hrs
Location:	Netherthorpe Airfield, Nottinghamshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to main landing gear, nosewheel and propeller
Commander's Licence:	Private Pilot's Licence
Commander's Age:	60 years
Commander's Flying Experience:	194 hours (of which 37 were on type) Last 90 days - 11 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot had flown from Full Sutton Airfield, Yorkshire, to Netherthorpe Airfield, Nottinghamshire. On his arrival in the Netherthorpe area he made radio contact with the airfield and was informed that the surface wind was from 210º at 15 to 20 kt. The visibility was good with cloud at 1,800 ft. He carried out an overhead join and made an approach to Runway 24, a grass runway with 370 m (1,210 ft) of landing distance available and an upslope; the runway surface was wet.

The approach was flown with full flap at a speed of 60 kt and a normal flare and touchdown was made. After a ground roll of some 30 to 40 m the aircraft lifted into the air again, drifted to the right and then dropped heavily back to the ground. The landing gear was damaged but the occupants were uninjured and were able to disembark normally.

The pilot commented that the wind conditions were blustery and he thought that runway surface irregularities may have caused the aircraft to become airborne again. The flight test stall speeds for this particular aircraft are not known but a typical stall speed for the type, with full flap, would be around 44 kt.

ACCIDENT

Aircraft Type and Registration:	Pierre Robin DR400/140B Major, G-BFJZ
No & Type of Engines:	1 Lycoming O-320-D2A piston engine
Year of Manufacture:	1978
Date & Time (UTC):	14 November 2005 at 1615 hrs
Location:	Headcorn Aerodrome, Kent
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to left wing
Commander's Licence:	Student pilot
Commander's Age:	46 years
Commander's Flying Experience:	12 hours (all on type) Last 90 days - 12 hours Last 28 days - 11 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

On the morning of the accident the student pilot had flown with his instructor, completing several circuits whilst covering various emergency procedures. The student had then continued to fly several solo 'touch and go' circuits without incident.

In the afternoon the instructor again flew with the student, completing more circuit training and some upper air work. The student then took off to complete three more solo 'touch and go' landings. The weather at the time was good with a light surface wind blowing down the runway.

The first circuit and touch down were without incident and after ensuring the aircraft was straight and on the runway centreline, the student applied full power to commence a rolling takeoff. As the aircraft accelerated down the runway, the student increased pressure on the right rudder pedal to keep the aircraft straight; however, he applied too much pressure and the aircraft began to steer to the right. The student counteracted this by applying left rudder but he over compensated, sending the aircraft off to the left. The aircraft crossed over the left hand edge of the runway and its left wheel hit a runway marker. The student closed the throttle and applied the brakes in order to bring the aircraft to a halt. Despite the student applying right rudder again, the aircraft continued to steer to the left and before it could be stopped, its left wing struck a timber fence that ran parallel with and close to the runway, spinning the aircraft round through 180º. The impact brought the aircraft to a halt and the student shut down the engine, switching off the magnetos. He informed ATC of the accident before vacating the aircraft uninjured.

The student pilot attributed the cause of the accident to his over-use of the rudder pedals.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28-140 Cherokee, G-ASPK
No & Type of Engines:	1 Lycoming O-320-E2A piston engine
Year of Manufacture:	1964
Date & Time (UTC):	19 December 2005 at 1408 hrs
Location:	Land's End Airfield, Cornwall
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to nose landing gear, engine cowling, wings and windscreen
Commander's Licence:	Student pilot
Commander's Age:	62 years
Commander's Flying Experience:	85 hours (of which 84 were on type) Last 90 days - 13 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The student pilot was returning from an uneventful solo navigation exercise. There was a light south-westerly wind of about five knots, the visibility was greater than 10 km and the cloud base was at 2,200 ft amsl. Runway 25 was in use, which is a grass runway 695 m in length; however, a displaced threshold reduces the landing distance to 630 m.

Following a stable approach at 80 to 85 mph, with full flap selected, the aircraft was reported to have made a smooth landing, touching down further along the damp, grass runway than normal. With idle power selected, the pilot allowed the aircraft to slow to about 40 mph before applying the brakes, which are hand operated. The aircraft veered rapidly to the left, through approximately 30º; the pilot released the brakes and tried to regain directional control. He stated that no amount of pressure on the right rudder pedal would turn the aircraft back to the right and, because the aircraft was heading towards a boundary hedge, he reapplied the brakes, with the result that the aircraft veered further to the left as it slowed down. The pilot estimated that the aircraft struck the hedge at about 25 mph and then stopped. Uninjured, he vacated G-ASPK without delay through the cockpit door and, although there was a smell of fuel, reported that there was no fire. The aircraft sustained damage to the spinner, nose landing gear, engine cowling, wings, and windscreen.

The pilot was unable to explain why the aircraft had veered to the left after he had applied the brakes and why he could not correct the turn. He considered that it was possible that either there had been uneven braking due to the damp surface conditions or that he had been pushing against a part of the aircraft structure other than the right rudder pedal.

Two witnesses considered that the aircraft had landed longer than usual and one thought that the combination of that and the aircraft's speed was going to result in the aircraft going around. The other witness, the authorising instructor, commented that once the aircraft had veered through 30º or more it would have been very difficult to regain the original heading, especially on a damp, grass surface. He had estimated the braking action as being medium/good. An initial examination of the brakes confirmed that, when progressively applied, they operated correctly and acted evenly on both main wheels. A photograph taken after the accident, of the aircraft's tracks across the grass surface, reveals a steady, continuous turn to the left.

ACCIDENT

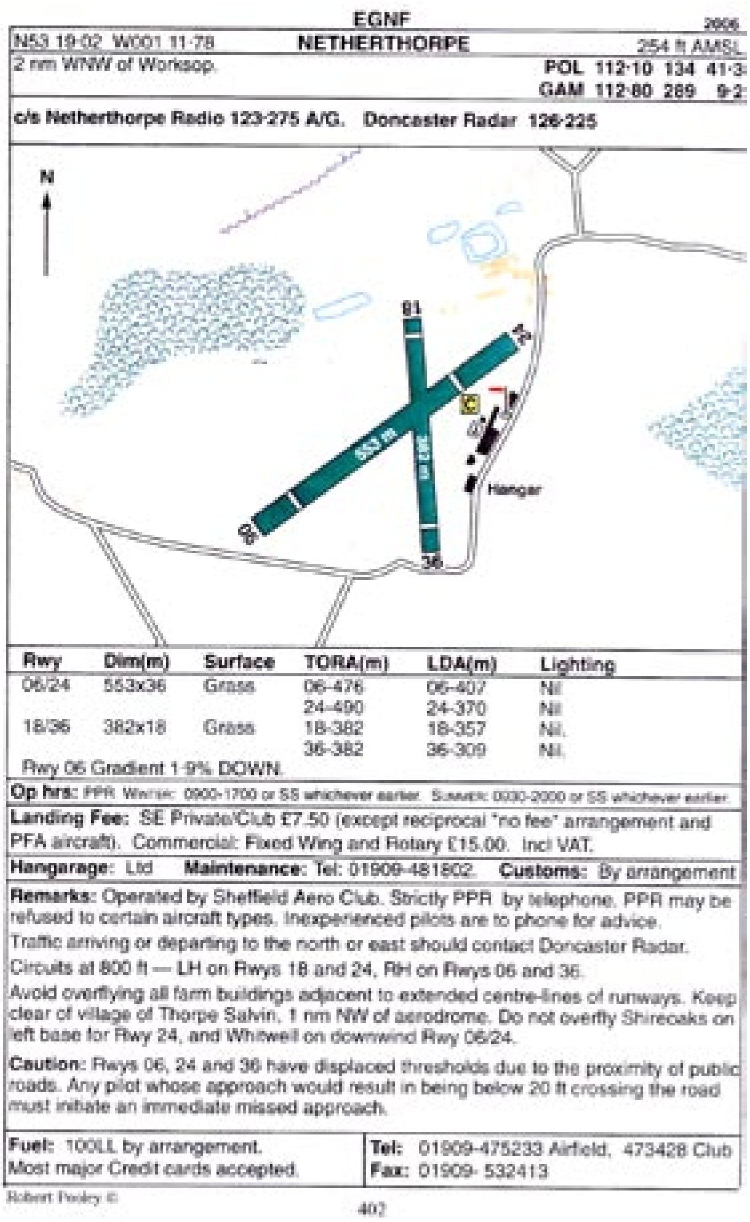
Aircraft Type and Registration:	Piper PA-28-140 Cherokee, G-AZWE
No & Type of Engines:	1 Lycoming O-320-E2A piston engine
Year of Manufacture:	1972
Date & Time (UTC):	31 August 2005 at 1400 hrs
Location:	Netherthorpe, Nottinghamshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Serious) Passengers - 1 (Serious)
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	54 years
Commander's Flying Experience:	415 hours (of which 321 were on type) Last 90 days -13 hours Last 28 days - 4 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft was departing from Netherthorpe's Runway 06 with no headwind and an OAT of 29ºC. After the pilot rotated, the aircraft became airborne but then sank back down onto the runway with the airspeed stagnated. It crossed the airfield boundary, with the throttle closed, and hit a stone wall approximately 75 m beyond the runway's end which rendered both occupants unconscious. The aircraft did not catch fire. Given the aircraft's configuration, weight, weather and runway conditions at the time, it was determined that there was insufficient take-off run available for the aircraft to become safely airborne.

