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COMMERCIAL AIR TRANSPORT

GENERAL AVIATION

SPORT AVIATION / BALLOONS

ADDENDA and CORRECTIONS

(ALL TIMES IN THIS BULLETIN ARE UTC)

INCIDENT

Aircraft Type and Registration:	ATR 42-300, G-TAWE
No & Type of Engines:	2 Pratt & Whitney Canada PW120 turboprop engines
Year of Manufacture:	1994
Date & Time (UTC):	20 January 2006 at 2107 hrs
Location:	Runway 31 at Glasgow Prestwick Airport
Type of Flight:	Public Transport (Passenger)
Persons on Board:	Crew - 3 Passengers - 34
Injuries:	Crew - None Passengers - None
Nature of Damage:	Nose gear uplock bent and five runway edge lights damaged
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	57 years
Commander's Flying Experience:	13,233 hours (of which about 5,000 were on type) Last 90 days - 123 hours Last 28 days - 38 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and report by Glasgow Prestwick Airport

Synopsis

The commander initiated a night takeoff when lined up with the left runway edge lights.

History of the flight

While taxiing for a departure from Runway 31, the commander was given clearance to enter the runway by either 'R1' or 'Q'. The disposition of these holding points is as shown in Figure 1. He elected to enter by 'Q' and lined up the aircraft in a position he thought was just to the left of the runway centreline. The first officer then commented that he did not think that the 'perspective' looked quite right and the commander taxied G-TAWE to the left until it was lined up exactly over lights.

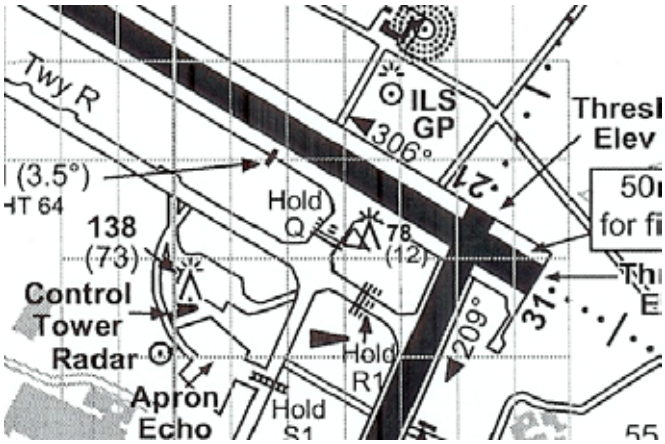


Figure 1

Disposition of the holds for Runway 31

Both crew members agreed that they were now on the centreline and the commander commenced the takeoff. However, almost immediately the crew were aware of increasingly loud 'bumps' from beneath the aircraft and the commander abandoned the takeoff.

He realised that he may have lined up on the left edge lights of the runway and obtained permission from ATC to return to 'stand'. He subsequently informed ATC that the aircraft may have struck some lights. An inspection by ATC confirmed that five edge lights had been damaged.

Other information

Airport

Runway 31 has a declared width of 46 m but has a hard surface extending a further 23 m from each edge. Because of the width of the hard surface, the UK AIP contains the following warning:

> *'Because of the extreme width of the concrete/ asphalt surface forming Runway 13/31 (92 m) paved shoulders extend beyond each side of the runway. In certain conditions (poor visibility and at night) the runway edge lights may be mistaken for the centre-line (albeit the edge lights are raised and the centre lights are flush mounted). Pilots of departing aircraft should exercise extreme caution when lining up on the centre-line of the runway in such circumstances.'*

All taxiways have green centreline lights except for the entry to Runway 31 by holding point 'Q'. There are blue edge lights on all taxiways. The lights were on at the time of the incident.

Weather

The METARs for Prestwick for both 2050 and 2120 hrs were as follows: Surface wind 300º/12 kt; visibility greater than 10 km; cloud few at 1,200 feet and scattered at 2,800 feet.

Rain showers had been reported both before and after the incident. The commander of G-TAWE stated that there had been a heavy rain shower as he lined up on the runway.

Discussion

The commander, who was familiar with the airport assessed that the incident would have been avoided if he had followed the taxiway centreline lights from 'R1'. He also considered that the heavy rain shower had distorted his vision.

The UK AIP contains a warning about the possibility of mistaking the runway edge lights for the centreline lights. In the incident involving G-TAWE, the use of 'Q', which has no centreline lights as a lead-in to the runway was a contributing factor. Since the incident, ATC no longer allow aircraft to use 'Q' when entering the runway at night or in poor visibility.

ACCIDENT

Aircraft Type and Registration:	Boeing 777-232, N864DA
No & Type of Engines:	2 Rolls-Royce Trent 892-1-7 turbofan engines
Year of Manufacture:	1999
Date & Time (UTC):	20 May 2005 at 0635 hrs
Location:	Stand 50, London (Gatwick) Airport
Type of Flight:	Public Transport (Passenger)
Persons on Board:	Crew - 13 Passengers - 296
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to the leading edge of the left engine intake cowl; substantial damage to the passenger airbridge
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	57 years
Commander's Flying Experience:	18,000 hours (of which 250 were on type) Last 90 days - 225 hours Last 28 days - 80 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft was taxied onto the stand at an appropriate speed and aligned with the centreline; the airbridge was parked in the correct location. The stand guidance system had been calibrated correctly, and it was serviceable and operating at the time of the incident. The aircraft overran the stopping point and collided with the airbridge. The leading edge of the aircraft's left engine intake cowl was damaged, and there was substantial damage to the airbridge. Ten safety recommendations have been made.

History of the flight

The flight crew, consisting of the commander and two co-pilots, had reported for duty at Atlanta Airport, Georgia, USA at 2120 hrs UTC (1720 hrs local) on 19 May 2005. One co-pilot acted as handling pilot during the takeoff and landing whilst the other acted as a relief pilot, taking control for part of the cruise phase.

The aircraft departed from Atlanta at 2322 hrs UTC (1922 hrs local) and landed at Gatwick Airport at 0620 hrs UTC (0720 hrs local) on 20 May 2005 after an uneventful flight. Once on the ground the commander took control from the handling co-pilot in order to taxi the aircraft. When clear of the runway ATC instructed the crew to taxi the aircraft to Stand 50; whilst taxiing to the stand the crew shut down the left engine, in accordance with the company standard operating procedures.

As the aircraft approached the allocated stand, both the commander and the operating co-pilot confirmed visually that the stand was clear of obstructions. The commander turned the aircraft onto the stand, using the Azimuth Guidance for Nose-In Stands (AGNIS) system to position it on the centreline, the AGNIS is located at the far end of the stand. He stated that he then alternated his gaze between the AGNIS and the Parallax Aircraft Parking Aid (PAPA) board, situated some distance to the left of the AGNIS; he identified the Boeing 777-200 stopping mark on the PAPA board. The commander stated that as the aircraft progressed onto the stand he saw that the AGNIS system indicated that the aircraft was no longer on the centreline and he was momentarily distracted whilst regaining the centreline. He stated that when he looked again at the PAPA board, it indicated that the aircraft was then approaching the stopping point for the Boeing 777-300 and, before he had a chance to stop the aircraft, he felt it judder. He applied the brakes and, on looking up, saw that the emergency STOP light, situated next to the AGNIS, was flashing. There were no abnormal indications on the flight deck and the crew waited for the ground engineer to speak to them via the aircraft intercom system. Once the ground engineer had connected his headset he informed the crew that the aircraft's left engine had struck the passenger airbridge. The crew then shut down the right engine and the passengers were later disembarked using stairs on the right side of the aircraft.

The arrival on the stand from the ground staff's perspective

The ground crew handling the flight's arrival consisted of a team leader and five other ground handlers. They arrived at Stand 50 in good time and after checking that the stand was clear of obstructions, and that the airbridge was parked in the correct position, the team leader switched on the stand's parking guidance system (AGNIS and PAPA). The ground crew member with the aircraft chocks, then stood close to the position where, from previous experience, he knew that the aircraft's nose wheel should stop.

The aircraft was also being met by a dispatcher, who awaited its arrival in the control cabin at the end of the passenger airbridge. Waiting with him were an airline representative, two handling agents, two security agents, and two passenger wheelchair agents.

When the aircraft turned onto the stand the ground crew member with the chocks monitored its progress. When it continued past its expected stopping point he ran to the emergency STOP sign activation switch, positioned at ground level at the end of the stand, and turned it on. He estimated he activated the switch just as the aircraft's left engine contacted the airbridge.

As the aircraft approached it was also visible to the dispatcher standing in the control cabin at the end of the airbridge, although his view from that position was limited. As the aircraft was moving past the end of the airbridge the dispatcher felt the airbridge suddenly move. Initially he thought it was the airbridge malfunctioning, but then realised that it had been struck by the aircraft. The airbridge continued to move, and he and those with him ran back along the airbridge towards the terminal.

There were no injuries to any of the waiting ground staff, although some of the agents waiting on the airbridge suffered slight shock.

Examination of the aircraft and stand

The damage to the aircraft was restricted to a tear and two large dents in the leading edge of the left engine intake cowl.

The aircraft had stopped with its nose wheels on the centreline of the stand and with the fuselage at a very slight angle to it. The nosewheels had stopped 7.3 m forward of the correct parking position for a Boeing 777-200 and 1.74 m forward of that for a Boeing 777-300. The airbridge had been parked in the correct location for the arrival of the aircraft, with its wheel carriage inside the circle painted on the ground.

The airbridge had suffered substantial damage. Inspection confirmed that the left engine had struck the end of the airbridge at the point which houses the rotating mechanism for positioning the control cabin at the end of the airbridge parallel to a parked aircraft. The rotating cabin had been pushed off its left support roller, causing it to move upwards and tilt approximately 10º. The cabin rotation drive motor securing bolts had sheared, the drive chain had broken and the sidewalls of the cabin were damaged.

The AGNIS and PAPA board indicator lights and the emergency STOP light were serviceable and correctly calibrated. It was noted that there was no cover in place behind the slot cut in the PAPA board, through which the light is viewed. This allowed the terminal building, which was of glass construction with vertical window pane supports, of a similar appearance to the light tube, to be seen through the slot.

Commander's rest and duty time

The commander had taken a rest period of 24 hours preceding the flight and had reported for the flight to Gatwick at 2120 hrs UTC, in Atlanta; his flight duty time commenced at this point. In order to report on time the commander left his home, in Texas, at 1230 hrs UTC (0730 hrs local) to take a flight from Dallas to Atlanta, where he arrived at about 1700 hrs UTC.

The flight to Gatwick departed from Atlanta at 2322 hrs UTC, landing at 0620 hrs UTC; a flight duration of nearly seven hours. The commander stated that during the flight he had rested for two and a quarter hours on a bunk in the aircraft's crew rest area.

The arrival time at Gatwick equated to a local time of 0120 hrs at the commander's home in Texas.

Flight Recorders

The aircraft Flight Data Recorder (FDR) and the Cockpit Voice Recorder (CVR) were removed and successfully replayed.

Flight Data Recorder

Ground speed data was verified by using recorded ground speed and heading data to derive the low speed taxi path of the aircraft, this was then compared to the GPS positional information, which was recorded at a much lower sampling rate. The comparison showed a high degree of correlation, hence validating the recorded ground speeds.

The pertinent data from the FDR is shown in Figure 1, commencing at the point when the aircraft had started to turn off the taxiway onto the stand, and ending shortly after the application of the park brake.

The left engine had been stopped prior to the aircraft being turned onto stand and the right engine power lever remained at idle throughout the parking procedure. On turning onto the stand, the aircraft heading passed fractionally through the final heading by 0.2ºT followed by a correction to the right by 0.5ºT before recovering back onto the final heading. At this time the aircraft had a recorded ground speed of between 4 and 5 kts and was slowing. The aircraft heading had stabilised 17 secs after the peak deviation and the ground speed

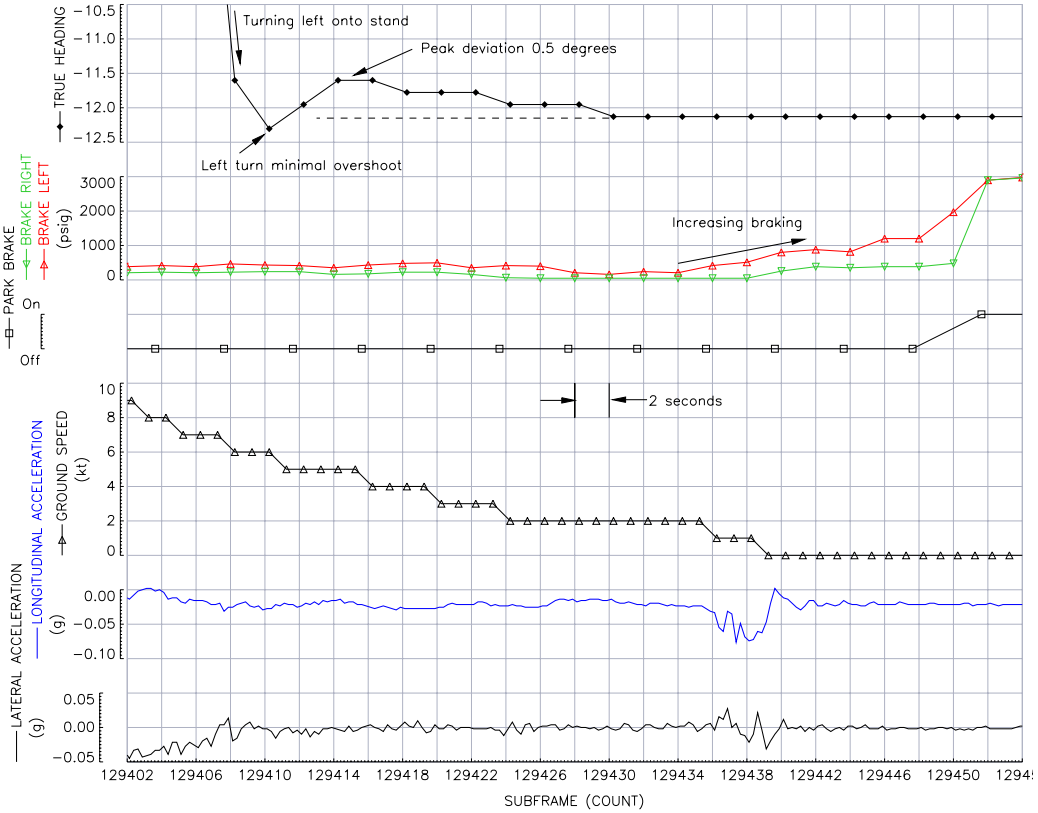


Figure 1

Time history of the key FDR parameters during the taxi onto stand.
Incident to N864DA on 20 May 2005 at Gatwick airport

reduced to approximately 2 kt. About 4 to 5 secs after stabilising at this speed, the data showed disturbances in the lateral and longitudinal acceleration parameters and a drop in ground speed to zero; this is consistent with the aircraft colliding with the stand. The direction of the longitudinal acceleration is consistent with the aircraft decelerating and it peaked at approximately 0.05g from the reading at rest. The direction of the lateral acceleration was consistent with a force pushing to the right, this was followed by a motion back to the left after a further jolt or oscillation. The peak lateral acceleration was less than 0.03g. The time from the first indications of the impact to the time the aircraft had settled was 4 to 5 secs; the park brake was applied 7 to 11 secs later.

Cockpit Voice Recorder

The CVR was a two-hour, solid state unit, with four audio inputs. These were recorded separately for the last 30 minutes and as a mixed audio stream for the whole two hours. The power to the CVR was isolated one hour and ten minutes after the incident had occurred and as a result, only the mixed audio recordings were available for analysing the conversations at the time of the event. The lower quality of the recording produced from the mixed audio streams made it more difficult to decipher some conversations that might have been clearer had the separately recorded, individual audio tracks been available.

From the recording, in the seconds after the impact, the commander can be heard to say *"I never saw, I never saw it change. I missed it."*. The subsequent conversation between the three pilots makes it apparent that they were initially unaware of the seriousness of the impact, indeed before the commander had been told what had happened he had requested that they be pushed back to the appropriate stopping point by a tug. Cockpit discussions also confirmed that the aircraft had stopped beyond the Boeing 777-300 mark on the PAPA board.

Stand 50 and its visual docking guidance system

At the time of the incident there were 110 aircraft parking stands at Gatwick Airport. These used a variety of centreline and stopping guidance to allow aircraft to park without the aid of a marshaller. Stand 50 had guidance and markings for three different parking positions and could accommodate either a single wide-bodied aircraft or two narrow-bodied aircraft; the latter two aircraft parking positions were designated Stand 50L and Stand 50R.