History of flight

The pilot and his passenger, another qualified pilot, had planned a day's flight in this aircraft from their home base at Dunkeswell. They planned to land at several different airfields before returning to Dunkeswell at the end of the day and were each going to fly alternate legs. They had booked into Netherthorpe by telephone and been made aware that the runways there were particularly short. Although the commander noted this, he commented that he was very distracted by domestic issues and was relying on his less experienced flying partner to have dealt with any performance issues. After departing Dunkeswell, they landed at Garston Farm strip in Wiltshire and then flew to Turweston Airfield where the aircraft was refuelled to full tanks before departing to Netherthorpe. They took off from Runway 27 at Turweston, which has a Take off Run Available (TORA) of 800 m, during which time they became momentarily airborne, sank back onto the runway became airborne again and eventually climbed away. The first approach into Netherthorpe was to grass Runway 06 and the pilot initiated a go-around as he touched down, having decided that the aircraft's speed was slightly too fast. They landed off the second approach to the same runway and took lunch in the clubhouse. The acting Chief Flying Instructor at Netherthorpe explained that both runways (06/24) were in operation as the wind was blowing directly across the runway and suggested that they used Runway 06 for departure due to its downhill slope[1]. They accepted his suggestion and shortly afterwards taxied for Runway 06 which has a TORA of 476 m, Figure 1.



Rwy	Dim(m)	Surface	TORA(m)	LDA(m)	Lighting
06/24	553x36	Grass	06-476	06-407	Nil
			24-490	24-370	Nil
18/36	382x18	Grass	18-382	18-357	Nil.
			36-382	36-309	Nil.

Rwy 06 Gradient 1·9% DOWN.

Op hrs: PPR. Winter: 0900-1700 or SS whichever earlier. Summer: 0930-2000 or SS whichever earlier.

Landing Fee: SE Private/Club £7.50 (except reciprocal "no fee" arrangement and PFA aircraft). Commercial: Fixed Wing and Rotary £15.00. Incl VAT.

Hangarage: Ltd **Maintenance:** Tel: 01909-481802. **Customs:** By arrangement

Remarks: Operated by Sheffield Aero Club. Strictly PPR by telephone. PPR may be refused to certain aircraft types. Inexperienced pilots are to phone for advice.
Traffic arriving or departing to the north or east should contact Doncaster Radar.
Circuits at 800 ft — LH on Rwys 18 and 24, RH on Rwys 06 and 36.
Avoid overflying all farm buildings adjacent to extended centre-lines of runways. Keep clear of village of Thorpe Salvin, 1 nm NW of aerodrome. Do not overfly Shireoaks on left base for Rwy 24, and Whitwell on downwind Rwy 06/24.

Caution: Rwys 06, 24 and 36 have displaced thresholds due to the proximity of public roads. Any pilot whose approach would result in being below 20 ft crossing the road must initiate an immediate missed approach.

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Figure 1

Footnote

[1] The mean downhill slope of Runway is quoted as 1.9%.

Engine power checks were completed as normal and the flaps were left retracted for the takeoff, which was commenced from a rolling start using the full runway length. The aircraft appeared slow to accelerate and the non flying pilot called out the airspeed in miles per hour, as per his usual routine. At approximately 60 mph, the pilot attempted to raise the aircraft's nose but the nosewheel did not leave the ground so he returned the control column to the neutral position. At 65 - 67 mph, he attempted to rotate again and the aircraft became momentarily airborne before settling back down on the runway with the airspeed stagnating. The pilot called to his colleague "we are not going to make it" and closed the throttle as they approached the end of the runway. Neither pilot recalls hitting the airfield boundary fence but both remember seeing a stone wall ahead before losing consciousness.

Performance

It was not possible to determine the exact weight of the aircraft at the time of the accident but it is likely to have been at close to its maximum weight of 2,150 lbs when it departed Turweston with full fuel tanks. Thus, departing Netherthorpe, its weight would have been approximately 2,100 lbs.

The grass runway was firm and the grass was about 2-3 inches long. The grass was cut each Thursday, and was cut on schedule the morning after the accident. After cutting, it was about 1½ inches long.

The manufacture's flight manual provides takeoff performance data for a takeoff with full throttle, flaps retracted and lift off initiation at 73 mph. CAA Change Sheet No 3 Issue 1 to this flight manual states that:

> *'It has been established from air testing that the aeroplane fails to achieve the performance scheduled in Section V of the flight manual'*

and offers correction data to the Take off Distance Required (TODR). TODR is defined as the distance required from the start of the take-off run until the aircraft achieves a height of 50 ft.

Netherthorpe Airfield is 250 ft amsl and the prevailing weather conditions were a surface wind of 150º/10 kt and a temperature of 29ºC. Taking into account the downslope of 1.9% on Runway 06, the performance table in the flight manual including the correction data, suggests a TODR of 856 m using a short, dry grass runway. This figure includes some margin for loss of performance for which it is difficult to make an allowance operationally, such as small and unavoidable variations in airspeed and variations from the average airframe drag and engine power. The manual also notes that the take-off run must be taken as 55% of the TODR, ie, 471 m. This distance has been factored by 1.15 to provide scheduled data, so the calculated take-off run with no safety factors included would have been 409 m.

Runway 06 at Netherthorpe has a total runway length of 553 m and a TORA of 476 m. The TORA finishes 77 m from the end of the runway in order that departing aircraft can climb clear of any vehicles positioned on the public road adjacent to the airfield.

The flight manual gives no guidance for short field take-off technique or performance figures for taking off with any flap setting other than retracted.

Aircraft information

The aircraft was manufactured in 1972 and carried the constructor's number 28-7225303. It last received a star annual inspection on 17 June 2005, by which time it had accumulated a total of 13,071 flying hours. At the time of the accident it had accumulated 13,144 hours. The last 50 hour inspection was carried out on 9 August 2005, at

13,118 hours. There were no defects or rectifications recorded in the log books since that inspection.

Examination of the accident site and wreckage

The aircraft's landing gear had left ground marks from the end of the runway to the boundary fence, and also across the adjoining field beyond the end of the runway, but there were no marks visible on a road between the airfield and the adjoining field. The ground marks indicated that, close to the end of the runway, the aircraft had tracked slightly to the left while yawing to the right. It had then passed through the boundary fence, striking a fence post and hedge with the left wingtip. This initiated a significant yaw to the left which continued as the aircraft entered the adjoining field, causing the aircraft to track some 15º to the left of the runway heading. The left yaw then reduced but the track continued until impact with a substantial stone wall occurred some 275 ft from the end of the grass at the edge of the airfield. The final track was approximately 045º M and the final heading was approximately 035º M.

Examination of the wreckage and witness information did not indicate that there had been any major pre-accident defects with the aircraft's structure, flight controls or engine. At impact, the aircraft had been configured with the flaps retracted and examination of the flap selector gate showed that this had been the pre-accident setting. The aircraft was destroyed in the impact but damage to the propeller indicated that it had been turning under low power at the point of impact with the wall. Initial contact was made by the aircraft with its left wing tip, which caused the left wing to detach and swung the aircraft further to the left, just before the propeller made contact with the wall. Even though the damage to the aircraft was severe, the cabin remained intact and the seats remained secured to the floor. The passenger's diagonal harness had pulled out of the aircraft structure, due to overload; otherwise the belts and harnesses were undamaged and appear to have functioned as intended.