Centreline guidance onto all three parking positions was by AGNIS. This system comprises two closely spaced light bars, at cockpit level, positioned side-by-side in a box at the end of the stand and thus directly ahead of the pilot. The light bars appear to the pilot as either red or green depending on the aircraft's lateral position relative to the stand's centreline. If the aircraft is on the centreline both light bars are green. If the aircraft is to the left of the centreline, the left light bar is red whilst the right one remains green, and if it is to the right of the centreline, the right light bar is red whilst the left one remains green. The system is aligned to be used by the pilot in the left seat only.

Stopping guidance for Stand 50 was provided by a PAPA board. This is a large reference board positioned at cockpit level at the end of the stand, some distance to one side of the AGNIS unit; on Stand 50 it was to the left. There is a horizontal slot in the reference board behind which is positioned a vertical fluorescent light tube. Several vertical reference marks are painted on the board, each identified as relating to a particular type, or group of types, of aircraft intended to use the stand. As an aircraft moves along the stand centreline, the vertical light tube appears to move across the slot as a result of the parallax effect. When the light aligns with the mark for the particular type of aircraft using the guidance, the aircraft is at the correct stopping point. The stopping guidance, as with the AGNIS, is aligned for use from the left seat only. The PAPA board for Stand 50 has two markings for use by Boeing 777 aircraft. The B 777 mark is intended for use by Boeing 777-200 series aircraft whilst the B777-3 mark is intended for the longer Boeing 777-300 series aircraft.

In this incident the commander's view of the PAPA board was obstructed by a window pillar, requiring him to move his whole body either forwards or backwards in order to see the board behind the pillar. It was also raining when the aircraft arrived at the stand, further reducing the commander's ability to see the PAPA board clearly. As the system is only correctly aligned when viewed from the left seat, the pilot sitting in the right seat is unable to provide any form of assistance during the stopping manoeuvre.

There was an emergency STOP sign positioned immediately adjacent to the AGNIS guidance lights which, when activated, illuminates with the word STOP in red. Should the ground crew wish to stop an aircraft at any time during the parking manoeuvre, they can activate the emergency STOP sign by using either of two buttons, one located at the airbridge operator's station and the other on a panel at ground level at the end of the

stand. On Stand 50 the ground level button was mounted on the side of one of the PAPA board support pillars. It was positioned at ninety degrees to the stand centreline and its identification board was masked by that for the fuel hydrant emergency shut-off, which was on the same pillar and facing into the stand. As such the ground level button was not immediately visible from the main area of the stand.

The aircraft operator provided instructions for its pilots on the use of the parking aids at Gatwick Airport. These were in the airfield charts issued to each pilot flying to the airport. The briefing note supplier had used the airport operator's instructions as its reference material.

Operation of the airbridge

Stand 50 was served by a single passenger airbridge. It was manoeuvred into position using controls situated in the rotating cabin, at the end which abuts the aircraft. The airbridge was moved by a set of powered, steerable wheels on the end of the legs which support the control cabin end. When the airbridge was parked, awaiting the arrival of an aircraft, the wheels should have been positioned in a circle painted on the ground. In this position the cleared distance between the airbridge and a correctly parked Boeing 777-200 was 6.8 m. The airbridge controls included an emergency stop button which stopped the airbridge moving and another similar button which activated the emergency stop sign by the AGNIS. The purpose of neither button was clearly marked. A limited view of aircraft manoeuvring onto the stand was available through transparent panels in the doors and structure of the airbridge control cabin.

Airbridges were only allowed to be operated by suitably qualified personnel. At Gatwick, information relating to their use was provided by the airport operator through Managing Director's Instructions (MDI). MDI A17/02 related to aircraft stand guidance and stopping guidance and cross-referred to the '*Airside Safety and Operations Safety and Training Standards for Airbridge Operations*'. This document set out the standards required by the airport operator for the training, licensing, operational safety and audit procedures of those using airbridges. It included the statement:

> *'The presence of any persons on the airbridge except the operator while moving the airbridge is forbidden, unless they are:*
>
> - *In the process of being trained*
> - *Audited by BAA*
> - *Assisting BAA Engineering'*

The dispatcher had 20 years experience and was correctly licensed; however, he was unaware of the requirement to have only one person on the airbridge whilst it was being operated.

Recommended international standards - (ICAO Annex 14)

Annex 14 to the Convention on International Civil Aviation sets out the international standards and recommended practices for aerodromes. Chapter 5, Section 5.3.24 of this Annex concerns visual docking guidance systems and sets out the basic characteristics of such systems which are regarded as essential, and makes recommendations regarding others considered desirable. Of particular relevance to this incident is the standard for the location of the stopping position indicator, described at 5.3.24.14, which states that the centreline guidance and stopping point indicators should be, effectively, co-located.

The commander had previously used a variety of stand

guidance systems and the system he was most familiar with, and found easiest to use, was that installed at his home base of Atlanta, USA. Lateral guidance on these stands was provided by a system of lights similar to the AGNIS system at Gatwick. Stopping guidance was provided by a series of three lights: red, amber and green. These were situated at the end of the stand, with the AGNIS, and were controlled by a ground handler who manually selected each light in turn. A green light indicated that the aircraft should continue forwards, amber that it was approaching the stopping point and red that it should stop. The commander had also used airports where guidance was provided by combined laser and radar guidance systems such as the Aircraft Positioning and Information System (APIS) and 'Safe Dock'. These systems provide the pilot with both lateral guidance and correct stopping point indication by means of a series of lights contained within a single unit positioned at the end of the stand, on the centreline and at cockpit level. These visual docking guidance systems, where the centreline guidance and stopping point indicators are co-located, meet the recommended international standards.

Recent investigations into collisions on stand

In 2004 the AAIB investigated two incidents at Heathrow Airport involving aircraft colliding with stands: one to a B737-700, YR-BGF[1], and another to a B747-400, G-BNLG[2]. Heathrow and Gatwick are operated by the same parent company. Several safety recommendations were made as a result of these investigations, some of which are relevant to this incident.

Investigation into the incident involving YR-BGF

It was established that there was only a single emergency STOP light on each stand at Heathrow, positioned at the end of the stand close to the AGNIS unit. It was considered that the commander had been concentrating on the stopping point mirror which was at a considerable angular separation from the AGNIS unit. It was concluded that, as a result of this separation, the pilot of YR-BGF had not noticed the illumination of the emergency stop indication, which the ground crew had activated after the aircraft had progressed beyond the correct stopping point. The following recommendation was therefore made:

Safety Recommendation 2005-011

It is recommended that, in addition to the stop light at the end of each stand, Heathrow Airport Limited should also install an emergency STOP light adjacent to any aid used by the pilot for alignment, or stopping, in such a position that, irrespective of which aid is being used, the light falls within the handling pilot's field of view.

Investigation into the incident involving G-BNLG

a) Buttons to activate the emergency STOP sign were not present on all airbridges at Heathrow. Where the buttons did exist there was inadequate marking to indicate their purpose and to differentiate them from the co-located, and equally poorly marked, emergency buttons intended to stop the airbridge from moving. When asked, a number of airbridge operators were unable to differentiate between the buttons. The following recommendation was therefore made:

Footnote

[1] Report reference EW/C2004/03/02 published in AAIB Bulletin 5/2005.

[2] Report reference EW/C2004/04/02 published in AAIB Bulletin 5/2005.

Safety Recommendation 2005-014

"It is recommended that Heathrow Airport Limited should expedite the program to install duplicate emergency stop buttons at all of its airbridge control stations and ensure that all such buttons are clearly and unambiguously marked."

Buttons to activate the emergency STOP light were present on all airbridges at Gatwick at the time of the incident to N864DA. However, the marking of emergency buttons positioned on airbridges was poor, leading to confusion by the operators in identifying their purpose.

b) Heathrow Airport used a series of Operational Safety Instructions to disseminate information on procedures and equipment in use at the airport. There was inadequate indexing or cross referencing provided to readily identify the existence and location of relevant documents and information had become dispersed. The following recommendation was therefore made:

Safety Recommendation 2005-016

It is recommended that Heathrow Airport Limited should review the system by which Operational Safety Instructions are published to ensure that they are either incorporated into a relevant document, such as the Aerodrome Manual or Aeronautical Information Publication, or are provided with an effective index such that the information they provide is readily identifiable."

Gatwick Airport Ltd (GAL) used a similar system for disseminating information, although they were referred to as Managing Director's Instructions. The information in these instructions was inadequately indexed and the cross referencing was poor. At Gatwick Airport, information on the operation of airbridges was not contained in either the Aerodrome Manual or Managing Director's Instructions, as might be expected, but in a Safety and Training Standards Document. Whilst this document contained all the relevant material it was intended for use by those with a training or managerial role and, as a result, this information was not readily available to the operators.

The dispatcher was unaware of the requirement to have only one person on the airbridge when it was being operated. During the course of this investigation, information obtained suggested that the practice of having more than one person on the airbridge, whilst it was being operating, was common at the airport. Having been made aware of the problem, the ground handling company involved took immediate steps to stop the practice.

c) The investigation revealed the presence of unofficial and redundant ground markings on stands at Heathrow. The following recommendation was therefore made:

Safety Recommendation 2005-018

"It is recommended that Heathrow Airport Limited should review all ground markings related to aircraft parking stands, to ensure that their meanings are unambiguous, that markings are clearly displayed and that clear diagrams of such markings are prominently displayed on any aircraft stand."

Similar ground markings were in evidence at Gatwick. Other stopping marks were intended to be used only temporarily whilst, for instance, work was undertaken on the stand and aircraft were required to stop short. These marks had remained after their initial requirement had passed.

d) The investigation into the incident involving G-BNLG revealed that despite the presence of ground crew on the apron, the STOP button at ground level on the stand was not activated. It was considered logical to have a ground crew member actually manning the STOP button for it to be effective in preventing a collision once an overrun had been identified by the ground crew. The following recommendation was therefore made:

Safety Recommendation 2005-020

"It is recommended that British Airways should require that a member of their ground crew assumes the responsibility of being adjacent to the ground level emergency STOP light button and of monitoring the arrival of the aircraft onto the stand, whenever ground crews are present on a stand whilst an aircraft is manoeuvring to park."

In the incident involving N864DA at Gatwick, once the ground crew realised the aircraft had overrun its correct stopping position, a ground crew member had run to the emergency STOP button and activated the emergency STOP sign. He was however unable reach the STOP button in time to prevent the aircraft striking the airbridge. Subsequent to the incident the ground agents concerned took immediate steps to ensure that where possible a member of the ground crew was positioned next to the STOP button on the stand during parking operations. However, this procedure was abandoned after a few weeks because the agent at the STOP button could not determine adequately the point at which the aircraft should stop.

Analysis

Evidence from the FDR indicates that the aircraft had been correctly aligned with the centreline of the stand and had taxied along it, at an appropriate speed, for some distance prior to the impact.

The PAPA guidance system at Gatwick Airport requires the pilot in the left seat to alternate his gaze between the AGNIS unit, directly ahead of him, and the PAPA board, situated either to his left or right. By placing the board to one side of the aircraft there are times when it may only be visible through a side window rather than through the main front screen. Not only does this result in reduced visibility during periods of rain, since such windows are not usually equipped with wipers, but the view of the PAPA board may also be obstructed by the pillars between the various flight deck windscreens. The problem is exacerbated when the PAPA board is placed to the right of the aircraft and can only be seen by looking across the cockpit through the windows on the other side of the flight deck. Moreover, when considering this incident, if the pilot had been concentrating on the PAPA board during the final stages of the parking manoeuvre, it is unlikely that he would have seen the emergency STOP light illuminate, because of the wide angular separation between the AGNIS indicator and the PAPA board.

With the exception of the PAPA board, all other forms of guidance used by the commander provided an active indication that the aircraft has reached the correct stopping point, whether by a marshaller crossing his arms, a light changing colour or the word 'STOP' illuminating. The PAPA board system, whilst indicating the aircraft's approach to, and arrival at, the correct stopping point, does not physically change to highlight that the aircraft has reached this point. A comparison of the guidance systems encountered by the commander revealed that, with the exception of the PAPA board, all the other systems have the required elements effectively co-located directly ahead of the

aircraft, in accordance with the standard described in ICAO Annex 14. The CAA is encouraging UK airport operators to replace such systems with ICAO Annex 14 compliant, advanced docking visual guidance systems as soon as is practicable.

Whilst no comments on the CVR specifically indicated where the commander's vision was concentrated at the time of the impact, his subsequent comments suggest that whether he was looking at the PAPA board or AGNIS, he was expecting some active indication that he should stop. It is possible that he was concentrating solely on the AGNIS lights. The aircraft was correctly on the centreline and the consistent heading, as recorded on the FDR, meant that the commander would have seen the two green lights ahead of him throughout the final stages of parking. It seems possible that the comment *"I never saw, I never saw it change. I missed it."*, combined with his familiarity with the Atlanta stopping system, on which the lights change from green to amber to red, might indicate that the commander was concentrating on the AGNIS and was expecting the light to change colour at the appropriate stopping point. It is also feasible that the emergency STOP light sign could have been misinterpreted to be part of the normal parking system. The ground handler who activated the emergency STOP light stated that this illuminated at about the same time as the aircraft came to a halt, immediately after the impact.

The investigation considered whether the commander had confused the B777-3 mark for the B777 mark appropriate for his aircraft type; however, this is inconsistent with the fact that the aircraft over-ran this mark too. Indeed had the aircraft stopped at the mark intended for the Boeing 777-300 series aircraft it would still have stopped 1.3m short of the airbridge. Whilst it does not appear to have been a factor in the incident GAL accepted that, for clarity, the B777 mark should more appropriately have been labelled 'B777-2'.

The investigation considered whether the absence of a back-plate, behind the slot in the PAPA board, might have lead the pilot to mistake a window support in the terminal building for the light tube. After examination this possibility was discounted, although the absence of the back-plate on a considerable number of the other PAPA boards at the airport might possibly lead to pilot confusion. This absence seems to have been an oversight and, although it would not have rendered the PAPAs unusable, it may have reduced the clarity of the indications.

The investigation also considered whether crew fatigue was a possible contributory factor in the incident. The commander's allocated rest period prior to the flight was reduced by the time taken for him to travel to Atlanta. He left his home approximately 18 hours prior to the landing at Gatwick, although he had taken the opportunity during the flight to rest for two and a quarter hours in a bunk, in accordance with the company procedures. The operator requires all of its crews to sign a statement when reporting for duty that they are fit to conduct the flight. Whilst the commander no doubt felt sufficiently rested when reporting for duty it is possible that he would not have felt so on arrival at Gatwick. It is of note that of the three pilots on this flight, two lived in Texas (where the operator had recently closed one of its bases), and one in Florida, all some distance from their base at Atlanta. Whilst the responsibility for being fit to conduct a flight remains with an individual crew member, an operator should not ignore a situation where it must be known that, due to their home locations, their crew members are travelling considerable distances prior to operating flights.

Comparison of this incident with those recently investigated at Heathrow Airport reveal a number of similarities. In light of the recommendations made as a result of these previous investigations it is clear that the information contained in the recommendations was not shared across those airports operated by the same parent company.

Both airports had poorly marked airbridge mounted emergency buttons, where these were fitted. Gatwick however, unlike Heathrow, did have additional emergency STOP light buttons fitted in all its airbridges. Furthermore, the emergency stop button at ground level on Stand 50 at Gatwick, whilst well marked, was poorly positioned so that its location was not obvious to ground crew monitoring an aircraft's arrival on the stand.

Both airports shared a similar system for disseminating information although they were referred to by different names. The systems were similar in that they both led to information becoming fragmented and difficult to locate.

The dispatcher involved in the N864DA incident had 20 years experience of operating airbridges and was correctly licensed. He was unaware of the requirement to have only one person on the airbridge when it was being operated, but the importance of this instruction was borne out by both the close escape had by those on the airbridge on this occasion, and that of the dispatcher in the incident referred to in the G-BNLG investigation report. The practice of having more than one person on the airbridge, whilst it was being operated, was reported to be common at the airport. The lack of a readily accessible set of instructions for the operation of airbridges is believed to be significant in allowing this bad practice to become widespread. Having been made aware of the problem, the ground handling company involved took immediate steps to stop the practice. However, the existence of an easily accessible reference document would have increased the probability of the ground crews adhering to the requirements in the first place.

Both airports had unofficial and redundant ground markings. The effective removal of redundant ground markings is problematic but where they are allowed to remain it potentially leads to confusion by both ground crew and flight crew. This was a contributory factor in the incident involving G-BNLG at Heathrow, where the airbridge was parked in the wrong position by a member of ground crew because the markings of the parking position for the airbridge has been changed whilst the old markings remaining visible. This is also potentially confusing for pilots trying to identify whether the airbridge is correctly parked prior to the aircraft entering the stand.