The fuel, magnetos and battery master switch were turned off shortly after the accident, and the throttle and mixture controls had been moved during the impact and/or evacuation. The engine tachometer had jammed on impact at about 650 rpm, and this was consistent with the engine being at idle at the point of impact with the wall. The air speed indicator was undamaged, and was removed from the aircraft. When checked for accuracy, it was found to be not more than 1 mph in error between 74 and 40 mph. It was, however, an old style of presentation which made it easy to confuse the dual knots and mph scales[2]. The aircraft carried a GPS, but this was not recording data during the takeoff.

Figure 2

G-AZWE's air speed indicator. The larger figures are mph, the smaller figures are knots. Note that the legend 'KNOTS' is larger than that for 'MPH'.

Footnote

2 This type of ASI was implicated in an accident to a PA-28, G-OSOW, at Bournemouth International Airport. The report on this accident was published in the 8/2000 edition of the AAIB Bulletin.

The left fuel tank was ruptured by impact with the wall and the right tank drain valve had sheared off, allowing fuel to escape. A considerable quantity of fuel had been collected by the fire services as it drained from the aircraft.

Netherthorpe Procedures

The CAA's *Aeroplane Performance* Safety Sense Leaflet 7c quotes Article 43 of the Air Navigation Order, which states that it is the responsibility of the pilot-in-command to ensure that the aircraft will have adequate performance for the proposed flight. The leaflet goes on to say that it may not be necessary to check the performance data before every flight, especially if there is an obvious surfeit of runway available.

Netherthorpe, however, is a licensed airfield with one of the shortest available take-off and landing distances in the UK. Performance margins for certain types of light aircraft, particularly when taking off from this airfield, can become very small and several previous accidents and incidents have occurred where the short runway length has been a contributory factor.

The Aero Club which operates Netherthorpe requires visiting aircraft to request prior permission before attempting a landing. They reserve the right to refuse certain types of aircraft and require inexperienced pilots to call in advance for advice. This advice would consist of a discussion with one of the club's instructors who explains the peculiarities associated with Netherthorpe, with particularly emphasis on the length of the runways. The commander of G-AZWE had phoned in advance and assured the Aero Club that he was familiar with short grass fields. Nevertheless he was told that the runways were short and that an overrun had occurred the previous day.

Discussion

Although Netherthorpe was always a planned destination on this day's flight, neither pilot had fully considered the performance requirements for operating from that airfield. The pilot flying at the time of the accident had noted the runway length as 553 m but was not aware of the TORA for Runway 06 which was 476 m. He had developed a personal limit for runway operations in this aircraft of 500 m, which was based upon previous experience and discussions with other pilots. Prior to their arrival at Netherthorpe, neither pilot had checked the performance figures given in the flight manual and both commented that this was not a procedure they had carried out since their basic training.

On this particular day they were flying at an unusually heavy weight, due to the full refuel at Turweston, and were subject to an unusually high ambient temperature. The difficulty they experienced in getting airborne from Turweston, on what was a much longer and also a paved surface, should have been an indication that aircraft performance was a potential problem that day. Although they had received a telephone brief on the issues of short field operations at Netherthorpe from the resident flying club, the only performance issue the pilots debated was which runway to use for departure. Using an alternative takeoff technique, or delaying the takeoff until more favourable conditions existed, were not considered. The accident pilot had a pressing engagement scheduled for the following day in Devon and this, combined with a number of other domestic issues, may have added 'self induced' pressure to depart on their next leg without delay. It is also likely that these issues were a significant distraction to his concentration on flying.

The performance data from the flight manual, suggests that the aircraft could not have become airborne any earlier then 67 m before the end of the published TORA on Runway 06. Witness statements indicate that at, or about, this point, the aircraft did become airborne but then sank back onto the ground. Why this should have occurred is unclear but it may have been that the aircraft was influenced by ground effect. Ground effect reduces the induced drag on aircraft significantly at heights up to one half of the wingspan. G-AZWE had a wingspan of 30 ft and would be subject to this effect at heights up to 15 ft. If the lift off technique had not been correct, the aircraft may not have had the energy to climb when leaving ground effect. Neither of these pilots were used to flying the aircraft at its maximum take-off weight and initiating lift off at speeds of six to eight mph slower than recommended would be unlikely to have given them enough energy to climb away. This may explain the similar problem experienced at Turweston where the aircraft was even heavier and lift off was initiated five mph slower than recommended. Fortunately, there was sufficient runway remaining for the speed to increase after the aircraft settled back down and allow the takeoff to continue successfully.

Although it is the ultimate responsibility of the commander to ensure adequate performance for the flight, Netherthorpe is an unusual airfield from which to operate. He had been made aware of the runway length but a combination of mistaking runway length for TORA, distraction and a reliance on his flying partner to have resolved any performance issues, led to this accident. The Aero Club at Netherthorpe encourage visiting pilots to consider their aircraft's landing performance prior to arrival but, having landed there, there is no active method of doing the same for departure. There have been another five incidents/accidents at Netherthorpe since 1997 where take-off performance has been the dominant issue. In light of these incidents, it was considered that a more formal method of raising performance awareness prior to the arrival/departure of visiting pilots needed to be established at the airfield.

Safety action

As a result of this accident, Netherthorpe Airfield is amending the airfield information contained in the Aeronautical Information Publication and other airfield directories. The remarks section will contain the following:

> *'Inexperienced pilots are to phone for advice before arriving at Netherthorpe and are to contact a member of the flying staff for a short briefing before departure.'*

In view of this, no formal safety recommendations are made.

INCIDENT

Aircraft Type and Registration:	Piper PA-28-161 Cherokee Warrior II, G-BXAB
No & Type of Engines:	1 Lycoming O-320-D3G piston engine
Year of Manufacture:	1984
Date & Time (UTC):	16 October 2005 at 0939 hrs
Location:	Manston Airport, Kent
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to both main landing gear spats; dents and skin punctures to left wing
Commander's Licence:	Private Pilot's Licence
Commander's Age:	49 years
Commander's Flying Experience:	220 hours (of which 40 were on type) Last 90 days - 19 hours Last 28 days - 6 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot plus reports from ATC and the airport operator

Synopsis

On its return to Manston Airport at the end of a local flight, the aircraft made an approach to Runway 10, which was operating with a displaced threshold due to survey work related to a temporary PAPI installation. The aircraft touched down short of the displaced threshold and collided with a theodolite, damaging the left wing and left main wheel spat and causing survey personnel to run to safety. There were no injuries and the aircraft taxied clear of the runway without further incident. Damage to the right main wheel spat was caused by a separate impact with a runway guard light. The pilot was aware of the displaced threshold; it was marked in accordance with relevant regulations and promulgated by NOTAM[1].

History of flight

During the approach, ATC made several references to the existence of a displaced threshold which the pilot acknowledged. Nevertheless, the ATCO in the aerodrome control room judged that the aircraft would

Footnote

[1] Notice to Airmen – the normal method of disseminating information to pilots concerning the establishment, condition or change in an aeronautical facility, service, procedure or hazard.

land short of the displaced threshold and warned the pilot about it once again. He then observed the aircraft fly level at a height of approximately 30 ft, drop suddenly with a markedly nose-up attitude, and touch down before the displaced threshold. Personnel involved with the survey saw the aircraft approaching and were able to run clear. They reported that the aircraft touched down approximately 10 to 12 m left of the runway centreline and swerved towards the left hand edge of the marked runway, (30 m from the centreline), where it struck a tripod and theodolite. The aircraft then turned sharply back to the active runway and taxied to the flying school, where it parked and shut down. The pilot reported to ATC that the aircraft had landed short of the displaced threshold but did not mention having struck any objects on the ground.

In her statement to the AAIB, the pilot reported that she was aware of the displaced threshold, but that, during the approach, she allowed the aircraft to become slow, causing it to touch down earlier than intended. She commented that it was not until arriving at the flying school that she was advised that the aircraft had collided with a theodolite.

Damage to aircraft

The aircraft was inspected by engineering personnel on behalf of the flying school as soon as it became apparent that it had hit something. The inspection revealed damage to the left main landing gear spat, three small impact marks on the left wing leading edge forward of the left main landing gear, a skin puncture on the top surface of the left wing at approximately mid chord and a circular skin puncture on the lower surface of the left wing. The right main landing gear spat was also damaged.

Following an assessment of the damage, temporary skin repairs were affected using adhesive metallic tape. The aircraft was determined to be otherwise serviceable and flew again that afternoon. Permanent repairs were made subsequently with reference to the aircraft maintenance manual.

Other damage

Inspection of the manoeuvring areas used by the aircraft revealed damage to a runway guard light at holding point E2, 80 m north of the marked runway edge. A piece of glass reinforced plastic matching the damaged right main gear spat was found within the light unit.

Tyre marks north of the painted runway edge, close to the point of impact with the theodolite, indicated that the aircraft had crossed partially onto the sterile area before turning back towards the active section.

Airfield information

Manston Airport has a single, broad, asphalt and concrete runway, laid originally to provide a large landing area for damaged military aircraft. Currently Runway 10/28, which is 2,752 m long and 61 m wide, forms the central part of this area; it is marked in accordance with standards published in Civil Aviation Publication (CAP) 168 - *Aerodrome Licensing*. The temporary PAPI installation and associated survey activity was located at the left hand edge of Runway 10, 771 m east of the normal touchdown threshold. The displaced threshold was a further 142 m east of this position and identified by a pair of black and white marker boards placed in accordance with CAP 168. This resulted in an LDA of 1,839 m. (See Figure 1.)

Meteorological information

Information recorded at the time of the incident indicated a surface wind from 100° at 12 kt, varying between 060° and 140°; 6,000 m visibility, sky clear, temperature 15°C and dew point 11°C. The runway surface was damp.

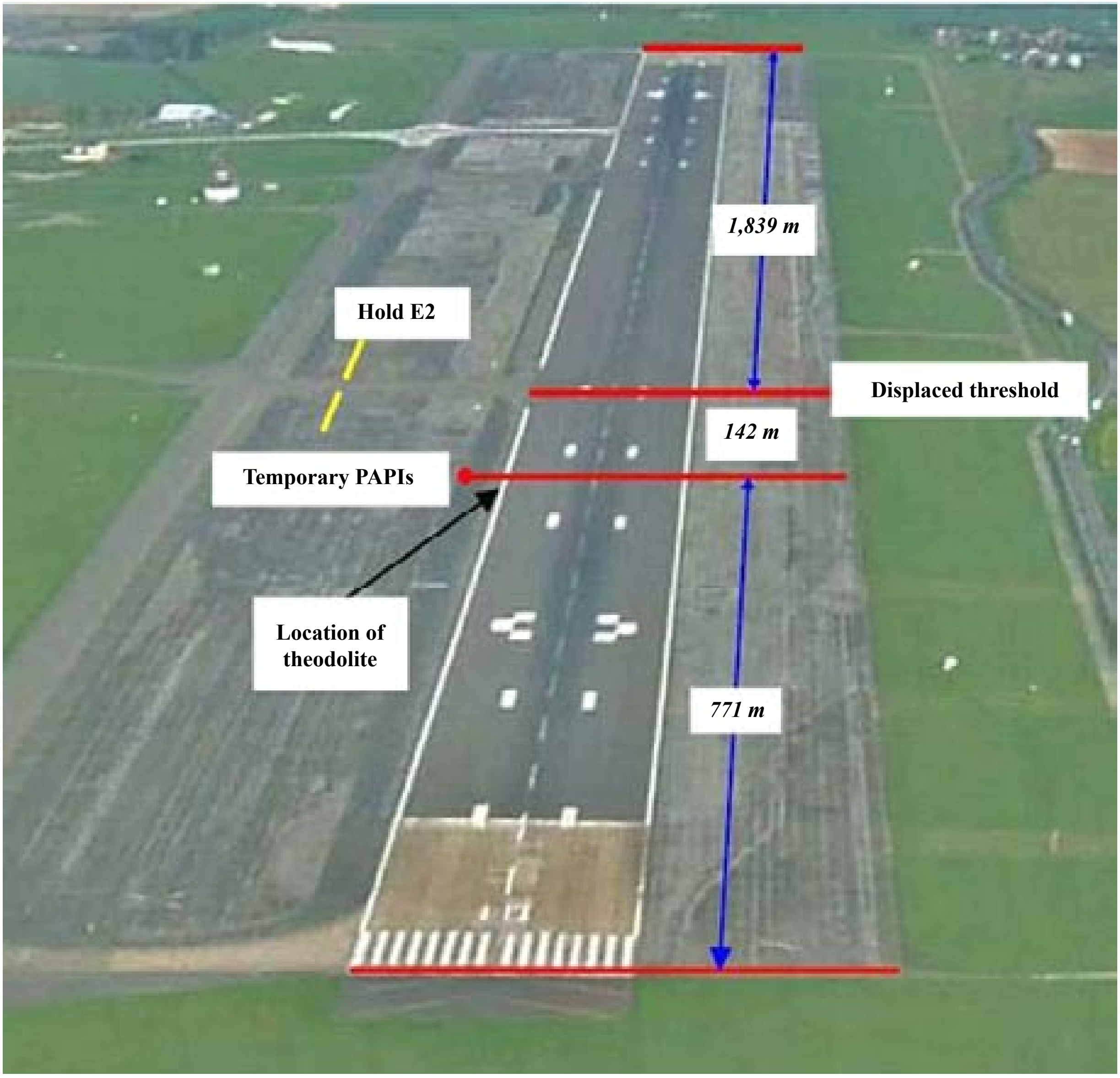

Figure 1

Runway Overview

Other information

The pilot flew with an instructor on the following day in order to assess her conduct of landings beyond the temporary displaced threshold. Her technique appeared to be to approach the runway as though its full length was available and then to fly level in the landing configuration until crossing the displaced threshold. Her landings showed a marked improvement after the instructor briefed her to plan and execute an approach by reference to the displaced threshold alone. The Chief Flying Instructor of the flying school stated that, following this exercise, he was satisfied that the pilot was competent to exercise the privileges of her licence.

Analysis

Aircraft performance

The nose-up attitude of the aircraft and its sudden drop indicates that it stalled just prior to touchdown, probably as a consequence of flying level in the landing configuration as demonstrated during the pilot's subsequent flight with an instructor. It is also consistent with the pilot's statement that she allowed the aircraft to become slow.

Other damage

The location of damage to the guard light suggested that the aircraft had manoeuvred in the sterile area adjacent to the taxiway at Hold E2, a considerable distance from the active runway. However, the survey personnel did not recall seeing the aircraft in that location at any time during the incident, and tyre marks found at the site indicated that it had regained the active runway almost immediately after hitting the theodolite. There were no reports immediately prior to the incident of the aircraft having suffered impact damage. Therefore, it is possible that the aircraft hit the guard light as it entered Runway 10 for the intended flight.

Conclusion

The early touchdown and loss of directional control probably resulted from the decision of the pilot to approach the runway as though its full length was available and then to fly level in the landing configuration until crossing the displaced threshold.

ACCIDENT

Aircraft Type and Registration:	Piper PA-38-112, G-OATS
No & Type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1978
Date & Time (UTC):	27 October 2005 at 1112 hrs
Location:	Sheffield (City) Airport, Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Minor) Passengers - Nil
Nature of Damage:	Substantial; aircraft beyond economic repair
Commander's Licence:	Private Pilot's Licence
Commander's Age:	55 years
Commander's Flying Experience:	204 hours (of which 169 were on type) Last 90 days - 9 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The pilot reported that he joined the circuit at Sheffield in a downwind position for Runway 10. The surface wind was southerly at 8 to 10 kt and there was some turbulence on the base leg and final approach. On his first approach the pilot overshot the centreline and initiated a go-around at 400 ft. On the subsequent circuit the turn onto final approach was again wide, but the pilot regained the extended centreline and then elected to use only the first stage of flap because of the turbulence. The pilot recalled that as he commenced the flare the airspeed had increased to 85 to 90 kt (the normal approach speed for the aircraft is 70 kt with two stages of flap); he then held the aircraft off the runway, with the throttle closed, in order to lose speed prior to the touchdown. The aircraft landed hard on the main landing gear and bounced. The pilot was unable to regain control and the aircraft bounced twice more, the nose landing gear collapsing on the third bounce. Both occupants vacated the aircraft without difficulty and there was no fire. The pilot reported that, with hindsight, he believed he should have used the second stage of flaps and that a go-around would have prevented the accident.

ACCIDENT

Aircraft Type and Registration:	Reims Cessna FA152, G-MPBH
No & Type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1981
Date & Time (UTC):	10 January 2006 at 1050 hrs
Location:	Between Nair and Forres, Scotland
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Top of fin and rudder removed (including beacon)
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	67 years
Commander's Flying Experience:	10,000 hours (of which 5,000 were on type) Last 90 days - 29 hours Last 28 days - 14 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

The purpose of the flight was to carry out a training exercise for practice forced landings without power. The practice was started from 3,000 ft agl and, following the successful identification of a landing area and completion of the touch drills, the instructor took control of the aircraft. He continued to fly down to approximately 20 ft agl in order to demonstrate to the student that a successful landing could indeed have been made from the approach. The instructor then carried out a go-around but as he looked ahead he saw a single line power cable in front of the aircraft. He felt and heard the aircraft strike the cable but found that he still had control available. Unable to land ahead he climbed to 500 ft agl and, while he checked that there was no untoward vibration or adverse control response, asked the student to inspect the aircraft for damage. The student reported that there was some damage to the fin.