As at Heathrow, there were also numerous hand-painted and unofficial ground marks in existence on stands at Gatwick. These are used by ground crew when marshalling or towing aircraft onto stand when the normal aircraft parking aids are of little use. They are generally made using paint sprayed from hand-held aerosol cans and there is generally no means available to determine who made the mark, why it was made or whether it has been made in the right place. Where a range of stopping positions is required for different aircraft types, this can lead to there being a series of marks which in turn can lead to mis-identification, especially as the identification marks attached to each line are of varying clarity. In all cases, the use of ground marks to indicate to ground staff the correct stopping point for an aircraft gives rise to difficulties. A solution to the problem is known to exist at least one UK airport where the stands are designed so that a common stopping position is used by all aircraft and the airbridge is capable of being manoeuvred into

position on all types authorised to use the stand. This allows one common stopping mark to be applied on the ground for use by ground staff. This effective solution is however reliant on the initial design of the stand and choice of airbridge and it is accepted that this may not be appropriate for all existing airport infrastructures. Where a common stopping point is not possible, an alternative mechanism should be identified by airport operators that does not rely on ground crew using marks of unknown origin, authority and accuracy for the parking of aircraft.

Finally, an issue arose at both Heathrow and Gatwick over the manning of emergency stop buttons positioned at ground level on the airport stands. Only one of the three handling agencies involved in the incidents investigated specifically required the button to be manned whilst aircraft were in the process of parking on the stand. Of the three incidents it was only their ground crew that had managed to activate the emergency stop sign in sufficient time for it to have potentially prevented the incident occurring. That it failed to do so was because neither of the pilots was looking at it when it was activated. Whilst the location of the signs has already been discussed, if they are not activated in a timely manner then, irrespective of their position, they can never serve their intended purpose. It therefore seems logical to have the button manned whenever possible during parking operations, since this then allows for a rapid reaction when the threat of an imminent collision becomes evident.

Subsequent Actions

The aircraft operator, GAL and the ground handling agency involved have carried out internal investigations leading to initial preventative action being taken by all parties. In particular, the aircraft operator has taken the following actions:

a The operator has produced a computerised training package for its crews regarding aircraft parking aids.

b On 6 July 2006, their Director (Flight Operations) issued an internal memorandum to all of their pilots regarding the parking hazards associated with the PAPA/AGNIS system.

c On 12 July 2006, the operator's General Manager (Flight Safety Programmes), together with their Airport Customer Service Regional Director responsible for the UK, met with the Station Manager for London (Gatwick) to discuss the issues relating to PAPA/AGNIS. On 18 July 2006 the following employee notification was disseminated to all of the agent's ramp employees and posted in all break rooms, both at Gatwick and other relevant destinations.

> *A designated ramp employee of either Team Leader Grade or above must be available in the vicinity of the emergency stop button for all arriving [the operator] aircraft. This individual must take the appropriate action if those actually working around the aircraft indicate that it is necessary to stop the aircraft in the event of any emergency situation.*

This procedure will also be forwarded for implementation to the other international stations used by the operator, where PAPA/AGNIS is installed. The only exception is Manchester, where a manual stop light system is used to indicate to parking aircraft that they should stop.

CVR Handling

Given that the incident happened on stand it is unfortunate that over one hour elapsed before power to the CVR was isolated. Deactivation of the CVR after an accident or incident is part of the published crew procedures. However, the practicalities of isolating the power from the CVR fitted to the B777 are not straightforward since the CVR circuit breaker is located in the electronics bay of the aircraft instead of on the flight deck. Access to the electronics bay from within the aircraft is via a hatch in the cabin floor adjacent to the front left door of the aircraft, alternatively access can be gained from beneath the aircraft via a hatch. A survey of the other types of aircraft used by the operator revealed that the B777 was the only aircraft with the circuit breaker not on the flight deck.

As a backup to the crew procedures, the operator Technical Operations Policies And Procedures required that:

> *"2. On Ground - In the event of an accident or incident on the ground, a responsible Delta employee at the scene ensures that the voice recorder circuit breaker is opened."*

Discussions with the operator revealed that it is not made clear in the operator procedures how the responsible employee is identified in a timely manner.

The operator is actively reviewing their procedures and policies in this area. However, as with previous investigations, there is a need for the certifying authority to ensure that the oversight of operations include ensuring appropriate procedures and training and in place to handle CVRs after accidents and incidents.

Conclusion

At the time of the incident the aircraft was serviceable. It was taxied onto the stand, along the centre line, at an appropriate speed. The airbridge was parked in the correct location and the stand guidance was correctly calibrated, serviceable and operating. The aircraft passed the correct stopping point and the aircraft collided with the airbridge.

The design of the stand guidance system did not comply with the standards described in ICAO Annex 14. The CAA is encouraging UK airport operators to replace such systems with ICAO Annex 14 compliant advanced docking visual guidance systems as soon as is practicable. Contributory factors to the incident were the commander's lack of familiarity with the parking system and possible fatigue.

Safety Recommendations

As a consequence of this incident the following recommendations are made:

Safety Recommendation 2006-076

It is recommended that BAA should ensure an effective transfer of airside safety related information between all of their airports.

Response to Safety Recommendation 2006-076

BAA has accepted this recommendation. Information exchange within BAA is now achieved through meetings involving the Operations Directors of the various airports in the group; these meetings are held every 4 months. The Duty Managers of the different airports make contact more frequently in order to share immediate safety related information.

Safety Recommendation 2006-077

It is recommended that Gatwick Airport Limited should ensure that all PAPA boards are fitted with backing plates and that aircraft type markings on the boards are unambiguous.

Response to Safety Recommendation 2006-077

Gatwick Airport Limited has accepted this recommendation. An audit has been carried out to identify those PAPA units at Gatwick Airport without a backing plate. It was found that backing plates were not fitted to those older units which had been manufactured without provision for such plates to be fitted. New backing plates have been designed and will be fitted where required. Newly manufactured PAPA units have enclosed systems where no such backing plate is required. Aircraft type markings on the PAPA boards have been revised to remove ambiguity.

Safety Rcommendation 2006-078

It is recommended that BAA should review all current and future visual guidance docking systems at their airports with a view to complying with ICAO Annex 14, Chapter 5, Section 5.3.24.

Response to Safety Recommendation 2006-078

BAA has accepted this recommendation. A program has commenced across BAA airports to replace older generation guidance systems with those complying with ICAO Annex 14, Chapter 5, Section 5.3.24. A risk assessment has been conducted for each stand and guidance systems are being replaced on a priority basis related to this assessment. Thirty 'Safe Dock' docking systems have now been installed at Gatwick Airport.

Safety Recommendation 2006-079

It is recommended that Gatwick Airport Limited should install an emergency STOP light adjacent to any aid used by the pilot for alignment or stopping, in such a position that, irrespective of which aid is being used, the emergency STOP light is within the handling pilot's field of view.

Response to Safet Recommendation 2006-079

Gatwick Airport Limited has partially accepted this recommendation. They pointed out that when the STOP button is activated all lights within the guidance system extinguish, at which point a pilot should bring the aircraft to a halt immediately. They also considered that such STOP lights, which are visible in some light conditions even when not illuminated, could confuse some pilots who might expect them to illuminate to provide active stopping guidance when the aircraft was at the correct stopping point. Gatwick Airport Limited has agreed to carry out a risk assessment for each stand, taking these factors into account, before deciding if additional lights were required.

Safety Recommendation 2006-080

It is recommended that Gatwick Airport Limited should ensure that the location of emergency STOP buttons, at ground level on stands, is clearly identifiable to ground crews operating on the stand.

Response to Safety Recommendation 2006-080

Gatwick Airport Limited has accepted this recommendation. The location and signage of the emergency STOP buttons, at ground level on stands, has now been standardised and is clearly identifiable to the ground crews operating on the stands.

Safety Recommendation 2006-081

It is recommended that Gatwick Airport Limited should ensure that all emergency STOP buttons positioned in airbridges are clearly and unambiguously marked.

Response to Safety Recommendation 2006-081

Gatwick Airport Limited has accepted this recommendation. An audit of the airbridges at Gatwick Airport has been completed and all emergency STOP buttons positioned in the airbridges are now clearly and unambiguously marked.

Safety Recommendation 2006-082

It is recommended that Gatwick Airport Limited should review the system by which Managing Directors Instructions are published to ensure the information they provide is readily identifiable.

Response to Safety Recommendation 2006-082

Gatwick Airport Limited has accepted this recommendation. A suitable index will be added to the Managing Directors Instructions to ensure that the information they provide is readily identifiable.

Safety Recommendation 2006-083

It is recommended that Gatwick Airport Limited should review all ground markings related to aircraft parking stands to ensure that they are clearly marked and that their meanings are unambiguous.

Response to Safety Recommendation 2006-083

Gatwick Airport Limited has accepted this recommendation. Unofficial ground markings have been removed. All future marks will have to be authorised by the Duty Operations Manager and will only be made using a suitable stencil.

Safety Recommendation 2006-084

It is recommended that Gatwick Airport Limited should examine the practicability of requiring a member of the ground crew to assume the responsibility of being adjacent to the ground level emergency STOP light button, and of monitoring the arrival of the aircraft onto the stand, whenever ground crews are present on a stand whilst an aircraft is manoeuvring to park. An effective means of monitoring whether the aircraft has overrun its correct parking position should also be devised.

Response to Safety Recommendation 2006-084

Gatwick Airport Limited has accepted this recommendation. Gatwick Airport Limited will consult ground operation organisations working at the airport to determine whether it is feasible to have the ground level emergency stop button manned during parking manoeuvres.

Safety Recommendation 2006-085

It is recommended that Delta Airlines review the effectiveness of their measures to control crew fatigue, taking into account the time for crews to travel from their residences to the bases at which they are required to report for flight.

Response to Safety Recommendation 2006-085

Delta Airlines has accepted this recommendation. Their Director (Flight Safety) will conduct a review of Delta's crew fatigue countermeasures together with the Director (Flight Operations) and the Director (Crew Resources and Scheduling).

Previous Safety Recommendations

Following an incident at London (Heathrow) airport, involving a Boeing 777 aircraft[3] operated by another American operator, the following safety recommendations were made. Both recommendations are relevant to this incident.

Safety Recommendation 2005-52

It is recommended that the Federal Aviation Administration and the Joint Aviation Authorities review their processes of oversight of Operator's procedures and training support to ensure the timely preservation of Cockpit Voice Recorder recordings in accordance with ICAO Annex 6 Part I, 11.6, following a serious incident or accident. The operator procedures and training should provide the necessary skills and information to identify accidents and serious incidents and implement the necessary tasks to preserve these recordings in a timely manner.

Safety Recommendation 2005-53

It is recommended that the Federal Aviation Administration require United Airlines, and any other airline regulated by the Federal Aviation Administration with similar procedures, to ensure that their procedures allow for the prompt identification of accidents and serious incidents and the timely preservation of Cockpit Voice Recorder recordings.

Footnote

[3] Report reference EW/C2004/07/03 published in AAIB Bulletin 9/2005.

ACCIDENT

Aircraft Type and Registration:	DH89A Dragon Rapide, G-AKIF
No & type of Engines:	1 Gipsy Six Series 1 piston engine 1 Gipsy Six Series 1A piston engine
Year of Manufacture:	1944
Date & Time (UTC):	2 August 2006 at 1332 hrs
Location:	Duxford Aerodrome, Cambridgeshire
Type of Flight:	Public Transport (Passenger)
Persons on Board:	Crew - 1 Passengers - 8
Injuries:	Crew - None Passengers - None
Nature of Damage:	Both propellers bent, left engine-mount distorted, left bracing struts to upper fuselage deformed, cowlings bent and landing gear fairing damaged
Commander's Licence:	Air Transport Pilot's Licence
Commander's Age:	48 years
Commander's Flying Experience:	1,980 hours (of which 112 were on type) Last 90 days - 35 hours Last 28 days - 18 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Shortly after touching down on the grass runway at Duxford Aerodrome a gust of wind, or a bump in the runway, caused the aircraft to become airborne again. The pilot checked forward on the control column to bring the main landing gear back onto the ground but was unable to control the nose-down pitching motion of the aircraft and the engine propellers struck the ground.

History of the flight

This accident occurred on the pilot's fourth flight of the day, all on the same aircraft and using Runway 24, which has a grass surface and an LDA of 890 m. The surface wind was from 310º at 16 kt, giving a crosswind component of 14 kt, and had been of a similar velocity throughout the day. It was also gusty with the pilot experiencing windshear of up to 15 kt on the approach.

After a normal approach, the aircraft touched down on the right main wheel and then the left, but before the tail wheel made contact with the runway the aircraft lifted off again. The pilot believed that this happened due to either a gust of wind or a bump on the runway. He checked forward on the control column to bring the main wheels back into contact with the ground and

then checked back again as the tail continued to rise. However, he was unable to arrest the nose-down pitch in time to prevent the propellers striking the ground. The aircraft was brought to a halt on the runway and the passengers disembarked using the normal exit.

There was considerably more damage to the left side of the aircraft than the right giving rise to the possibility that the left wing may have stalled during the landing sequence, adding to the pilot's control difficulties. In the prevailing gusty conditions, a shear of 15 kt on touchdown could lead to a wing stall, particularly on the downwind (left) wing. The pilot commented that landing on the longer, parallel asphalt/concrete runway might have been a preferable option. This would have offered a more predictable landing surface and additional time to consider and execute a go around if necessary.

INCIDENT

Aircraft Type and Registration:	Dornier 328-110, D-CPRW
No & Type of Engines:	2 Pratt & Whitney PW 119B turboprop engines
Year of Manufacture:	1998
Date & Time (UTC):	28 November 2005 at 0923 hrs
Location:	Isle of Man (Ronaldsway) Airport
Type of Flight:	Public Transport (Passenger)
Persons on Board:	Crew - 3 Passengers - 16
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	53 years
Commander's Flying Experience:	5,575 hours (of which 310 were on type) Last 90 days - 150 hours Last 28 days - 30 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft had a covering of frost and was de-iced/anti-iced using a heated mixture of Type II+ de-icing fluid and water. The commander commenced the takeoff run and at the calculated rotation speed pulled the control column aft. The aircraft did not appear to rotate in response to the control input and he abandoned the takeoff. The aircraft was brought to a stop on the runway.

The probable cause of the incident was the incorrect V_1/V_R speed selected. Contamination must have been present on the tail surfaces because the aircraft would not rotate at the 'normal' rotation speed for its configuration and load but it was not possible to determine whether the contaminant was ice or thickened fluid. The problem may have occurred because fluid was sprayed from the trailing edge towards the leading edge. Two safety recommendations were made.

History of the flight

Having completed their flight planning the crew arrived at the aircraft. Large areas of the aircraft surfaces had a covering of hoar frost; in particular, the central areas of the wing and tailplane upper surfaces were covered with a depth of 1 to 2 mm. In accordance with the company operating procedures, the commander requested de-icing/anti-icing. The aircraft was the fifth aircraft to be de-iced/anti-iced that morning and at 0833 hrs a vehicle-mounted articulated work platform used for de-icing/anti-icing arrived at the aircraft. The

aircraft was subsequently de-iced/anti-iced using a one step process with a heated mixture of 75% Type II+ fluid and 25% water. The operator sprayed the fluid from the rear of the wings and the rear of the horizontal tail surfaces to remove the frost. He also removed the frost from the vertical tail surfaces by spraying from the rear. The operation was completed by 0844 hrs. Whilst he was outside the aircraft, the commander monitored the de-icing/anti-icing of the aircraft as it was carried out.

The crew completed the pre-start checks and a 'full and free' check of the flying controls that is normally performed during the taxi checks. The loading calculations confirmed that the aircraft was within mass and balance limits. The aircraft was started and whilst taxiing, the flaps were checked and set, and the trim was set by placing the indicator on the EICAS on the nose-down edge of the green band displayed.

The 0850 hrs ATIS was current and gave the runway in use as 26 with a surface wind of 360º/09 kt, 10 km visibility, cloud FEW at 2,500 ft, outside air temperature +4ºC, dew point -4ºC and QNH 1002 hPa. The takeoff mass was 12,396 kg, which with the flaps set at 12º, required a V_1/V_R of 109 kt under normal conditions.