The instructor, who was satisfied with the performance of the aircraft, retracted the flaps and proceeded cautiously back to RAF Kinloss, a distance of approximately 10 nm, where the aircraft landed without further incident.

An inspection of the aircraft showed that the upper portion of the fin and rudder, including an aerial and the rotating beacon, had been severed by the wire. An inspection of the site showed that the wire had been cut.

The instructor commented afterwards that the adjacent telegraph poles, which should have given him an indication that there was a wire ahead, were not visible to him because there were pine trees around them. Since this incident the operator's flying order book has been amended to the effect that practice forced landings will not be continued below a height of 100 ft agl.

ACCIDENT

Aircraft Type and Registration:	Slingsby T67C Firefly, G-FORS
No & Type of Engines:	1 Lycoming O-320-D2A piston engine
Year of Manufacture:	1990
Date & Time (UTC):	25 May 2005 at 1607 hrs
Location:	Near Potterspury, 6 miles northwest of Milton Keynes
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - 2 (Fatal) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	JAA Airline Transport Pilot's Licence with FAA and CAA Instructor Ratings
Commander's Age:	59 years
Commander's Flying Experience:	6,000 hours (of which at least 25 were on type) Last 90 days - 18 hours Last 28 days - 8 hours
Information Source:	AAIB Field Investigation

Synopsis

An instructor and his student were conducting a training flight when the aircraft was seen to enter a spin. The aircraft was still in a spin when it impacted the ground. There was no evidence of a mechanical problem; however, it is possible that the engine might have stopped during the spin. Whilst it was not possible to establish what the instructor planned to do on this flight, the investigation concluded that the aircraft probably entered an unintentional spin during an exercise involving oscillatory stalling. This particular exercise is not part of the UK Private Pilot's Licence syllabus. As this exercise is considered inappropriate for ab initio flying training, a recommendation has been made to the CAA to ensure that flying instructors do not include oscillatory stalling during early flying training.

Background to the flight

The commander had been a member of the Turweston Aero Club since November 2003 and had agreed that he would provide flying lessons to an acquaintance on a commercial basis. The student had no previous flying experience and the instructor first flew with him in G-FORS on 22 February 2005. Since then they had flown together on 12 occasions prior to the accident flight; all but one of these flights were in G-FORS. No training records were found of the flights although the completed exercises had been noted in the student's logbook with the entries initialled by the instructor. On the two flights prior to the accident, the instructor had recorded in his own logbook that the student '*Did well*'.

History of the flight

Both pilots arrived together at Turweston Aerodrome at about 1530 hrs. There was no evidence available of any formal briefing at the airfield and therefore no information available on the proposed content of the flight. Records indicate that the aircraft took off at 1545 hrs from Runway 27. The surface wind was approximately 200°/13 kt. After takeoff the aircraft turned towards the north. There was no radio call to indicate that the pilots changed frequency and the Turweston Air/ Ground Operator stated that he had not heard any emergency call on his frequency.

There were various eye and ear witnesses to the accident. One witness saw the aircraft flying very slowly in a straight line. He subsequently assessed the height of the aircraft as being about 500 ft. The witness could not hear any engine noise and kept watching the aircraft. He then saw the right wing drop and the aircraft enter a steep dive. As it descended, it appeared to be "turning from side to side" and then started to "spin clockwise". As it went out of sight behind some trees, the witness ran to telephone the emergency services. His wife, who was also watching the aircraft, saw it spinning out of sight behind the trees. She could not hear any engine noise either. Both witnesses confirmed that there were no other aircraft in the area at the time of the accident. They could not be certain about the number of turns the aircraft performed before going out of sight but considered that it had been spinning clockwise. Another witness, in a car, saw the aircraft for a very short time before it went out of sight behind a hedge. When he first saw the aircraft, it was just above tree top level and was in a high rate of descent. A further witness saw the aircraft when it was "spiralling out of control". He estimated that the aircraft did about two to four spins before going out of view behind some trees. His recollection was that the aircraft was spinning anti-clockwise and had a constant descent and turn rate. He could not hear any engine noise and confirmed that there were no other aircraft in the area. Another individual, who was first on the scene of the accident, had been working at home when he was alerted by a neighbour that there had been an aircraft accident. He cycled immediately to the area and, as the first individual on the scene, checked the occupants of the aircraft but he could not detect any signs of life. The instructor was in the right seat and the student was in the left seat.

The police recorded the first call about the accident at 1614 hrs and by 1624 hrs the first ambulance was on the scene and had confirmed that the two occupants of the aircraft had received fatal injuries.

Recorded information

The Turweston radio frequency is not recorded and a check of other possible radio frequencies showed no evidence of any calls being made by the occupants of G-FORS.

Radar information had been recorded and was available from both the Heathrow and Debden radar sites. Only primary returns were detected and therefore, no height information was available. The first radar returns were detected at approximately 1551 hrs some 7 km to the north of Turweston. During the flight, radar returns indicated that the aircraft carried out a left turn through at least 360º and there were then some indications of manoeuvring for 2¼ minutes before the aircraft took up a heading of approximately 010ºM for about 1¼ minutes at an average groundspeed of 110 kt. The final radar returns were detected close to the accident site at approximately 1605 hrs.

To evaluate the altitude of G-FORS during the accident flight another T67C was flown on the same recorded route. This indicated that the minimum altitude for primary radar contact was about 2,000 ft agl over the area, showing that G-FORS was at a minimum height of 2,000 ft agl from 1551 hrs to 1605 hrs when contact was lost.

Weather information

An aftercast was obtained from the Met Office at Exeter. The synoptic situation at 1800 hrs on 25 May 2005, showed a broad warm sector covering the British Isles with warm temperatures and light to moderate surface winds. The surface wind was assessed as 200º/ 13 kt, the surface temperature was 21ºC with a dew point of 12ºC, visibility was between 20 and 40 km, mean sea level pressure was 1019 hPa. There was a possibility, sometime during the afternoon, of some cloud with a base between 3,000 and 3,500 ft amsl. At 2,000 ft amsl, the wind was assessed as 220º/ 30 to 35 kt with an air temperature of 12ºC and a dew point of 6ºC. At 5,000 ft amsl, the wind was assessed as 230º/ 35 kt with an air temperature of 10ºC and a dew point of minus 4ºC. Using the CAA carburettor icing prediction chart, serious icing could be expected at any power at 2,000 ft amsl and light icing at any power at 5,000 ft amsl.

Aircraft description

The Slingsby T67C is a fully aerobatic, low-wing monoplane aircraft constructed from glass reinforced plastic and is fitted with a fixed tricycle landing gear. It accommodates two people seated abreast in the cockpit, who are protected by a single piece canopy that slides aft from its latched position. Power is provided by a single Lycoming four cylinder, horizontally opposed, air cooled, carburettor equipped piston engine giving 160 BHP at 2,700 rpm, which drives a two-bladed fixed pitch propeller. To enable control of the engine two throttle levers are provided, one at the centre and the other to the left of the cockpit, thus allowing either pilot to operate the throttles. These are interconnected by a lay-shaft and move in sympathy with each other.

The flying controls are conventional. The ailerons and elevator are operated by two interconnected control columns, which are connected to the flight control surfaces via push rods, pivot points and quadrants. The rudder is controlled by cables running from torque shafts in the cockpit to a quadrant in the tail and is operated by foot pedal mechanisms. As the seats are fixed, each of the four rudder pedals is individually adjustable to one of four positions. The rudder pedals are also connected to the nose wheel steering, which operates in the same sense as the rudder. The nose wheel is self-centred by a spring and cam mechanism mounted on the rear of the nose wheel leg. Elevator trim is also cable operated from a manual trim wheel, situated between the two seats, to a trim tab on the left elevator. The flaps are manually operated by a three-position lever located between the seats. This lever locks in each position and is released by operating a spring loaded plunger on the end of the lever.

Fuel is contained in two separate wing tanks, and is supplied to the engine via a fuel tank selector valve, filter and electrical and engine driven mechanical fuel pumps. The fuel selector valve can be selected to OFF, LEFT or RIGHT.