At 0922 hrs the aircraft was lined up on Runway 26 and the CONFIG check was completed with no abnormal items identified. Having been given takeoff clearance, the commander, who was the Pilot Flying (PF), smoothly advanced the power levers to set takeoff power. The CONFIG warning illuminated briefly but immediately ceased when the power levers were retarded. The power levers were then advanced with no CONFIG warning and the takeoff was continued. The Pilot Not Flying (PNF) called the IAS as the aircraft passed through 80 kt. The V_1/V_R call was made by the PNF at 109 kt and the commander moved the control column aft for rotation. Immediately he was aware that the aircraft was not responding to his elevator control inputs and so he selected the power levers to idle and applied heavy braking. Maximum reverse thrust was selected and the aircraft was brought to a stop on the runway. The only abnormal indication was of high wheel brake temperatures and the aircraft was taxied back to the parking area. Following discussion with the fire service the passengers disembarked and boarded a bus. The pilots undertook an elevator movement check; full and free movement with no restriction was found.

Personnel background, experience and training

Commander

The commander joined the operator on 16 April 2005, having previously flown a number of different aircraft types in Europe and North America. His previous employment was with a European operator flying SA 226/227 Metroliner aircraft on cargo flights throughout Europe. He successfully completed his Dornier 328 type conversion on 24 May 2005 and carried out 100 sectors of line training. His final line check was carried out on 20 July 2005 and he had been flying as an aircraft commander with the operator since that date.

Co-pilot

The co-pilot joined the operator on 6 March 2005 having previously worked as a flying instructor and charter pilot on light single and multi, piston-engined aircraft. He successfully completed a four week Dornier 328 type conversion course in August 2005. He commenced line training on 15 September 2005 and carried out 96 sectors including his final line check on the 27 November 2005, the day before the incident flight. At the time of the incident he had accumulated a

total flying experience of 1,305 hours of which 63 hours were on the Dornier 328.

Type Rating Training Organisations (TRTOs)

Both pilots had attended two separate, approved TRTOs for their type conversions. During the 'Performance' element of the course, the requirements relating to V_1/V_R speeds following the application of thickened fluid should have been covered.

Whilst the theory of ground de-icing/anti-icing was covered, at no time during the flight phase of the training were weather conditions encountered that required ground de-icing/anti-icing. Neither pilot could recall being made aware that the icing takeoff speeds should be used following application of thickened fluids. This information was, however, set out in the Aeroplane Flight Manual within the Normal Procedures.

Ground handler who carried out de-icing/anti-icing operation

The task was carried out by a ground handler with 12 years experience. He was a shift supervisor and had completed his computer-based 'winterisation' training course at the start of the winter season.

When interviewed the ground handler noted that there had been some debate during the last few years as to whether they should spray fluid from the leading edge or the trailing edge of horizontal surfaces. The benefits claimed for spraying from the rear were a warmer jet being applied to the aircraft surface, better access and increased speed.

Aircraft loading

The aircraft was correctly loaded with the 16 passengers distributed evenly throughout the cabin. The 48 kg of cargo was loaded into the rear hold. The aircraft Takeoff Gross Mass (TOGM) was 12,396 kg. The CG range at that mass is 22% to 37% MAC[1]; the CG position for departure was at 24.5% MAC.

Additional information

De-icing/anti-icing fluids

There are several types of fluids used for de-icing and anti-icing of aircraft. Type I fluids have a high glycol content and low viscosity; resulting in a fluid with good de-icing performance but with only limited anti-icing protection.

Thickened fluids such as Type II and Type IV have a lower glycol content than Type I fluids and, due to the addition of thickening agents, are designed to flow off the aircraft surfaces during the takeoff and climb; hence they provide good anti-icing protection between the application and the takeoff. The type II+ fluid used on D-CPRW was qualified to the industry standard specification SAE AMS 1428D, during which tests confirmed that under simulated takeoff conditions around 90% of a 75/25 fluid/water mix is eliminated from a surface based on an initial 2 mm thickness.

Contamination of aerodynamic surfaces

The aerodynamic performances of wing and horizontal tail surfaces are affected by changes to their profiles due to contamination from ice or de-icing/anti-icing fluids. The most critical region for a wing is typically the leading edge on the upper surfaces since this is the area where the aerodynamic flow is most likely to break down and cause the wing to stall. However, the direction of the horizontal tailplane force during rotation on takeoff is downwards and the most critical region for the tailplane is, therefore, the leading edge on the lower surface.

Footnote

[1] Mean Aerodynamic Chord.

Contamination of the tailplane can lead to the separation of the air flow over the tailplane lower surfaces. For aircraft with a fixed tailplane and elevator and without powered flying controls, such as the Dornier 328, this can ultimately lead to the aircraft pitching down, possibly violently, as the elevator operates in a region of separated flow on the lower surface.

Dornier 328 decision speeds

Decision speeds in icing conditions or in non-icing conditions with thickened fluids applied

As part of the certification process for a new aircraft type, a flight test programme is undertaken to establish the operational performance. The performance data derived from these tests are documented in the Aeroplane Flight Manual (AFM). For the Dornier 328 the operational performance in icing conditions was determined using artificial ice shapes attached to the leading edges of the wings. As a result the V_1/V_R speeds in the AFM for icing conditions are typically around 20 knots higher than those for non-icing conditions to allow an appropriate increased margin above the stall speed. Such a large increase is not unusual for turbo-prop aircraft such as the Dornier 328 that are fitted with de-icing, but not anti-icing, systems.

The application of de-icing/anti-icing fluids with a thickening agent also degrades the aerodynamic performance of the aircraft. Flight tests were also undertaken with the Dornier 328 in non-icing conditions with thickened fluid applied. As a result, the V_1/V_R speeds for non-icing conditions with thickened fluids applied were determined to be the same as those for icing conditions. Using the higher V_1/V_R speeds in such conditions increases the amount of fluid that is blown off the aircraft and counteracts the loss in aerodynamic performance due to the fluid remaining on the aircraft. However it was the wing's lift performance, not the tailplane effectiveness, that was the main driver for these raised V_1/V_R speeds.

Operators' procedures for scheduling takeoff speeds

The V_1/V_R speeds are calculated from a Takeoff Gross Mass (TOGM) obtained from the aircraft Flight Management System (FMS). The operator had provided laminated flip charts in which speeds for every 500 kg increase in TOGM were tabulated, and the crew select the speeds from the next highest chart weight corresponding to their calculated TOGM. The standard flap setting for takeoff is 12° and charts are provided for takeoff in icing and non-icing conditions.

Icing conditions are defined in the company Operations Manual as:

> *'Whenever the temperature is below 8°C and the visibility is less than 1,000 metres or in conditions of precipitation.'*

The Aeroplane Flight Manual, under 'Takeoff Normal Procedures', provides a NOTE which states:

> *If the aeroplane was treated with de/anti-icing type II or IV fluids, icing speeds V1, Vr, V2 and Vsec with horn heat on and related TAKEOFF performance for ICING CONDITIONS must be used irrespective of ambient conditions even if non-icing conditions exist. Dissipation of de/anti-icing fluids may be assumed after completion of the takeoff flight path'.*

The speeds for the incident TOGM contained in the laminated flip chart used in the incident are set out in Table 1 below:

12,500 kg	V_1/V_R	V2
Takeoff non-icing conditions	109	113
Takeoff icing conditions	128	129

Table 1

Takeoff speeds at 12,500 kg

The V_1/V_R speed used by the crew for the incident takeoff was 109 kt. Having used type II fluid for de-icing/anti-icing, the correct V_1/V_R was 128 kt.

The accelerate/stop distance for a V_1 of 109 kt extracted from the flight manual performance graphs is 1,020 m and for a V_1 of 128 kt it is 1,350 m. The useable length of Runway 26 is 1,613 m.

Flight recorders

The aircraft was fitted with a Flight Data Recorder (FDR) and a Cockpit Voice Recorder (CVR). The CVR and FDR were downloaded and the recordings analysed.

The FDR provided more than 90 parameters over a period of over 81 hours, covering 52 flights and the rejected takeoff. All speeds referred to are indicated airspeeds.

The CVR provided two types of recording, a half-hour four-track recording and a two-hour two-track recording. The recordings were of good quality and free from excessive noise. The CVR had remained powered for more than half an hour after the event so the two-hour recording was used. This contained one channel for the Cockpit Area Microphone (CAM) and another channel which was a mix of the crew channels and the PA. Some of the recording covered a period when the crew were not using their headsets and so the communications were only picked up on the CAM which was also subject to aircraft noise. The commander was providing instructional information to the first officer, which in combination with noise problems, caused difficulties when determining whether a conversation was related to an actual aircraft problem or was training related.

Recorded information

From the CVR recording it was apparent that the commander had observed frost on the aircraft but he was satisfied with the de-icing/anti-icing work that he had observed whilst outside the aircraft.

The aircraft was subjected to several delays. The aircraft waited in turn for de-icing/anti-icing and was then held back by a failure of the de-icing/anti-icing rig which all resulted in a loss of the assigned ATC slot and a need to wait for a new slot. During the delay a passenger, without any hold luggage, left the aircraft. The crew decided that the load figures did not need to be altered.

There were discussions relating to fuel indication problems and an issue with the park brake. The commander advised the co-pilot of the need to take things steadily when faced with multiple problems, such as they had suffered during that morning.

The gust locks were found 'in' just after the aircraft was declared configured for takeoff. The pertinent recorded parameters for the event are shown in Figure 1.

The takeoff roll sequence was started at 0921 hrs with 12º of flap, propeller speeds of 74% and engine torques of 7% (propeller speed and torque values are averages for the left and right engines). The engine torques started to rise and the aircraft started to accelerate. The engine torques then temporarily stabilised at 30% before climbing further to just over 90%. The propeller speeds dipped twice, once before the torque level-off and once after, and then climbed to 97%. The ground spoilers deployed during the first dip in propeller speed and then

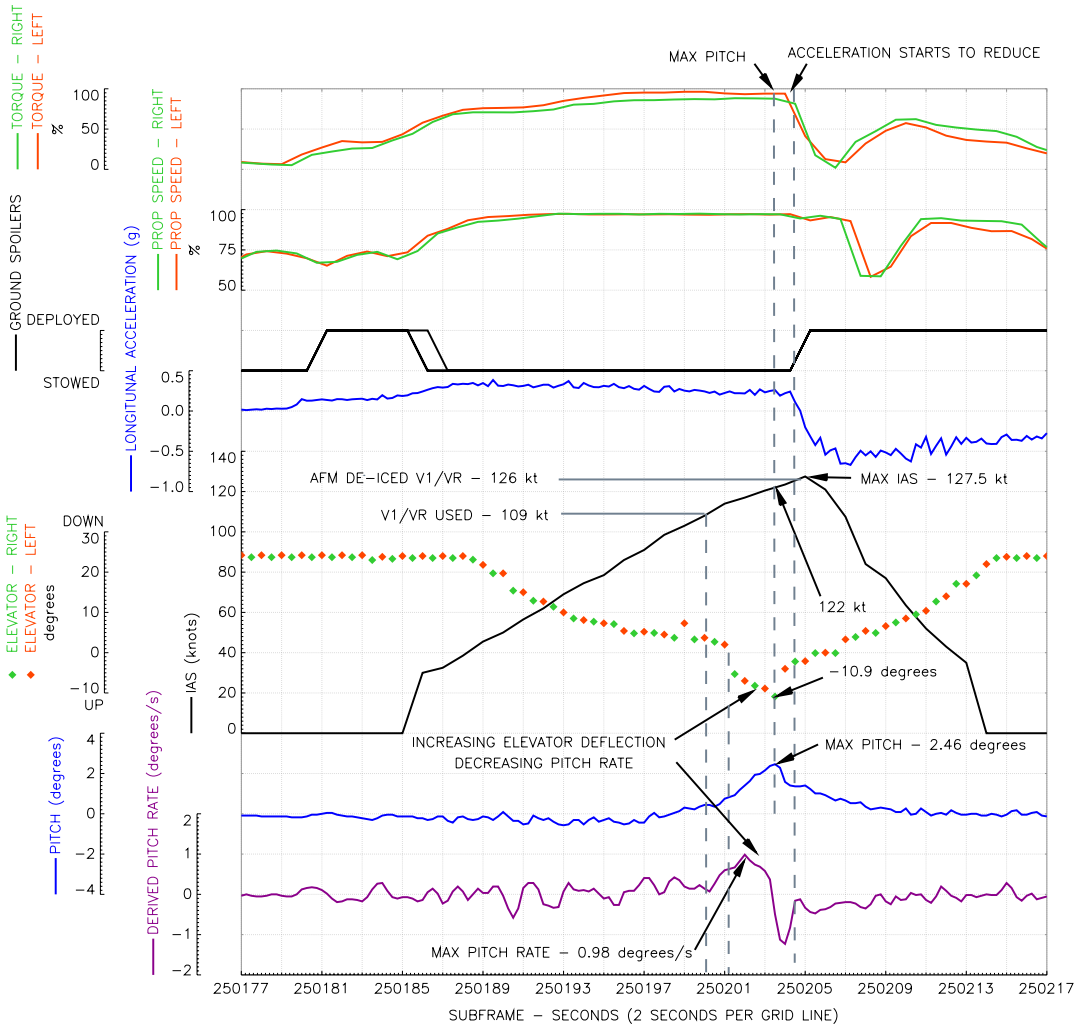


Figure 1

Pertinent Recorded Parameters for the Event

stowed during the final increase in propeller speed as the indicated airspeed parameter came 'on line' with a value of 30 kt. With the indicated airspeed passing 90 kt the aircraft pitch slowly increased by a small amount. Approximately 1 second after the aircraft reached the nominated rotate speed of 109 kt the elevator was brought to the 5º trailing edge up position. The aircraft pitch carried on increasing and the elevator angle was slowly increased. One second after the initial elevator input, the pitch rate of the aircraft peaked at just under 1º/sec with the aircraft pitch at 1.4º degrees and the elevator at 7º. By this time the aircraft had reached 117 kt.

One and a half seconds after the peak pitch rate was achieved, the pitch attitude peaked at just under 2.5° with a maximum elevator deflection of 10.9° and an air speed of 122 kt. A further second later the aircraft acceleration and engine torques started to reduce, the elevator was brought to a more neutral position and the aircraft pitch reduced. Within the next second the aircraft speed peaked at 127.5 kt and then started decelerating with the ground spoilers deploying.

Throughout the event, the elevator trim did not change. There were no parameters recorded for wind speed or

direction, gust lock status or brake status (pressure or temperature).

A comparison of speed, elevator input, pitch and pitch rate with three other flights is shown in Figure 2. The recordings are aligned to elevator movement at the point of rotation. This diagram further illustrates the abnormality of the aircraft's pitch response to elevator movement during the incident takeoff.

Aircraft inspection

The aircraft was inspected by the AAIB some eight hours after the incident. The elevator movement was full and free and de-icing/anti-icing fluid residue was still present on the tail surfaces, wings and the aft fuselage. The de-icing/anti-icing fluid streak marks on the lower surface of the horizontal tailplane surfaces, made either during the takeoff run or by the effects of

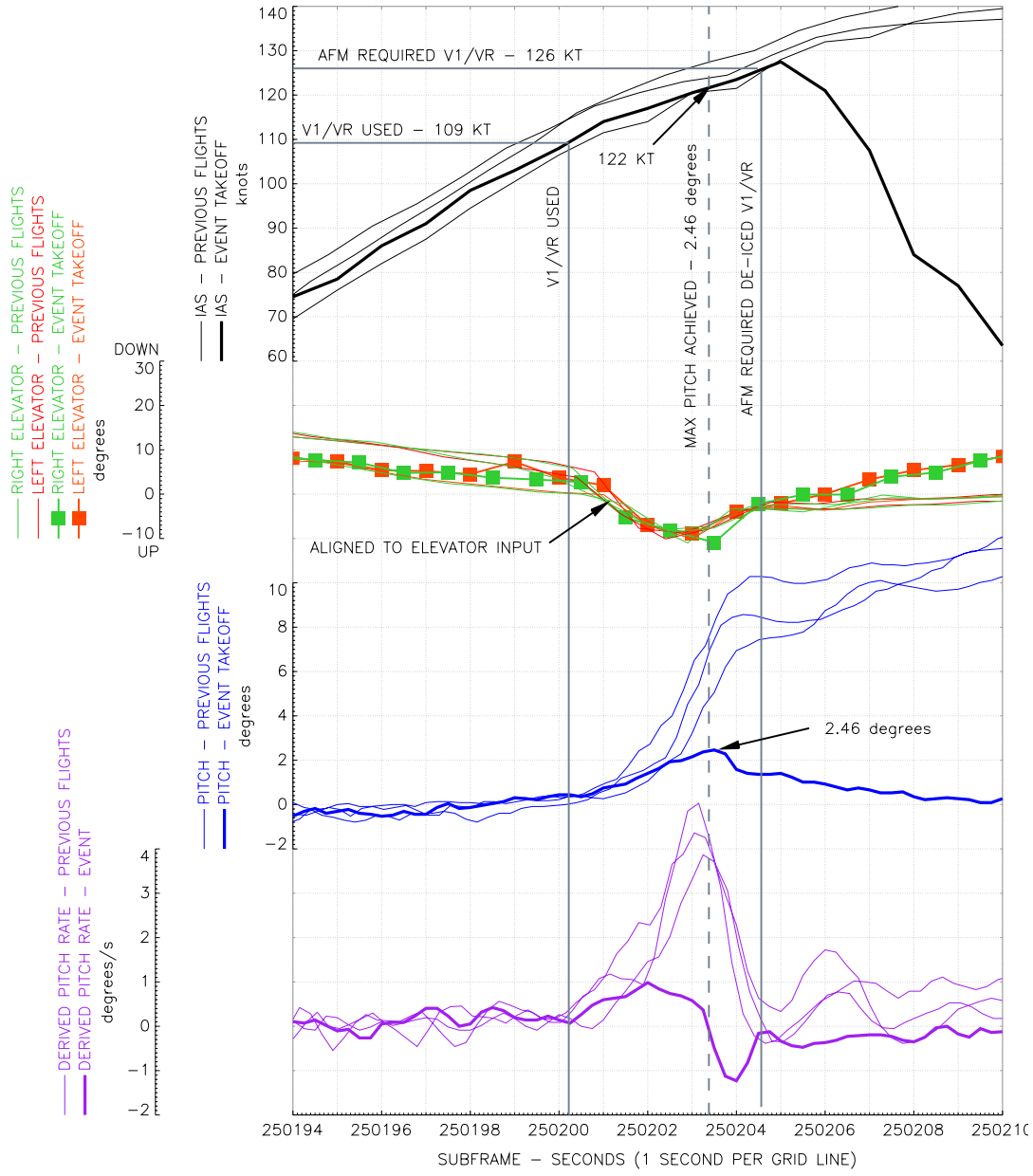


Figure 2

Comparison of Speed, Elevator Input, Pitch & Pitch Rate With 3 Other Flights

gravity, provided some evidence that little or no fluid had been applied to the leading edge of the horizontal tailplane lower surfaces.

The aircraft was released to service after an inspection of the brakes and the elevator system. The elevator system was also inspected during base maintenance six weeks after the event. This inspection included checks for residue from de-icing/anti-icing fluids. Nothing significant was found.

Additional information

De-icing and anti-icing techniques

There are several sources of information regarding the de-icing and anti-icing of aircraft. Perhaps the most notable are the UK CAA's FODCOM[2] 30/05 'Winter Operations', JAR-OPS 1 published by the JAA and '*Recommendations for De-icing/Anti-icing of Aircraft on the Ground*' published by the Association of European Airlines (AEA). These all state the importance of removing deposits of ice, frost, snow or slush from aircraft; the need for adequate inspections before and after removal of deposits; and the need to comply with any type specific aircraft ground operations.

Only the AEA guidance document (revised September 2006 and available from the AEA website http://www.aea.be/AEA) gives clear advice to spray operators whether fluids should be applied from the leading edges or trailing edges of wings and horizontal tailplane surfaces. Within paragraph 3.9.2.4 it advises:

> *'Spray from the leading edge to the trailing edge. Start at the highest point of the surfaces and work to the lowest parts. On vertical surfaces, start at the top and work down.'*

Footnote

[2] Flight Operations Department COMmunication.

There is also a pilot's guide to ground de-icing produced by the USA's NASA GRC Icing Branch. Aircraft icing on-line courses and resources are available on the Internet using the link http://aircrafticing.grc.nasa.gov/index.html. The on-line pilot's guide to ground de-icing contains a module entitled *'Supervise the Application'*. Within this module advice is given to pilots that:

> *'Whether you start at the wing tip or root, sweep from leading to trailing edge'.*

For the horizontal stabiliser it states:

> *'Sweep from leading to trailing edge. Make sure the anti-icing fluid forms a nominally uniform layer.'*

Analysis

The de-icing/anti-icing operation was undertaken by an experienced ground handler who had recently undertaken an annual refresher training course for winter operations. The commander monitored the process in accordance with his company procedures. The TOGM was calculated and the 'drop-line' trim sheet completed. The weights were loaded into the FMS and the trim set. Until this point the procedures followed by the flight crew were normal and correct.

Having determined the TOGM of 12,396 kg, the flight crew correctly took the next highest weight in the takeoff speed data charts of 12,500 kg. The weather at the time did not fall within the definition of icing conditions. However, the pilots were, not aware that they should use the 'Takeoff in icing conditions' scheduled charts instead of the 'normal' takeoff charts when the aircraft had been de/anti-iced with thickened fluid. For this reason, the incorrect V_1/V_R speeds were calculated. There was, therefore, a discrepancy of 19 kt between the normal speed of 109 kt and the 'icing conditions' speed of 128 kt.

The FDR data showed that the aircraft was rotated significantly before the AFM stated rotation speed for the given weight and conditions. A comparison with previous flights indicates that the effect of the given elevator input did not result in the normal aircraft pitch behaviour. The comparison flights did not match the event flight with regards to the speed at which the elevator input was initiated so a comparison of elevator effectiveness at a given speed cannot be made from this limited data.

The crew actions to abandon the takeoff occurred within three seconds of the pitch rate reducing.

Aerodynamic contamination due to ice or de-icing/anti-icing fluids

The dominant force for rotating the aircraft is produced by the tailplane and elevator. In the absence of any robust physical evidence or any appropriate flight test data, it would seem that some form of contamination of the leading edge of the lower surface of the horizontal tailplane, either by ice or by de-icing/anti-icing fluid, was the most likely reason for the lack of rotation.

Configuration warning

The cause of the CONFIG warning as the commander advanced the power levers was not identified. There had been problems previously with a spurious BRAKE warning as the power levers were advanced activating the CONFIG warning. The action of retarding the power levers to the aft limit of their travel caused the ground spoilers, which were armed, to deploy. When the power levers were advanced to continue the takeoff, the ground spoilers stowed. Consequently, the activity of the spoilers was not the cause of the CONFIG warning.

Conclusion

The probable cause of the incident was the incorrect V_1/V_R speed selected. Had the correct V_1/V_R speed been selected then the effects of any contamination of the horizontal stabiliser and elevator undersurfaces with thickened fluid would probably have been negated by the increased airflow and fluid run-off. Had the contamination been untreated frost, it is possible that the aircraft may not have rotated normally, even at the higher rotation speed.

Contamination must have been present because the aircraft would not rotate at the 'normal' rotation speed for its configuration and load but it was not possible to determine whether the contaminant was ice or thickened fluid. However, the de-icing/anti-icing fluid streak marks on the lower surface of the horizontal tailplane surfaces suggested that little or no fluid had been applied to the leading edge of the horizontal tailplane lower surfaces. This may have occurred because the fluid was sprayed from the trailing edge towards the leading edge instead of the recommended method of spraying from the leading edge towards the trailing edge.

Safety action taken

Following the incident, the operator issued a 'Notice to Aircrew' to all pilots on the Dornier 328 fleet. Attached was the relevant extract from the AFM. The brief summary was:

> *'If the aeroplane was treated with de/anti-icing fluids, irrespective of ambient conditions or temperatures and even if non-icing conditions exist: V1, Vr, V2 and Vsec with horn heat on and related takeoff performance for icing conditions MUST be used'.*[3]

Footnote

[3] Vsec = speed for single-engined-climb.

Safety Recommendations

Both pilots had completed type rating and line training. They were provided with an easy reference chart listing the appropriate takeoff speeds but they could not recall the need to use icing speeds in non-icing conditions following the application of thickened fluids. Therefore, it was recommended that:

Safety Recommendation 2006-072

The Joint Aviation Authorities should contact all Dornier 328 Type Rating Training Organisations within JAA member States and emphasise the need to train pilots to use icing speeds following de-icing/anti-icing with thickened fluids, even when in non-icing conditions.

Safety Recommendation 2006-073

EuroManx should provide annual pre-winter flying awareness refresher training and information to all its flight crews. This refresher training should emphasise the need to use the correct icing speeds even in non-icing conditions.

INCIDENT

Aircraft Type and Registration:	Dornier 328-110, D-CPRW
No & Type of Engines:	2 Pratt & Whitney PW 119B turboprop engines
Year of Manufacture:	1998
Date & Time (UTC):	18 January 2006 at 1255 hrs
Location:	On approach to Runway 24R at Manchester Airport
Type of Flight:	Public Transport (Passenger)
Persons on Board:	Crew - 3 Passengers - 17
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	46 years
Commander's Flying Experience:	4,600 hours (of which 400 were on type) Last 90 days - 148 hours Last 28 days - 51 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft failed to capture the glideslope during an ILS approach in IMC conditions to Runway 24R at Manchester Airport. The operating crew did not monitor the flight path of the aircraft and were only alerted that they had descended (with a high vertical speed) dangerously close to the ground some 5.5 nm from touchdown, by a "GLIDESLOPE" aural alert triggered by the EGPWS. The commander disconnected the autopilot and performed a go-around. ATC provided radar vectors to re-position the aircraft for another ILS approach, following which the aircraft landed without further incident.

History of the flight

The crew reported at 0600 hrs for a four sector day starting at the Isle of Man (Ronaldsway) Airport. Their third sector was from Ronaldsway to Manchester International Airport; the commander was the Pilot Not Flying (PNF) and the co-pilot was the Pilot Flying (PF).

The aircraft was in IMC and being radar vectored by Manchester ATC for an ILS approach. The flight had proceeded uneventfully until it was downwind for Runway 24R. At this point, the crew were advised by ATC that they were 16 miles from touchdown. After acknowledging this, there was a moment of confusion when the co-pilot saw that the DME was only indicating 11.4 nm. This was clarified by the commander who pointed out that ATC had given track miles to fly and

that the DME, which is co-located with the ILS, was reading direct mileage to the runway threshold.

ATC then instructed the crew to turn right, onto a base leg heading of 155º(M), and to descend from 4,000 ft QNH to 3,000 ft QNH. They were advised at this point that their range was 14 miles from touch down. 30 seconds later, they were instructed to "TURN RIGHT HEADING 210º(M)" and to "REPORT LOCALISER ESTABLISHED 24 RIGHT"; subsequently they were told to fly a speed of 160 kt until 4 DME. 25 seconds later, they were instructed to "DESCEND TO 2,000 FT AMSL AND FURTHER DESCENT ON THE ILS." This was acknowledged by the PNF. One minute later, the commander informed ATC that they were established on the localiser; this prompted ATC instruct them to change to the Tower frequency. At this point they were 8.5 nm from touchdown. After establishing radio contact with the tower controller, the crew were instructed to continue the approach to Runway 24R and asked to report at 4 DME. Whilst they were concentrating on configuring the aircraft for landing and trying to reduce the aircraft's IAS to 160 kt, the Mode 5[1] "GLIDESLOPE" EGPWS[2] alert sounded. The commander took control of the aircraft, disconnected the auto-pilot and initiated a go-around; the co-pilot advised ATC. The tower controller asked them if they had a problem, to which the co pilot responded "YEAH, WE HAD THE AUTOPILOT KICK OUT AND WE HAD A PROBLEM WITH THE ILS." The crew were then instructed to fly the standard missed approach procedure and to contact the ATC Director. D-CPRW had descended to within approximately 450 ft of the ground. ATC subsequently radar vectored the aircraft for a second ILS approach to Runway 24R; this ILS and landing were flown without further incident.

After shutdown, the commander was asked to telephone the ATC Duty Watch Manager, who asked him the nature of the problem. The commander told him that they had experienced difficulty with capturing the ILS and later stated that the autopilot would not capture the glideslope on the approach to the airfield. Consequently, he raised a defect report in the aircraft's technical log. The Duty Watch Manager informed him that he would be submitting a Serious Incident report; the commander said that he would be reporting the incident upon his return to the Isle of Man. At 1340 hrs, D-CPRW pushed back at Manchester and flew back to the Isle of Man. The ATC Watch Manager then reported the incident to the AAIB.

Meteorological information

The weather situation at 1200 hrs on 18 January 2006 showed a broad warm sector covering much of the British Isles including the Manchester area. The ATIS at 1255 hrs indicated that the visibility was 2,800 m in mist, with a broken layer of cloud at 300 ft agl and a surface wind of 270º/10 kt.

Aircraft examination

An integrated maintenance terminal system diagnostic test, and a functional test of the aircraft's autopilot and navigational systems, was undertaken by the company's maintenance provider and witnessed by the AAIB. These tests identified no faults or deficiencies in any of the aircraft systems. Also, ILS test equipment was used to establish if the system was capable of capturing the localiser, in addition to determining if the Vertical Speed (V/S) mode in the autopilot would disengage upon glideslope capture. A number of tests were run and both

Footnotes

[1] Relates to excessive glideslope deviation, landing gear down. See paragraph headed EGPWS, page 38.

[2] Enhanced Ground Proximity Warning System.

the localiser and glideslope captured on each occasion. The glideslope was then swept up and down, at different rates, with the glideslope armed and V/S selected. On each sweep, the glideslope was captured and the V/S disengaged.

A ground test of the Enhanced Ground Proximity Warning System (EGPWS) was undertaken in accordance with the procedure detailed in Avionics Mobile STC 1459-01. This unit provided information on many previous flights, the last 10 of which indicated that transient faults had occurred on flights 5, 6 and 7 and glideslope warnings had activated on flights 2 and 10. Consequently, the EGPWS unit was removed for the data to be downloaded under AAIB supervision. A functional test of the VHF navigational system was also carried out and found to be satisfactory.

In summary, the aircraft examination identified no faults in the autopilot or navigation systems that would have accounted for the aircraft not capturing the glideslope during the incident flight.

Operating crew's comments

The crew were interviewed the following day in the Isle of Man where the commander and the co-pilot both recalled the flight to Manchester with reasonable clarity. However, they both believed that they were cleared to descend from 3,500 ft to 3,000 ft as their final descent clearance from ATC before intercepting the ILS localiser, not to 2,000 ft from a starting altitude of 3,000 ft. While the co-pilot stated that he used the V/S mode to descend the aircraft, he was adamant that he only used approximately 500 fpm during the final approach.

He also stated that it was a "bone of contention" that the use of Standard Operating Procedures (SOPs) and checklists was not standardised within the company. While there was a checklist specifically for the Dornier 328, whenever he flew with the Fleet Captain (FC), for example, he was asked to use the FC's "significantly different" checklist; one that did not differentiate between PF and PNF, 'silent' checks or 'challenge and response' checks. The co-pilot had asked the FC "when was there going to be some form of standardisation across the fleet". He was told to expect something by 1 December 2005, but this date passed without a standardised checklist being issued or published. Consequently, the co-pilot was required to use one checklist when he flew with the FC, another when he flew with a freelance captain and yet another when he flew with the company's two other Dornier 328 captains. Consequently, basic procedures and 'calls' between flight crews were different on each flight. However, having spoken to co-pilots on different aircraft types operated by the company, he felt that this problem only related to the Dornier 328 fleet.

D-CPRW's flight crew, whilst acknowledging that this lack of standardisation might have been a contributory factor in this incident, stated that it was no justification for its occurrence.

ATC procedures

The Manual of Air Traffic Services (MATS) Part 2 states the following as the function of the ATC Director at Manchester Airport:

> *'2.4.1.3 Director*
>
> *1. Continued sequencing of inbound traffic from the point of handover from Approach North/South and positioning to final approach.*

2. Positioning of Woodford inbound flights to a position for transfer to Woodford ATC as necessary.

3. Coordination of inbound spacing requirements with Air Arrivals and liaison with Approach North and South. When Director is not being utilised, the telephones are to be position diverted to Approach South.

4. Assisting Approach South (and North) in the event of a total radar failure.

5. Radar monitoring of all aircraft approaches to Manchester (and Woodford if an aircraft is under the control of Manchester). If an aircraft is seen to deviate significantly from the anticipated approach profile, the appropriate action must be taken.'

Air traffic control officers' comments

Director's comments

The ATC Director at Manchester Airport was not aware of the incident with D-CPRW until the following day as, during the go-around, he was in the process of handing over his position to a colleague before ending his shift. He reported that, once an aircraft is established on the ILS Localiser, he plans for the aircraft to fly level for approximately one nautical mile before intercepting the glideslope. In this incident, he remembered the aircraft being cleared to 2,000 ft amsl, which is not an unusual situation, before becoming established on the localiser, when the crew were instructed to change to the Tower frequency. He added that, normally, he instructs aircraft to change to the Tower frequency when at a range of between 7 and 11 nautical miles.