Wreckage and impact information

The accident site was a firm, dry, level field containing a crop of wheat standing approximately 0.8 m high. The site was bounded by tall trees approximately 80 m to the south and hedgerows, containing isolated trees, approximately 50 m to the north and west. Five metre high, low voltage overhead electrical cables, running north-west to south-east, were positioned approximately 200 m to the east.

Impact marks indicate that the aircraft engine struck the ground at a nose down angle of 35º on a magnetic heading of 020º with little forward motion. The structure behind the engine bulkhead had broken and the main fuselage had rotated anti-clockwise before coming to rest on a magnetic heading of 005º. Flattening of the wheat indicated that the left wing struck the ground prior to the fuselage rotating approximately 15º in an anti-clockwise direction. The tail section, which remained partially connected to the fuselage, came to rest on a magnetic heading of 326º. There were two distinct wreckage trails leading from the aircraft. One trail extended 6 m in a straight line forward of the engine and consisted of fragments of the canopy, windscreen and engine cowling. The second trail extended 8 m on a magnetic heading of approximately 155º and consisted of fragments of the canopy and items from the cockpit.

Both wings had sustained impact damage on the lower surface sufficient to cause the fibreglass skin to break and disbond from the supporting structure, thereby allowing the fuel to leak out of the wing tanks. The left wing sustained slightly more damage than the right. Short, green coloured streak marks on the lower surface indicate that the aircraft had some forward motion; however, there was very little impact damage to the wing leading edges and to the rear fuselage and tail section, other than the area where the fuselage had broken. All three undercarriage legs had broken close to the aircraft structure. The aileron controls were still connected and operated in the correct sense. The elevator control rod in the rear fuselage was bent, consistent with the impact forces, and had failed at the connecting rod in the rear fuselage. Aft of this point, the control rod and elevator surface moved normally. The rudder cables, which had detached from the rudder pedals, were still connected to the rudder and operated freely and in the correct direction. The elevator trim cable had been pulled out of the fitting on the elevator trim tab; consequently it was not possible to establish the position of the trim. The flaps were in the up position.

One blade of the propeller had bent under the engine. On this blade there was a small dent on the leading edge, towards the tip, and light chord-wise scoring across the front face over the full length of the blade. There was also a large dent on the trailing edge caused when the blade made contact with the nose undercarriage casting. The second propeller blade was undamaged. The crankshaft flange, on which the propeller was mounted, had bent downwards and the fly wheel hub had fractured. The majority of the engine accessories, including the carburettor, had broken off the engine and the engine support frame had failed due to buckling. Whilst there was no fuel in the fuel tanks, there was clean blue fuel in the fuel pipe between the fuel selector valve and filter.

The fibreglass structure aft of the engine bulkhead had broken and the rudder pedal assemblies had broken from their mounting points. The canopy, which had shattered, was fully open with the handle in the open position. The left side of the windscreen frame had broken where it joined the fuselage. The right lug on the canopy securing latch was missing and the left lug was bent. There was also impact damage to the metal and plastic parts of the canopy securing latch. The distortion of the windscreen frame and the inertia from the rotation of the aircraft to the left, might have been sufficient to cause the canopy and latch to open; however the possibility that the canopy was open before the impact cannot be excluded. The area behind the pilot's seats was covered in a white powder from the ruptured dry powder fire extinguisher. In the cockpit the barometric pressure was set at 1016 hPa on the altimeter and the magneto switch was set to 'Both'. The throttle control rods and the structure supporting the engine controls in the cockpit had been damaged in the ground impact.

Both occupants were wearing five-point seat harnesses. The inertia shoulder harnesses remained locked and retracted in the inertia units; however the beam to which they were attached had broken away from the fuselage. The metal male connector on the left pilot's crotch strap had broken and the connector on the right pilot's crotch strap had distorted and come out of the Quick Release Fastener, which had also distorted. The waist belts were intact. The right occupant was sitting on the map and aircraft checklist. Neither pilot had been wearing a parachute.

Detailed examination of wreckage

Flying controls

The elevator, rudder and elevator control runs were all examined, as far as possible, and found to be in a good condition with no evidence that there had been a control restriction or pre-impact failure.

The rudder pedal mechanism had 'frozen' and the centering device on the nose wheel steering had punctured the engine bulkhead in a position consistent with full right rudder having been applied. Mud had also been forced into the left side of the nose wheel, which had been bent backwards and to the right. The lower edge of the hub on the right side of the nose wheel had bent outwards and the tyre in this area had split. This damage indicated that the left side of the nose wheel impacted the ground first.

Engine controls

The mixture control was fully IN (fully rich) and it was assessed that this position was not influenced by distortion of the structure. The position of the carburettor hot air-valve, and a kink in the control cable connected to the valve, indicated that when the hot airbox distorted in the impact, the carburettor heat had been selected to ON. In the cockpit there was a bend in the exposed portion of the carburettor heat control rod caused by the instrument panel during the impact. The bend corresponded with the carburettor heat control having been pulled out by approximately 23 mm towards the hot selection: the range of movement of the carburettor heat control on a similar aircraft was 34 mm. This also suggested that carburettor heat had been selected ON.

The left hand throttle was at idle and this position was corroborated by damage analysis on the throttle control rod in the cockpit and the connection to the carburettor.

Fuel system

It was established that the fuel selector valve was in the RIGHT TANK position and would allow the unrestricted flow of fuel between the right tank and fuel filter. The fuel filter was clean and contained a small quantity of clean fuel. Although the casing of the electrical fuel pump had been damaged, all the seals were intact and the filter, which contained a small quantity of fuel, was clean. The electrical pump selection switch in the cockpit was at ON and the electrical fuel pump operated normally when power was supplied. Whilst the casing of the engine driven fuel pump had been damaged, the diaphragm was intact, the pump contained clean fuel and when operated the pump provided a strong suction force at the inlet and pressure force at the outlet.

Engine

The flywheel was fractured and bent downwards. The crankshaft flange had also bent downwards and embedded itself in both halves of the engine casing. The damage to the flywheel and crankshaft flange was consistent with the propeller, at the 6 o'clock position, striking the ground with the engine producing very little power. Whilst most of the oil had leaked out of a hole in the sump, clean oil was found in the oil filter; there was no debris in the filter paper.

The engine was taken to an overhaul facility where it was stripped under AAIB supervision. Both magnetos were serviceable and the colour of the pistons and spark plugs indicated that the engine had been running normally. All the components were able to move freely once the bent crankshaft flange had been removed from the engine casing. The number 1 and 2 inlet tappet bodies were badly spalled, and spalling had just started on the number 1 exhaust tappet body. Spalling is the separation of flakes of metal resulting from sub-surface fatigue in the metal component. All the valves were found to be in good condition. The number 1 and 2 inlet valve lobe on the camshaft was found to be badly worn with the valve lift 33% less than the number 3 and 4 inlet valves; the camshaft was checked for trueness and found to be satisfactory.

The engine manufacturer stated that camshaft lobe and tappet body wear can develop in engines that are flown infrequently, or when engines are operated in cooler weather where the flight times are less than an hour.

Light bulb filaments

Stall warning, starter engaged and alternator warning lights were situated next to each other at the top of the instrument panel in front of the left seat pilot. The filament on the starter engaged warning light was intact and normal, whereas the filament on the stall warning and alternator warning lights were intact and extended. An intact and extended filament normally indicates that at the time of impact the filament was illuminated. On this aircraft the alternator warning light can normally expect to be illuminated when the engine speed drops below 800 rpm. Ground idle is normally between 600 and 800 rpm.

Maintenance and significant recent faults

The aircraft had been maintained in accordance with the Light Aircraft Maintenance Schedule. The last annual maintenance was completed on 20 December 2004, approximately 62 flying hours prior to the accident, and the most recent 50 hour inspection was completed on 12 May 2005, approximately 9 hours before the accident.

The recent fault history revealed that it was reported that:

> On 26 January 2005, approximately 51 hours prior to the accident, the elevator was stiff to operate. No fault could be found. Also the engine ran roughly at low rpm. The plugs were serviced and a ground run was carried out, which was satisfactory.
>
> On 20 April 2005, approximately 25 hours prior to the accident, the engine ran rough at low rpm. Three induction gaskets were replaced, the spark plugs were checked and 2 of them were replaced. No subsequent unserviceabilities were reported.

Medical information

A Post Mortem examination was carried out on both pilots. It was concluded that the accident had not been survivable and that both had died from multiple injuries consistent with an aircraft crash. There was no evidence of any natural disease, which could have either caused or contributed to death or the cause of the accident.