The Director then started to handover his position to his colleague. While he did not notice any deviation in the aircraft's vertical profile, he thinks he recalled the aircraft drifting south of the extended centre line. Just before he left his position, he was advised by the Tower controller that the aircraft had performed a go-around, but thought this was as a result of it drifting to the south.

Once an aircraft has left the (Director's) frequency, the prime consideration is to vector the following aircraft in such a way to ensure that it has the required vertical and lateral spacing in relation to the preceding aircraft. While the Director stated that he is aware of what is contained in MATS Part 2, he felt, realistically, that it is only possible to monitor the lateral profile of an aircraft on final approach.

In this incident, aircraft were being vectored to achieve seven nautical mile spacing on final approach, due to the poor weather. This separation was at the request of the Tower controller, in order for him to manage departing and landing aircraft. The Director felt that, if aircraft were being positioned with only three nautical mile spacing, he would have little, if any, chance of monitoring aircraft once they have left his frequency. He added that if he did notice a deviation in an aircraft's vertical profile he would have difficulty contacting the Tower controller to advise him in a timely manner, due to the limitations of the current telephone system and his normal work load.

Tower controller's comments

At the time of the incident, the Tower controller was conducting single runway operations. After D-CPRW had made his initial call on the Tower frequency, the controller was waiting to see the aircraft descend below the cloud base. When visual contact had been made, he could then have issued a conditional clearance of …'clear to line up after the landing Dornier 328'… to the next departing aircraft. When the crew reported

that the aircraft was going-around, he asked if they had a problem. At the time they were replying with "WE HAD THE AUTOPILOT KICK OUT AND WE HAD A PROBLEM WITH THE ILS.", he observed the aircraft on the Aerodrome Traffic Monitor[3] at 700 ft amsl, at a range of some 5.5 nm from the runway.

He informed the Duty Watch Manger of the incident but felt confident that the ILS was operating correctly, as he had dealt with inbound aircraft flying the ILS for some 30 minutes, without any problems being reported. Additionally, the aircraft following D-CPRW had just reported that they were successfully established on the ILS localiser. This aircraft was subsequently monitored by the Duty Watch Manager before engineers were instructed to check the serviceability of the ILS. No faults was found.

Company procedures

Standard Operating Procedures (SOPs)

The company's Operations Manual states, under *Aeroplane Operating Matters (Altimeter Setting and Checking)*, the procedure to be used upon receiving a clearance to climb or descend to a different altitude or FL, as follows:

> *'The PF initially sets the new altitude in the Altitude Pre-selector. He then states the new altitude/FL and adds "Set." Having cross checked the cleared altitude/FL in the pre-selector the PNF advises the PF of this by saying "Checked.".'*

Analysis of the CVR revealed that, throughout the flight to Manchester, the majority of altitude/FL clearances issued by ATC were not verbally announced by the PF to the PNF, as required by the SOPs, or cross checked by the PNF. On the one occasion the PNF did cross check an ATC altitude clearance it was not verbally announced by the PF.

Accident and incident reporting

The company's operations manual states that in the event of any emergency, accident or incident the Flight Operations Department is to be immediately informed by the aircraft commander.

Flight Recorders

General

The aircraft was equipped with a solid state 25 hour duration Flight Data Recorder (FDR) and a solid state two hour duration Cockpit Voice Recorder (CVR) The entire incident flight was recovered from both the FDR and CVR, and the CVR had also recorded the subsequent sector from Manchester to the Isle of Man. In addition to the flight recorders, the EGPWS computer was removed for downloading, which was successfully completed, with data from one hundred flight sectors being available. One entry related to the incident flight and this was used in conjunction with data from the FDR.

National Air Traffic Services provided secondary radar recordings based on Manchester radar and recordings of the radio transmissions from ATC and D-CPRW.

Recorded Data

The aircraft took off at 1220 hrs, the takeoff and subsequent climb to FL110 being uneventful. The aircraft remained at FL110 until 1234 hrs when it started to descend, initially to FL60, during which time the flaps were extended to 11°. FL 040 was attained at 1241 hrs.

Footnote

[3] A radar display at the Tower controller's position that utilises a feed from aerodrome based Watchman radar.

Figure 1 is a plot of the salient parameters of the initial approach and go-around. At 1251 hrs, the aircraft was approximately 12.5 DME track miles from the runway and on a magnetic heading of 090º; the autopilot was engaged with the lateral mode in Heading Select, and the pitch mode in Altitude Hold. About that time, ATC instructed the crew to make their heading 155º and to descend to 3,000 ft; this was subsequently followed by a heading change instruction to 210º. The crew acknowledged both heading changes and the altitude change, and the aircraft started to make a right turn and descend. During the descent, the autopilot pitch mode initially changed to FLC CAS[4], followed about 20 seconds later by a change to the V/S mode; the rate of descent increased to about 1,500 fpm. As the aircraft descended the crew said that the "NAV IS ARMED"[5]. As the aircraft approached 3,200 ft QNH, the autopilot pitch mode changed to Altitude Selected. Capture followed, 14 seconds later, by a change to Altitude Hold. The aircraft levelled off at 3,000 ft QNH, by which time it had completed its right turn and was on a magnetic heading of 209º. About that time, ATC advised the crew to maintain 160 kt to 4 DME.

When approximately 10 DME from the runway (Figure 1, Point A), ATC cleared the aircraft to descend to 2,000 ft for the ILS, which the PNF acknowledged. The autopilot Pitch mode then changed to V/S, the aircraft started to descend at about 1,500 fpm and, a short time later, the Altitude Alert 'chime' sounded[6] as the aircraft descended through 2,700 ft QNH. There was no apparent response from the operating crew.

The localiser deviation slowly reduced and, when it was at about 2 'dots', the autopilot mode changed to NAV LOC capture 1, which was quickly followed by NAV LOC capture 2. The localiser deviation continued to reduce and, as the aircraft crossed the localiser beam centreline, the lateral mode changed to APP LOC capture 2 and the aircraft started to make a left turn onto the localiser. At that time, the aircraft was 2.2 'dots' below the glideslope and at an altitude of about 2,350 feet (Figure 1, Point B). The commander advised ATC that they were established on the localiser and the crew were then passed to the tower frequency.

When the aircraft was at about 1,600 ft QNH, the glideslope deviation had increased to 3.5 'dots' (Figure 1, Point C) and this remained at 3.5 'dots' as the aircraft descended. Coincidentally, the autopilot lateral mode changed to APP LOC Track 1[7], followed almost immediately by APP LOC Track 2[8] and the aircraft stabilised on a magnetic heading of about 240º. Throughout this period, neither of the crew had referred to the aircraft's altitude or glideslope capture status.

When at 6 DME, the aircraft was at about 890 ft QNH (600 ft agl), the flaps were extended to 20º and, a short time later, the landing gear was extended. As the gear was lowered, the commander said "WHY HASN'T THAT…..UM", but his comment was without reference. As the landing gear locked down, an EGPWS "GLIDESLOPE" alert then occurred, (Figure 1, Point D). Almost immediately, the commander said "GLIDESLOPE…PULL-UP" and, after a delay

Footnotes

[4] FLC CAS – Flight Level Change and airspeed, both managed by the autopilot.

[5] The FDR did not record the switch positions on the autopilot guidance control panel.

[6] The Altitude Alert is triggered when the aircraft climbs or descends through 300 ft from the altitude in the Altitude Pre-selector.

Footnotes

[7] The autopilot Track 1 mode is designed for beam tracking when the aircraft is still a substantial distance from the airport. In this mode the autopilot is trying to establish the aircraft on the beam centre, when the beam may be unstable.

The autopilot Track 2 mode is designed for tight beam tracking. The mode is configured for a stable beam to allow the autopilot to tightly track any beam deviations and control the aircraft to meet CAT2 requirements.

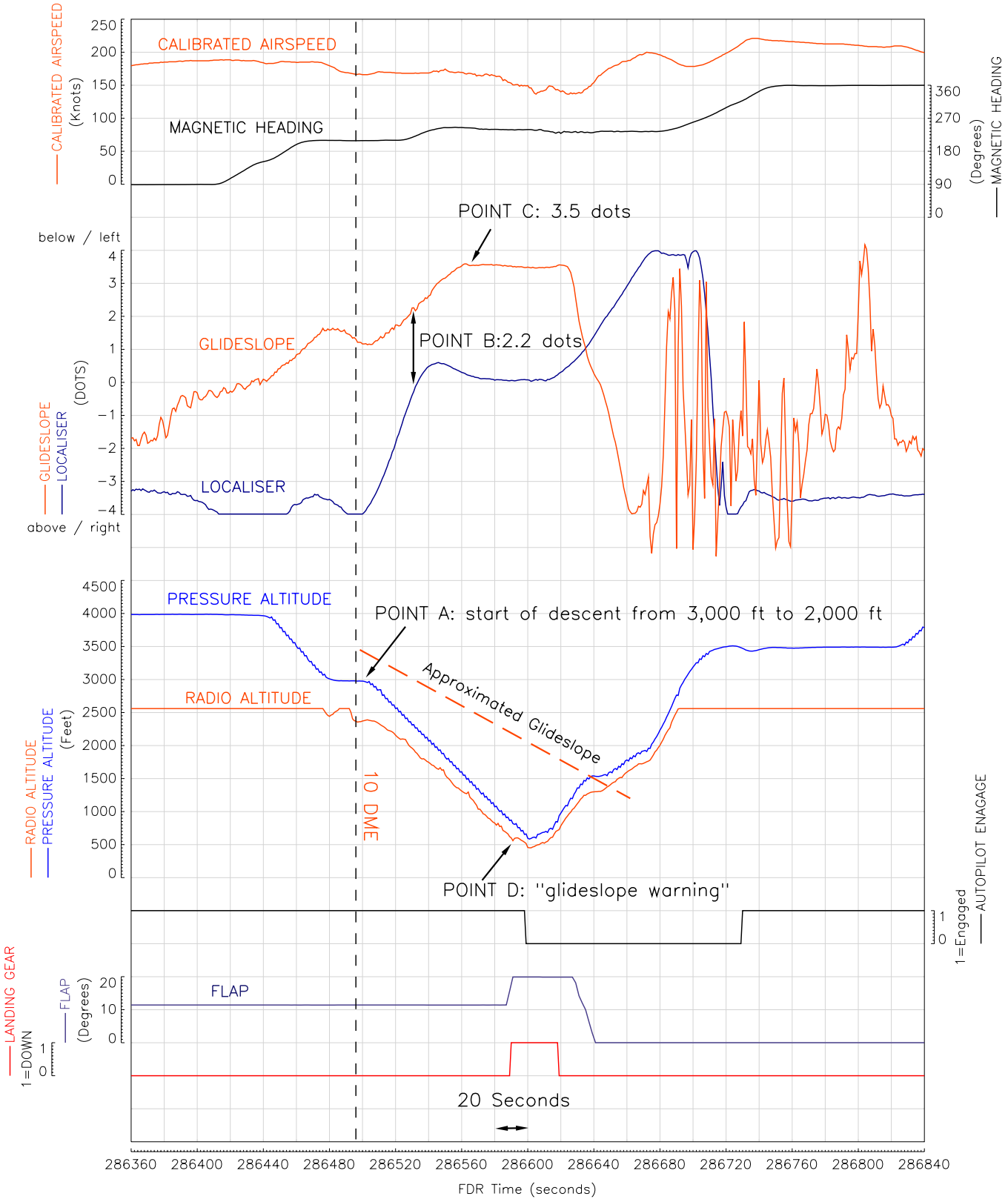


Figure 1

Salient FDR Parameters

of about six seconds, the autopilot was disconnected, the aircraft pitched up and started to climb. The aircraft had descended in IMC to about 450 ft above the ground. The commander subsequently advised ATC that they were going around due to an autopilot and ILS problem.

As the aircraft climbed both the landing gear and flaps were retracted and the crew carried out the missed approach procedure. The aircraft was flown manually to 3,500 ft QNH before the autopilot was engaged. The aircraft subsequently climbed to 4,000 ft QNH, under the instruction of ATC, and repositioned for a second approach.

The second approach and landing were uneventful. Both the localiser and glideslope were captured at 4,000 ft QNH and the aircraft then descended, tracking the ILS. The autopilot was disconnected at 250 ft agl and a manual landing was performed. The aircraft taxied from the runway to a stand where, at 1317 hrs, the engines were shutdown.

Autopilot Glideslope Capture

The aircraft was equipped with a Honeywell Primus® 2000 automatic dual flight control system that provided full three-axis control. To enable the capture of the ILS for a precision approach, the Approach mode is selected by the crew; the system then initially attempts to 'capture' the localiser beam. When this occurs, the system then computes when to initiate a glideslope capture manoeuvre. However, this manoeuvre is not triggered if the aircraft is greater than two 'dots' deviation from the glideslope and/or is diverging from the glideslope beam.

Enhanced Ground Proximity Warning System (EGPWS)

The aircraft was also equipped with a Honeywell MK-VI EGPWS. This provided a number of warning modes, one of which was Mode 5, and this provides two levels of alert whenever an ILS frequency is tuned and the aircraft descends below the glideslope with the landing gear down, see Figure 2. The first level alert occurs if the aircraft is below 1,000 feet radio altitude (RA) and the aircraft is 1.3 'dots' or greater below the glideslope. Alert lights in the flight deck illuminate and a 'soft' audio alert is generated; termed 'soft' because the audio message "GLIDESLOPE**"** is annunciated at half volume when compared to the second level of alert volume. A 20% increase in the glideslope deviation causes additional "GLIDESLOPE" messages to be aurally annunciated.

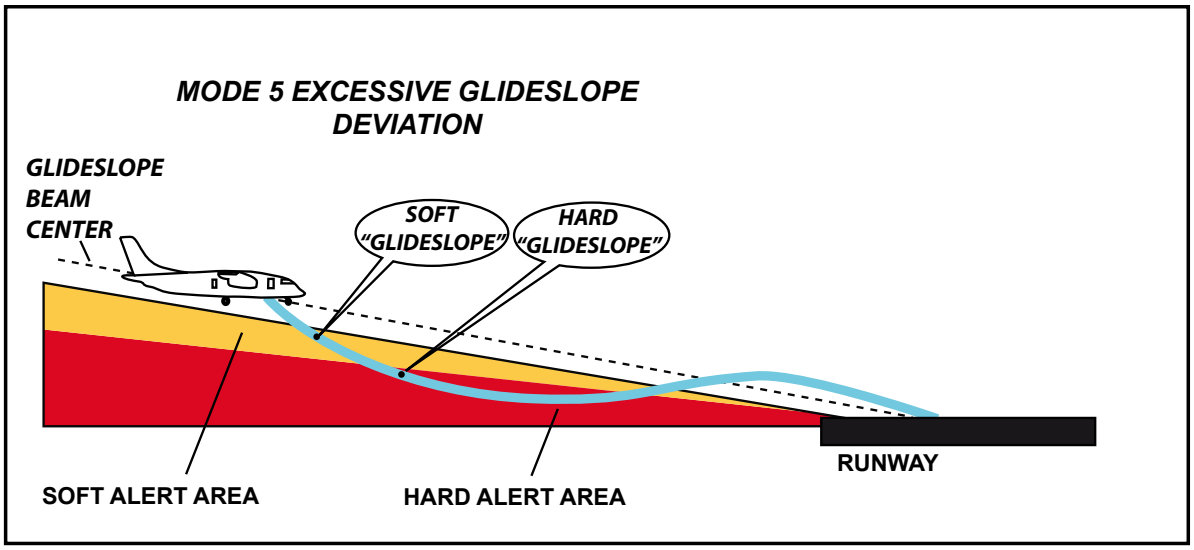
The second level alert occurs if the aircraft is below 300 ft RA, with 2 'dots' or greater glideslope deviation. This is called a 'hard' alert as a louder "GLIDESLOPE, GLIDESLOPE" message is aurally annnunciated every four seconds until the 'hard' envelope is exited. The alert lights remain on until a glideslope deviation of less than 1.3 'dots' is achieved.

To avoid unwanted alerts when capturing the localizer between 500 ft and 1,000 feet agl, 'below glideslope' alerts are only enabled if;

- the localizer is within ± 2 dots, if available
- the landing gear and flaps have been selected
- the glideslope Cancel is not active
- a front course approach has been determined

The upper altitude limit for the alert is modulated with vertical speed. For descent rates above 500 fpm the upper limit is set to the normal 1,000 feet agl; for descent rates lower than 500 fpm, the upper limit is desensitized (reduced) to a minimum of 500 ft agl.