Toxicological examination was essentially negative; neither pilot was under the influence of alcohol or drugs at the time of the flight. The instructor weighed 86 kg and the student weighed 116 kg.

Operational information

The instructor and his student were conducting a training exercise as part of a course for a Private Pilot's Licence (PPL). Details of previous flights had been recorded in both the instructor's and student's logbook. The student had flown all his exercises with the same instructor and had completed 12 flights totalling 12 hours 15 mins prior to the accident flight; all the flights except one were in G-FORS. It was noted that the student had completed one session of aerobatics, and had recorded a stalling exercise on eight of the flights, including one with 'oscillatory stalling' on 22 April 2005.

An aerodynamic stall occurs when there is a substantial breakdown of the organised flow across the wing resulting in a large reduction in lift. No reference to 'oscillatory stalling' was found in publications related to flying training within UK. However, another student who had flown with this instructor described this manoeuvre as maintaining the aircraft in a stalled condition whilst controlling any wing drop with rudder.

The instructor was experienced and had worked in both the USA and UK as a flying instructor. His most recent renewal of his UK instructor rating was on a flight with a CAA examiner on 12 June 2003, which remained valid until 5 July 2006. The student had no flying experience prior to his PPL course.

Another of the instructor's students was interviewed as part of the investigation. He had flown 14 dual flights with the instructor and was also a friend of the student involved in the accident. During the interview he confirmed that he had completed two sessions of spinning with the instructor but knew that the student involved in the accident had not experienced any spinning. He also confirmed that the instructor included oscillatory stalling during the PPL course. Both students had experienced this exercise with the instructor. During these exercises, the instructor would keep his feet and hands on the controls to monitor the student. On one occasion a student recalled that the aircraft went into a spin and the instructor took control and recovered the aircraft. Prior to any aerobatics or stalling, the instructor would complete a standard '*HASELL*' check and would use a minimum altitude of 3,000 ft for entry to each stall and a minimum altitude of 3,500 ft for entry to each spin. This student's experience of spinning was that only one turn would be completed and the height loss would be about 500 ft.

There was no requirement to carry out spinning during a PPL course although it is not precluded. The emphasis during initial training is on spin and stall awareness to enable the student to recognise quickly the onset of a stall or spin and take early recovery action.

Calculations indicated the aircraft was at a weight of approximately 942 kg with a CG position of 28% mean aerodynamic chord (MAC) at the time of the accident. This was at the aft limit for the CG and some 11 kg below maximum allowable weight. Fuel calculations indicated the aircraft had approximately 12 Imperial Gallons on board at the time of the accident.

There were two parachutes available in the crewroom at Turweston. Inquiries indicated that these had never been worn in any flight involving G-FORS. Each parachute weighed 7.6 kg and if both pilots had worn them on the accident flight, the aircraft would have exceeded the maximum allowable weight.

The aircraft certificate of airworthiness had been renewed on 19 December 2002 and was valid until 18 December 2005. The renewal process had involved a flight test on 17 December 2002 when the CAA approved airworthiness check pilot had carried out a spin to the left and to the right; both were recorded as satisfactory.

The Pilot's Notes for the aircraft included the following information about spinning.

1. The height loss during an erect spin is about 400 ft per turn, with each turn taking about 2½ seconds and the recovery taking about 500 ft.
2. If full pro-spin control is not maintained throughout the spin, the aircraft could enter either a spiral dive or a high rotational spin.
3. A high rotational spin is recognised by a steeper nose down attitude and a higher rate of rotation.
4. The recovery for a high rotational spin referred to the procedures for an '*Incorrect recovery*' (see para 6 below).
5. The '*Standard Recovery Technique*' is as follows:
   a) *'Close the throttle.*
   b) *Raise the flaps, if lowered.*
   c) *Check direction of spin on the turn co-ordinator.*
   d) *Apply full rudder to oppose the indicated direction of turn.*
   e) *Hold ailerons firmly neutral.*
   f) *Move control column progressively forward until spin stops.*
   g) *Centralise rudder.*
   h) *Level the wings with aileron.*
   i) *Recover from the dive.*

WARNING: WITH C OF G AT REARWARD LIMIT THE PILOT MUST BE PREPARED TO MOVE CONTROL COLUMN FULLY FORWARD TO RECOVER FROM SPIN'

6. The '*Incorrect Recovery*' was as follows:
   'A high rotation rate spin may occur if the correct recovery procedure is not followed, particularly if the control column is moved forward, partially or fully, BEFORE the application of full anti-spin rudder. Such out-of-sequence control actions will delay recovery and increase the height loss. If the aircraft has not recovered within 2 complete rotations after application of full anti-spin rudder and fully forward control column, the following procedure may be used to expedite recovery.
   a) *Check that FULL anti-spin rudder is applied.*
   b) *Move the control column FULLY AFT then SLOWLY FORWARD until the spin stops.*
   c) *Centralise the controls and recover to level flight (observing the 'g' limitations).'*

A copy of Service Bulletin 43 Issue 2, warning of the possibility of the engine stopping during a spin, was enclosed in the Pilot's Notes for this aircraft. The Service Bulletin advised the pilot that if the engine was not correctly leaned and the slow running adjusted to between 700 and 750 rpm then there was a chance of it stopping during a spin.

On 26 November 2005, a CAA Test Pilot flew two flights in a similar T67C to confirm the spinning characteristics of the aircraft type and to evaluate the consequences of practising an oscillatory stall.

1. On the first flight, the aircraft was at a weight of 910 kg with a CG of 25% MAC. The stall speed was established as 57 kt. In a full stall, the rate of descent was about 500 ft/ min. The use of rudder was explored during the full stall and the aircraft was very susceptible to a wing drop. It was noted that a smooth application of increasing rudder resulted in a large and rapid wing drop of 90°. Even with immediate centralisation of controls, the resultant height loss was some 1,000 ft. It was considered that any attempt to maintain controlled flight at the point of stall was unwise in that it could lead to loss of control without further warning. Two incipient spins were flown with the controls centralised after ½ turn; the recovery was effective with a total height loss between 900 and 1,000 ft. Four spins, in both directions, were carried out, with between two and four turns each. This indicated that the height loss in each turn was just over 400 ft and it required about 500 ft for full recovery with the recovery taking an additional half to one turn of the spin. The rate of turn was close to three seconds per turn. For these spins, the engine mixture was set to fully rich and the carburettor heat was selected ON; the engine continued to run although it was noted that the rpm decreased to about 600.

2. For the second flight, the aircraft was at a weight of 872 kg and a CG of 27.5% MAC. Five spins were carried out with up to four turns and in both directions. In three of the spins, the control column back pressure was released and the turn rate increased to about two seconds per turn. The recovery from these high rotational spins took between 2½ and 3½ turns. Additionally, on three of the spins, the engine stopped but restarted during the recovery of the spin; the mixture was set to full rich for all spins. On two of the spin recoveries, the corrective rudder was maintained to establish if the aircraft would enter a spin in the opposite direction. On both of these occasions, the aircraft entered a spiral dive.

Analysis

General

Evidence from witnesses was that the aircraft was in a spinning manoeuvre as it approached the ground. Whilst there was some difference between witness accounts as to the direction of the spin, impact marks and damage to the aircraft confirmed that G-FORS struck the ground while it was spinning to the left (anti-clockwise) and with the correct rudder input applied to recover from this manoeuvre. Allowing for the slight differences in witness accounts, it was possible that the aircraft had been in a spin to the right from which it had been recovered only to re-enter a spin to the left. Radar evidence also indicated that the aircraft entered the final manoeuvre above a minimum height of 2,000 ft agl, which is at variance with one witness estimate of 500 ft. The investigation attempted to determine whether the spin had been caused by mechanical failure or by the pilots either intentionally or unintentionally entering a spin.

Engineering

Engineering analysis revealed no indication of structural failure, control restriction or any other onboard emergency that would either cause the aircraft to inadvertently enter, or fail to recover from a spin. Illumination of the alternator warning light and damage to the propeller blade indicated that when the aircraft crashed the engine was producing very little power and might possibly have just been windmilling very slowly. Whilst there was no fuel in the ruptured fuel tanks, the presence of fuel in the fuel filter, in both the electrical and mechanical fuel pumps and the extensive fuel spillage suggested that the aircraft had not run out of fuel. The position of the engine controls also indicated that whilst the engine had been throttled back, it had not been shut down. The carburettor heat control was selected ON. Either pilot might have made this selection as part of his routine checks, to clear carburettor icing or because he intended to operate the engine at a low power setting.

With the mixture control set at fully rich and the carburettor heat at ON, the engine would have been running on the rich side and would therefore have been susceptible to stopping during a spin. Whilst the engine stopping in flight would not directly cause the aircraft to enter a spin, or prevent it from recovering, it would have been distracting, particularly during such a critical phase of flight.

Since the aircraft had some history of a rough running engine, and evidence was found of a worn cam shaft, consideration was given to the possibility that the fault had returned and distracted the pilots. The engine manufacturer has stated that the reported rough running was most likely caused by an ignition or carburettor fault, or a leak in the induction system. The magnetos were found to be serviceable and given that the spark plugs and leads had recently been checked it is unlikely that they were the cause of any problem. The condition of the carburettor and induction system meant that it was not possible to prove the pre-accident integrity of these systems. The engine manufacturer also stated that worn camshaft lobes would have caused a gradual reduction in the maximum static power of the engine and would not have affected the slow running. There had been no previous reports that the engine was lacking in power, which suggested that any deterioration in engine performance would have been negligible.

Operational

There was no specific documentary or witness evidence to indicate what the instructor intended to do during the flight. There was a record in the student's logbook of the exercises undertaken during previous flights and it was apparent that he had completed a number involving stalling, but none involving spinning. Although it was not a required exercise, the instructor was known to include spinning during his training flights. The possibility that the flight was planned to include some spinning could not be excluded.

If the flight was to include spinning, it is likely that the instructor would first demonstrate a spin to the student. The radar recording showed a 360º turn, which could have been a clearing and positioning turn prior to some handling exercises. The aircraft's altitude could not be accurately determined but a trial indicated that the minimum height at this time would be at least 2,000 ft agl. Evidence from other students was that the instructor would use a minimum entry height of about 3,500 ft agl for any spinning manoeuvre. The flight time prior to the initial clearing turn was sufficient to achieve a height of at least 4,000 ft agl. It was not possible to determine the exact manoeuvres carried out after the 360º turn but it was possible that they included some aerobatics. Thereafter, there was a period of about 1¼ minutes when the aircraft maintained a constant northerly heading until loss of contact close to the accident site. Following such a period of relatively constant flight, it would be good airmanship to complete another clearing turn before further manoeuvring. Evidence from another student about the instructor's normal approach to flying was that he was conscientious and would normally have completed such a clearing turn. It was therefore considered unlikely that the final spin was an intentional manoeuvre.

The remaining possibility was that the spinning manoeuvre was unintentional and that the instructor was unable to recover the aircraft before it struck the ground. For the spin to be unintentional, the aircraft would have to be in a situation whereby a spin was possible. The essential components of a spin are that the aircraft's wing(s) are stalled and that yaw and/or roll is present. Prior to a fully developed spin, there is an incipient stage during which prompt centralisation of controls would normally prevent the development of a full spin. With close monitoring by the instructor, it is difficult to envisage a scenario whereby the student could inadvertently enter a full spin before the instructor could recover the situation. It would be possible for this to occur if there had also been some sort of distraction, such as an engine problem or some sort of control malfunction or restriction, including a loose article impeding the control(s).

However, the instructor was known to include oscillatory stalling during instruction and there was a record of this in the student's logbook. One other student of the instructor described the oscillatory stall as being in a deep stall with the pilot controlling any wing drop with applications of rudder. This manoeuvre contains all the requirements for a spin. Furthermore, the extent of any wing drop would be very dependent on the rate of speed decrease, lateral balance of the aircraft and aileron/rudder control position. Although the instructor was known to monitor the controls during student manoeuvring, it is possible that a violent wing drop during an oscillatory stall could have resulted in the student applying full or near full opposite rudder. The subsequent entry into a spin could have been rapid and potentially disorientating for someone with no previous experience of spinning. Furthermore, any appreciable forward movement of the control column at the same time could have resulted in an increased turn rate, increasing any disorientation. The instructor would be expected to have immediately attempted to take control but, if the student had applied inappropriate control inputs, some time might be required for the instructor to get the student to release the controls. During this time, any erratic control inputs could have resulted in a change in turn direction and/or a change in spin characteristics. Once he had taken control, the instructor would need to identify the turn direction and then take the appropriate recovery actions.

Another unknown factor is the altitude at which the aircraft entered the spin. It is possible that the instructor had used an entry height of about 3,000 ft agl for a stalling exercise, as was his normal procedure. This would have resulted in less time for recovery and the closer than normal proximity of the ground would have meant increased stress for the pilots. The aft CG position may also have delayed recovery. Another possible complicating factor during the spin could have been a distraction, such as an engine problem/ stoppage or a loose article impeding the controls.

For this scenario to be possible, the aircraft would have been involved in stalling during the final northerly track. An evaluation of this track indicated an average radar ground speed of 110 kt. With the known wind from approximately 220º to 230º at 30 to 35 kt, this would mean that the aircraft was travelling at an average airspeed of approximately 80 kt. This could have been the aircraft climbing at the normal climb speed of 77 kt but could also be consistent with a reducing airspeed prior to a stall (approximately 57 kt).

To evaluate the possibility of this scenario, a CAA test pilot flew in the same aircraft type on 26 November 2005. This indicated that the aircraft characteristics in a spin were in accordance with the Pilots Notes and that any deliberate delay in recovery from the stall was unwise. Use of rudder during a full stall could initiate a large and rapid wing drop and subsequent loss of control.

Therefore, although an unidentified control problem, loose article or other distraction could not be eliminated as a contributing factor, it is considered that the most likely scenario was that the aircraft entered an unintentional spin during an exercise involving oscillatory stalling. The instructor was unable to recover the aircraft from the spin before the aircraft struck the ground.

One aspect was considered to be highly relevant. The inclusion of oscillatory stalls during early flying training would appear to be unnecessary and inappropriate. While accepting that this is not a normal manoeuvre within UK flying training it is recommended that the CAA highlight the circumstances of this accident and issue guidance to all UK registered flying instructors to ensure that oscillatory stalling is not included in flying exercises during ab initio flying training.

It was also noted that neither pilot was wearing a parachute although they were available within the flying club. Following a spinning accident to G-BLTV on 3 November 2002, the AAIB made the following recommendation: *'The Civil Aviation Authority should conduct a review of the present advice regarding the use of parachutes in GA type aircraft, particularly those used for spinning training, with the aim of providing more comprehensive and rigorous advice to pilots.'* This was accepted by the CAA and an updated Safety Sense Leaflet 19A *Aerobatics* was published in LASORS containing the following information on parachutes:

> *'While there are no requirements to wear or use specific garments or equipment, the following options are strongly recommended:*
>
> *Parachutes are useful emergency equipment and in the event of failure to recover from a manoeuvre may be the only alternative to a fatal accident. However, for physical or weight and balance reasons their carriage may not be possible or practicable, the effort required and height lost while exiting the aircraft (and while the canopy opens) must be considered. If worn, the parachute should be comfortable and well fitting with surplus webbing tucked away before flight. It should be maintained in accordance with manufacturer's recommendations. Know how to use it, and regularly rehearse, how to use it, and remember the height required to abandon your aircraft when deciding the minimum recovery height for your manoeuvres.'*

It is possible that the use of parachutes would not have made any difference in the accident involving G-FORS because of the possibly limited altitude and time available. Furthermore, the use of parachutes on this occasion would not have been permissible because of weight considerations. Nevertheless, the evidence indicated that the use of parachutes, although readily available, was not a normal procedure at the Aero Club. The advice contained within CAA Safety Sense Leaflet 19A is still considered valid.

Safety Recommendation 2005-146

It is recommended that the United Kingdom Civil Aviation Authority highlight the circumstances of this accident and issue guidance to all UK registered flying instructors to ensure that oscillatory stalling is notincluded in flying exercises during ab initio flying training.

FORMAL AIRPORT ACCIDENT REPORTS
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2004

1/2004 BAe 146, G-JEAK
during descent into Birmingham
Airport on 5 November 2000.

Published February 2004.

2/2004 Sikorsky S-61, G-BBHM
at Poole, Dorset
on 15 July 2002.

Published April 2004.

3/2004 AS332L Super Puma, G-BKZE
on-board the West Navion Drilling Ship,
80 nm to the west of the Shetland Isles
on 12 November 2001.

Published June 2004.

4/2004 Fokker F27 Mk 500 Friendship,
G-CEXF at Jersey Airport,
Channel Islands on 5 June 2001.

Published July 2004.

5/2004 Bombardier CL600-2B16 Series 604,
N90AG at Birmingham International
Airport on 4 January 2002.

Published August 2004.

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.

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