Data from the preceding 100 flights was downloaded from the EGPWS. Of these flights, there were ten



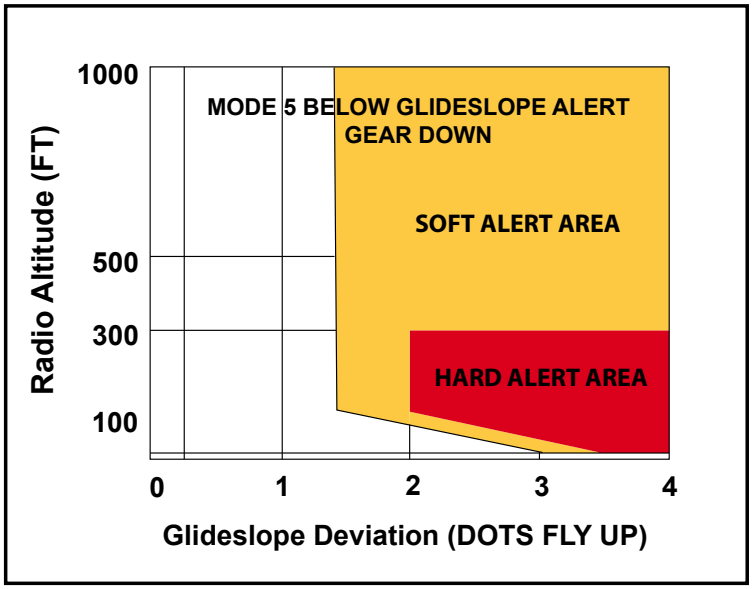


Figure 2

EGPWS Mode 5 hard and soft alert areas

EGPWS events that would have triggered alerts, of which nine were Mode 5 warnings of a similar nature to this incident. One was a Mode 1 "SINK RATE, SINK RATE, PULL UP" warning. The full circumstances surrounding these events is not known, as they had not been reported or investigated. The operating company reported that they had received no reports of EGPWS alerts (real or spurious) from their Dornier 328 crews, either by Air Safety Reports or a Mandatory Occurrence Report.

Autopilot capture/descent

When the aircraft was cleared by ATC from 3,000 ft to 2,000 ft the aircraft descent was performed by the autopilot in vertical speed (V/S) mode, with a selected

descent rate of about 1,500 fpm. As the aircraft descended through 2,350 ft QNH, the autopilot captured the localiser; the aircraft was 2.2 'dots' below the glideslope at that time. As a result of the high descent rate, the aircraft diverged further below the glideslope and, as the deviation was not within the required 2 'dots' and the aircraft was effectively flying away from the beam, the autopilot system was not able to capture it. As the aircraft continued to descend, the glideslope deviation increased to about 3.5 'dots' at 1,600 ft QNH, but the crew did not discuss the glideslope capture status or the fact that they were now below their cleared altitude of 2,000 ft and descending rapidly.

Once the aircraft descended through 1,000 ft RA, the aircraft would have entered the EGPWS Mode 5 first level alert area. When it was at about 600 ft RA, the landing gear was lowered and, almost immediately, the EGPWS generated a soft "GLIDESLOPE" warning, which was heard by the commander. The aircraft continued to descend for a further six seconds before the autopilot was disconnected and a missed approach carried out.

Additional information

The crew of D-CPRW were using current Jeppesen approach charts. The relevant approach chart for Runway 24R, Figure 3, shows the Final Approach Fix at 10 DME, based on the ILS, at an altitude of 3,500 ft amsl; the runway elevation is 249 ft.

Aeronautical Information Circulars

Aeronautical Information Circulars (AIC) published by the CAA are notices containing information that does not qualify for the origination of a NOTAM or for inclusion in the AIP. As a general rule, AICs refer to subjects that are of an administrative rather than an operational nature. They are, however, also used to publish advanced warnings of impending operational changes and to add explanation or emphasis on matters of safety or operational significance. Aeronautical chart issues and corrections are also notified through the medium of the AIC.

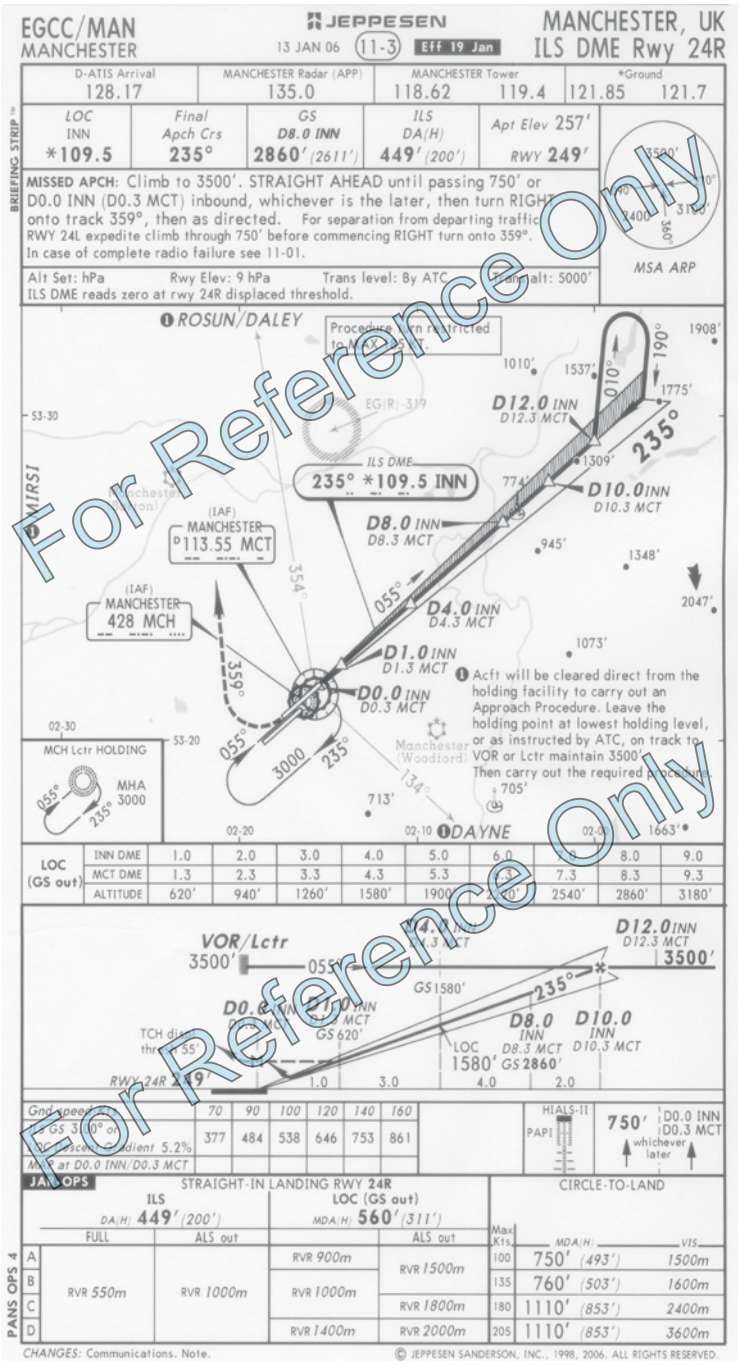


Figure 3

An extract from AIC 111/2004 (Pink 74), *Controlled Flight Into Terrain (CFIT) - Risk Avoidance*, is shown below:

> ***'10. Ground Proximity Warning Systems (GPWS) and Minimum Safe Altitude Warning Systems (MSAWS)***
>
> *10.1 The relevance of GPWS and MSAWS needs to be clarified. Both systems have been designed to provide alerts and warnings (via the controller in the case of the latter) that the aircraft has infringed certain preset thresholds and that, if not corrected by the pilot, it may fly into terrain.* ***Neither system is a substitute for crews so planning and executing their flight that the need for GPWS or MSAWS never arises.*** *Despite continuous improvements being made to them, and the undoubted safety benefit each can provide, neither system can be relied upon absolutely.*
>
> ***10.2 There is not, and there never will be, any better 'CFIT Avoidance' system than pilots and other flight crew members who by their pre-flight preparations and in-flight actions ensure that all relevant preventive measures to avoid CFIT are applied conscientiously on every occasion.'***

Other incidents

The AAIB reported on a similar incident at Stansted Airport in Bulletin 7/2005 (N523MC, EWC2004/12/03). In this incident the Approach controller failed to notice the aircraft flying significantly below the glideslope. The AAIB is currently investigating three other incidents of aircraft deviating significantly below the approach path. On these three occasions the controllers noticed the deviations and took the appropriate action.

Presently there is no MSAWS, or equivalent system, installed at any airport in the UK where the National Air Traffic Service (NATS) provides the ATC service. NATS were approached to see if they are considering the installation of any system which would aid an approach controller to identify when an aircraft deviates significantly below the correct approach path. Their response is shown below:

> *'NATS are currently investigating various technology solutions to determine if it is possible to provide air traffic controllers with appropriate alerts if an aircraft deviates significantly below the approach path. A key element of this investigative activity is ensuring that any alert is provided to the relevant controller (i.e. the controller on frequency) in sufficient time for the controller to assimilate the information and issue appropriate instructions to the aircraft.'*

Analysis

Tests carried out on the aircraft failed to identify any faults in the ILS/autopilot /EGPWS systems that could be considered as causal or contributory factors in this incident.

The aircraft came to within 450 ft of the ground, whilst in IMC some 5.5 nm from the runway. In the absence of any identifiable technical problem with the aircraft, it was considered that this resulted from the flight crew not performing adequate 'cross cockpit' monitoring, not applying Cockpit Resource Management (CRM) techniques and poor use of SOPs throughout the flight. Whilst the crew noticed, initially, that they were below the glideslope, the aircraft continued with an excessive rate of descent and the range from touchdown was not checked against the associated heights on the approach plate. The crew subsequently became distracted while

configuring the aircraft for landing and trying to reduce their IAS. When data from the CVR and the radar recording were synchronised, it was apparent that the aircraft was descending through 2,700 ft QNH as the Altitude Alert chime sounded. This indicated that 3,000 ft was set in the Altitude Pre-selector window at that time, as opposed to the cleared altitude of 2,000 ft. Both the crew members reported that they did not recall receiving the clearance to descend from 3,000 ft to 2,000 ft given by the approach controller, and believed that their final descent clearance from ATC before intercepting the localiser was from 3,500 ft to 3,000 ft. However, as the PNF actually acknowledged the clearance to 2,000 ft, he must have done so by some form of 'reflex action' but did not change the Altitude Pre-selector from 3,000 ft to 2,000 ft. As a result, and the use of the V/S mode to descend, the aircraft may have continued into the ground had the crew not been alerted to the situation by the EGPWS.

The company's Operations Manual required that an incident such as this should have been reported immediately to the company. As a result, the aircraft flew another (35 minute) sector before it was impounded for the investigation. Fortunately, a two hour duration CVR was fitted to the aircraft and the recording of the incident flight was preserved. Should a 30 minute duration CVR have been installed, or the subsequent sector have been longer, the recording would have been over-written, resulting in the loss of data essential to the investigation. Whilst it would have been possible to confirm the clearance given by ATC to descend from 3,000 ft to 2,000 ft from recordings of the ATC frequency, it would not have been possible to identify the Altitude Alert which sounded in the cockpit at around 2,700 ft. This would have raised the possibility that some unidentified system error might have occurred.

Safety Recommendations

Although the aircraft was registered in Germany, it was operating under an AOC for an Austrian based company, EuroManx Airlines GmbH. In view of the findings of this investigation in relation to the operation of the aircraft, the following safety recommendation is made:

Safety Recommendation 2006-086

It is recommended that the Austrian aviation authority, AustroControl, review the flight crew training and operational procedures of EuroManx Airlines GmbH, with the intent of ensuring that the operation of their aircraft is conducted in accordance with approved procedures.

Conclusion

The crew were nearing the end of an uneventful flight in a serviceable aircraft. Due to a failure to operate the aircraft in accordance with SOPs, the safety of the aircraft was seriously compromised. A possible Controlled Flight into Terrain (CFIT) accident was only avoided by the crew taking appropriate action upon being alerted by the EGPWS.

ACCIDENT

Aircraft Type and Registration:	Cessna 152, G-BNDO
No & type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1987
Date & Time (UTC):	11 July 2006 at 1630 hrs
Location:	Wick Farm, Layer Marney, Essex
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Left wing buckled, nose landing gear bent backwards, structure dented, engine shock loaded, alternator belt broken
Commander's Licence:	Private Pilot's Licence
Commander's Age:	53 years
Commander's Flying Experience:	200 hours (of which 190 were on type) Last 90 days - 3 hours Last 28 days - 0.5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and AAIB inquiries

Synopsis

The pilot, believing that he had an electrical fire, undertook a precautionary landing. During the ground run the nose wheel hit a rut causing the aircraft to turn over on to its back. Both the pilot and passenger were uninjured. An engineering investigation found that the alternator drive belt had failed.

History of the flight

The pilot carried out the pre-flight check during which he confirmed that there was sufficient oil in the engine and then departed from his home airfield at Andrewsfield on a local cross country flight. After flying for approximately 35 minutes at a height of 1,800 ft the pilot noticed blue smoke coming out of the forward section of both sides of the engine cowling. At the same time the pilot became aware of a strong smell of 'electrical burning' and reported hearing a change in the engine noise similar to when the magneto checks are carried out. He checked the engine indications, which appeared normal, and noticed that the low voltage warning light was glowing very brightly.

The pilot, believing that he had an electrical fire, decided to make an immediate landing in a large field of wheat directly ahead of the aircraft. As he closed the throttle to idle the smoke appeared to stop; nevertheless, he

made a Mayday call to Andrewsfield Radio on 130.55 Mhz and continued with the precautionary landing. The pilot states that he consulted the emergency checklist for 'fire in flight', but elected to leave the electrical Master Switch ON so that he could operate the flaps and radio. The aircraft was established on a stable approach, with a 5 kt tail wind, and once full flaps were selected, the pilot stated that he turned off the Master Switch and subsequently held the aircraft in the flare until the mainwheels touched down at approximately 50 kt. However, as the nose was lowered the aircraft appeared to come to an abrupt halt and turned over on to its back. The engine stopped as the propeller struck the ground and the pilot exited the aircraft through his door and then assisted the passenger to vacate the aircraft. Shortly afterwards two farmers and the Police and Air Ambulance helicopters arrived to offer assistance. Both the pilot and passenger were unhurt.

Damage to aircraft

The nose landing gear leg was bent back against the fuselage; the fin, rudder and wings were buckled and distorted; the windscreen was cracked; one blade on the propeller was bent; the engine was shock loaded, the casing on the alternator had suffered impact damage and the drive belt had failed. There was no evidence of a fire having occurred.

Comment

From photographs of the accident site and comments from an engineer who inspected the aircraft it was established that the aircraft touched down on all three wheels in a level attitude. The engineer stated that there was a large rut across the field approximately 12 m after the touch down point, which he believes caused the nose landing gear to collapse and the aircraft to turn over. The flaps were found in the retracted position.

Another battery was fitted to the aircraft and its electrical systems were operated for 15 minutes and found to operate normally with no evidence of any electrical burning smells. The engine oil level was found to be satisfactory with no indication of there having been either an oil leak or spillage.

It is believed that the blue smoke and the illumination of the low voltage warning light were both caused when the alternator drive belt failed.

INCIDENT

Aircraft Type and Registration:	Cessna 152, G-BNKC
No & Type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1978
Date & Time (UTC):	7 May 2006 at 1115 hrs
Location:	Shobdon Aerodrome, Herefordshire
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Engine shock loaded
Commander's Licence:	Student pilot
Commander's Age:	36 years
Commander's Flying Experience:	20 hours (all on type) Last 90 days - Not known Last 28 days - Not known
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Whilst carrying out circuit training and touch-and-go landings the aircraft veered to the left of the runway and came to a halt after entering a field of oil seed rape.

History of the flight

The student pilot was carrying out solo circuits and touch-and-go landings. After completing a successful landing the pilot opened the throttle to take off again. As the engine power increased the aircraft started to veer to the left. Instead of applying right rudder to correct the left swing, the pilot accidentally applied left rudder. The aircraft continued to veer to the left and came to a halt after entering a field containing a crop of oil seed rape. The pilot's flying instructor observed the accident and agreed with the pilot's recollection of events.

ACCIDENT

Aircraft Type and Registration:	Europa, G-SHSH
No & type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	2002
Date & Time (UTC):	27 June 2006 at 1340 hrs
Location:	Kemble Airfield, Gloucestershire
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Propeller blades broken and minor damage to right wing tip
Commander's Licence:	Air Transport Pilot's Licence (including Single Engine Piston Flight Instructor's Rating)
Commander's Age:	43 years
Commander's Flying Experience:	5,738 hours (of which 1 was on type) Last 90 days - 52 hours Last 28 days - 6 hours
Information Source:	Aircraft Accident Reporting Form submitted by the pilot

Synopsis

Shortly after touchdown, the aircraft began to oscillate in pitch and yaw and the pilot was unable to correct these oscillations. The propeller struck the ground and the aircraft ground looped to the left. It was the pilot's first flight in a mono-wheel Europa.

History of the flight

The commander of the aircraft was conducting a biennial validation check on the second pilot during the flight. The second pilot was the aircraft owner and regularly flew this aircraft but the commander had no previous experience on this particular type. Runway 08, which had an asphalt surface, was used during the check flight. The surface wind was from 080° at 6 kt and the visibility was good with a high cloudbase.

With the validation check successfully completed, the commander took control and flew a normal circuit to Runway 08 from which he landed. On touchdown the aircraft bounced slightly; however, once established on the ground it began to oscillate in pitch and yaw. The commander was unable to correct these oscillations which became divergent, culminating in the propeller striking the ground. This caused a rapid yaw to the left leading to the aircraft's right wing tip scraping the ground and the aircraft stopping on the runway

approximately 90° off the runway heading. Both pilots, who were wearing 4-point harnesses, were uninjured and were able to evacuate the aircraft through the normal exits.

The commander attributed the accident to his lack of experience on this type of aircraft. Although he had previous tail wheel aircraft experience, the Europa's landing gear, comprising a single main wheel, a tail wheel and wing outriggers, has some unique handling characteristics. There have been nine groundloop occurrences reported to the AAIB since 2000 of which the majority have occurred to pilots with less than 20 hours on type when landing on asphalt or concrete runways. Recent articles in the Europa Club magazine and advice from the PFA emphasise existing guidance that where possible, pilots gain experience using grass strips before progressing to hard runway surfaces. Grass is more tolerant to drift during landing and makes directional control easier during the rollout.

ACCIDENT

Aircraft Type and Registration:	Jabiru UL-450, G-CCAE
No & type of Engines:	1 Jabiru 2200A piston engine
Year of Manufacture:	2003
Date & Time (UTC):	13 July 2006 at 1715 hrs
Location:	Croft Farm, Defford, Worcestershire
Type of Flight:	Private
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Propeller damaged, nosewheel suspension bent
Commander's Licence:	Private Pilot's Licence
Commander's Age:	52 years
Commander's Flying Experience:	358 hours (of which 26 were on type) Last 90 days - 8 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

During an extended ground roll and whilst under heavy braking, the nosewheel entered a depression in the runway. The combination of loads on the nose landing gear distorted the suspension strut, allowing the propeller to hit the ground.

History of the flight

The pilot reported that aircraft had landed normally and was completing an extended ground roll into an area of runway not normally used. Whilst under heavy braking, the nosewheel entered a depression in the runway, causing the aircraft to nod forward and the propeller to strike the ground. The combination of loads was sufficient to distort the spring suspension strut at the rear of the nose landing gear leg and its attachment bracket to the leg. The nose landing gear of the Jabiru consists of a trailing fork, which supports the wheel, attached to a fixed leg. Suspension is provided by a spring strut located between the fork and a bracket welded to the rear face of the fixed leg. The combination of the distortion to the spring strut and bracket, which allowed the nosewheel to rise further than normal, the dip in the ground and tyre deflection, resulted in the loss of propeller tip clearance with the ground.

ACCIDENT

Aircraft Type and Registration:	Luscombe Silvaire 8E, G-BVMD
No & type of Engines:	1 Continental Motors C90-14F piston engine
Year of Manufacture:	1947
Date & Time (UTC):	28 July 2006 at 1705 hrs
Location:	Great Massingham Airfield, Norfolk
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Left wing tip and propeller bent, left landing gear torn off and associated fuselage damage
Commander's Licence:	Private Pilot's Licence
Commander's Age:	40 years
Commander's Flying Experience:	155 hours (of which 11 were on type) Last 90 days - 6 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

After misreading the windsock at Great Massingham Airfield, the pilot landed downwind. During the subsequent ground roll, despite the application of corrective rudder, the aircraft veered to the left. The pilot applied heavy right wheel braking which, together with the aircraft's higher groundspeed from the downwind landing, resulted in a ground loop, causing the left landing gear to collapse.

History of the flight

Approaching Great Massingham Airfield from the south, the pilot saw that the windsock was exactly aligned with Runway 04/22 and believed that it indicated the wind was from 220º; the wind on the day was recorded as 280º, variable to 040º at 6 kt and, at the time of the accident, was probably blowing from 040º. The pilot joined the 'downwind' leg for a landing on Runway 22 and, although the approach and initial touchdown were normal, the aircraft's groundspeed appeared faster than expected. During the later stages of the ground roll, at approximately 25 mph, the aircraft veered to the left. The pilot found he could not correct this by using the rudder and attempted to straighten the aircraft by applying right wheel braking. The aircraft ground looped to the right, during which the left landing gear collapsed, resulting in damage to the left wing and propeller. Both occupants were uninjured and vacated the aircraft unassisted.

The pilot attributed the accident to landing downwind, which gave a higher than normal groundspeed, and overcompensating when applying the right wheel brake.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28-180 Cherokee, G-AZYF
No & type of Engines:	1 Lycoming O-360-A4A piston engine
Year of Manufacture:	1968
Date & Time (UTC):	3 July 2006 at 1041 hrs
Location:	Scilly Isles (St Mary's) Airport
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Nose leg, nose wheel fairing and propeller, engine shock-loaded
Commander's Licence:	Private Pilot's Licence
Commander's Age:	66 years
Commander's Flying Experience:	350 hours (of which 197 were on type) Last 90 days - 10 hours Last 28 days - 7 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

After landing on the grass part of Runway 09 at Scilly Isles (St Mary's) Airport, the aircraft hit a small ridge or pot hole and became airborne again. Subsequently the aircraft landed on its nose wheel which then collapsed. After the aircraft stopped the occupants vacated uninjured.

History of flight

The aircraft was flying from Land's End Airport to Scilly Isles (St Mary's) Airport. Runway 09 at St Mary's was in use; it is 523 m in length and its grass and asphalt surface was dry. The first 250 m of Runway 09 is grass followed by 273 m of asphalt. The first 100 m of Runway 09 rises at a 1:20 gradient (5%). The pilot reported that the weather was CAVOK, the wind was from 040º at 15 kt and it was "blustery".

The pilot stated that after an uneventful transit he positioned the aircraft downwind for Runway 09. At the end of the downwind leg ATC instructed him to fly one right hand orbit, so as to increase the separation between his aircraft and another making an approach to Runway 09.

After the orbit the pilot reversed the turn and rolled out on final approach. At this point he realised that he was

slightly south of the extended centreline and closer to the runway than he would have wished. The aircraft was by then also slightly high and fast but he felt "comfortable". At this time the pilot had extended two stages of flap, which is his normal landing configuration, but in an attempt to slow down and descend, he elected to deploy a third stage of flap.

Knowing that the runway was relatively short, the pilot wanted to ensure that he landed close to the threshold. He touched down approximately 5 kt fast, at 75 kt, and "a little heavy" close to the threshold. The aircraft rolled for approximately two seconds before it hit a small ridge or pot hole and then quickly became airborne again achieving a height of approximately 5 ft agl. The nose of the aircraft subsequently dropped quickly and the pilot was unable to raise it before the aircraft landed on its nosewheel. The nose leg collapsed and the propeller struck the ground. The pilot could not recall if the aircraft bounced more than once.

The ATCO in the control tower approximately 120 m away reported that the aircraft appeared to bounce "two or three times" to a height of approximately 10 ft agl. After the last bounce the aircraft was in a nose-low attitude before it landed. After landing the aircraft veered right and continued down Runway 18, which also has a grass surface, before coming to rest just off the edge of Runway 18. The pilot and his passenger vacated the aircraft uninjured.

Damage assessment

Inspection by the repair agency revealed damage to the nose leg, the nosewheel fairing, the propeller, the engine mount and the heater box. The engine had also been shock-loaded.

Discussion

As a result of the fresh crosswind the aircraft ended up south of the runway's extended centreline. The pilot reported, in hindsight, that he should have re-positioned the aircraft for another approach. He added that with the third stage of flap selected, he ended up in a very steep and fast approach and was descending "like an express lift."

As a consequence of the slightly fast landing and striking an uneven part of the grass runway during the landing roll, control of the aircraft was momentarily lost before it landed heavily on its nose gear.

ACCIDENT

Aircraft Type and Registration:	PZL-104 Wilga 35A, G-BWDF
No & type of Engines:	1 PZL Kalisz AI-14RA piston engine
Year of Manufacture:	1995
Date & Time (UTC):	6 August 2006 at 1600 hrs
Location:	Dunsfold Aerodrome, Surrey
Type of Flight:	Aerial Work
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Starboard forward link brace parted. Pitot tube assembly damaged and missing
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	41 years
Commander's Flying Experience:	585 hours (of which 48 were on type) Last 90 days - 57 hours Last 28 days - 29 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft had completed a banner towing operation and was returning to land. The banner was dropped uneventfully but as the aircraft climbed and turned left to enter the circuit the pilot heard a thump and felt the aircraft 'stagger' in the air. Control response was normal; the pilot made an abbreviated circuit and a normal landing. After landing an inspection showed the pitot tube had detached and the right front wing spar had broken.

History of the flight

The aircraft was being operated on a banner towing flight. The pilot prepared the banner and carried out a pre-flight inspection of the aircraft, which included removing the pitot cover. He took off, carried out a short circuit and picked up the banner. The flight was uneventful until he returned to the airfield. He dropped the banner and then made a climbing turn to the left with full power applied. As he did so he heard a thump and felt the aircraft 'stagger' in the air. The aircraft recovered and he realised he still had normal control so he completed a shortened circuit and landed. After landing, he taxied to the fuel bowser and then shut the aircraft down. The aircraft was refuelled and then he towed it back into the hangar. When it was in the hangar he noticed that the pitot tube was missing and on further inspection saw that there was also damage at the right wing root.

Witnesses on the ground saw the aircraft 'lurch' and then recover whilst in a climbing turn to the left. Several of them were sufficiently concerned that they approached the pilot subsequently to ask what had happened.

Damage to the aircraft

The pitot tube is mounted at the outboard end of the right wing. The loss of the pitot tube would have affected the indicated airspeed, although it was possible that there was still a reading. The pilot could not recollect exactly when he had last checked the airspeed indicator during the flight but he commented that during banner towing operations it is necessary to closely monitor the airspeed and was therefore certain that it was functioning throughout the towing operation.

The missing pitot tube was not found. There was no physical evidence on the wing either of a bird strike or of an impact with another object while the aircraft was in the air. The pitot tube had failed as a result of an overload with an upward and slightly inboard component. The load applied to the pitot tube had caused the resultant failure of the front wing spar in overload. The rear lower mainplane spar appeared to be undamaged.

Conclusion

It is difficult to readily identify an event, or sequence of events, that can explain the damage to the right wing. Possible causes include: an impact in the air with a model aircraft or a bird, structural fatigue or failure, or an impact on the ground during ground handling. There is no clear evidence to support any of these possibilities.

INCIDENT

Aircraft Type and Registration:	Reims Cessna F182Q Skylane, G-GCYC
No & Type of Engines:	1 Continental Motors Corp O-470-U piston engine
Year of Manufacture:	1980
Date & Time (UTC):	7 March 2006 at 1820 hrs
Location:	16 miles north of Newcastle
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Minor damage to the fuselage
Commander's Licence:	Private Pilot's Licence with IMC and night ratings
Commander's Age:	68 years
Commander's Flying Experience:	865 hours (of which 13 were on type) Last 90 days - 40 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot, report of event provided by Newcastle ATC and AAIB enquiries

Synopsis

During a flight from Dundee to Manchester the aircraft engine lost power and ran roughly. An emergency landing in poor weather and gathering darkness was carried out at Eshott with the assistance of radar and with additional guidance from a flying instructor, observing from the ground at the final landing location, passed by telephone to the radar controller and relayed to the pilot.

History of the flight

The aircraft was flying from Dundee to Manchester. En route, communication was handed from RAF Leuchars to the Newcastle Approach frequency which provided a Flight Information Service. At the time, two radar positions at Newcastle, RAD 1 and RAD 2, were manned and a third radar controller, known as RAD 3 was operating telephones and handling communications. An Air Traffic Control Assistant (ATCA) was also on duty in the radar room and another in the tower.

Shortly after the handover, when the aircraft was approximately 19 miles south of St Abbs Head, flying at 4,000 ft, the engine began to lose power and run roughly. The pilot transmitted that he wished to divert to Newcastle, but subsequently announced that he would not be able to reach that location and asked if ATC knew of a suitable place to land.

The RAD 1 controller knew that Millfield, a small grass airfield, was only four miles from the aircraft position but, believing that the machine was flying between solid cloud layers, he considered that, in approaching dusk, the field would be difficult to locate and this diversion would also involve turning the aircraft towards high ground. He therefore decided that Eshott would be a more suitable alternative. The pilot agreed and the controller requested him to Squawk 7700 and provided vectors towards that location.

Eshott is a 'Prior Permission Required' (PPR) airfield with paved surfaces forming part of a larger, otherwise disused airfield, thus being a fairly distinct landmark. It has an air/ground radio service which is only manned at weekends.

During this period the aircraft was entering and leaving radar and radio cover. A Jetstream 41 aircraft flying from Newcastle to Aberdeen was used to assist two way communications. Whilst this was happening a radar ATCA and the RAD 3 controller plotted the aircraft's position on a 1:250,000 topographical chart to confirm high ground in the vicinity. The RAD 2 controller phoned the manager of Eshott who is also a flying instructor and fortuitously was near the airfield tending livestock and in possession of his mobile telephone. In addition RAD 2 took over all the radar traffic being handled up to that point by RAD 1.

An ATCA found a copy of Pooleys Flight Guide and thus obtained the relevant information for Eshott airfield whilst the RAD 3 controller phoned 202 Search and Rescue squadron at RAF Boulmer to alert them to the situation. The Distress and Diversion service were also informed.

When the aircraft was about 10 nm from Eshott the pilot informed Newcastle that he had identified the airfield on his GPS; the RAD 1 controller continued to supply vectors. RAD 3 phoned the airfield manager again to confirm the aircraft was inbound by which time the latter had parked his car beside the eastern end of Runway 08 facing in an approximately northerly direction. He was thus positioned to one side of the thresholds of the two parallel and adjoining asphalt and grass Runways 19. He informed the Newcastle controller of the vehicle's position and the need for the pilot to land with the vehicle on his right. He put on his headlamps and hazard warning lights. He also informed Newcastle that the cloud was overcast between 600 and 800 ft.

With the aircraft at about two miles from Eshott the airfield manager informed RAD 3 that it was in sight and proceeded to pass heading and level information to enable the aircraft to reach the strip. This information was passed to RAD 1 who in turn passed it to the pilot. The manager turned off his headlamps as the aircraft came nearer but left the hazard warning lights in operation. During the landing the aircraft struck a small barbed-wire fence, inflicting minor damage to the propeller, lower engine cowling, the undercarriage leg fairings and the tailplane. This did not, however, adversely affect the aircraft which otherwise landed successfully.

Aircraft examination

Subsequent examination of the aircraft at the airfield reportedly revealed low compression on one cylinder. The aircraft was then dismantled by its maintenance company and returned to its base at Manchester. There an auxiliary fuel tank was used to supply fuel to the carburettor equipped engine, enabling an extended engine running test to be carried out. This revealed no problem with the engine. The engineer involved concluded that carburettor icing probably accounted for the rough running and loss of power of the engine.

Meteorological information

An assessment of the aftercast specially provided by the Met Office to assist the investigation shows that a series of frontal systems was affecting the UK and moving east to north-east. The first, an active occlusion, lay along the east coast from Norfolk to the Firth of Forth and across to the Isle of Skye, moving north-eastwards at 15 kt at 1800 UTC. It was estimated that this front passed through the Newcastle area in the period 1500-1700 UTC. A second, less active, occlusion lay to the west and a moist south-south-easterly air mass affected the UK between frontal systems. Cloud of various types appears to have been present at all levels from 900 ft amsl to a minimum of 8,000 ft in the area south of St Abbs Head, that above 1,500 ft appearing to be 8/8ths cover. Conditions between Inverness and St Abbs Head do not appear to have been significantly better.

Most importantly, the conditions south of St Abbs Head included 95 to 100% humidity in all height bands below 5,000 ft, with a freezing level rising from approximately 3,500 ft at midday to 4,500 ft at 1800 UTC. The effects of this humidity level and the ambient temperature put the conditions at the aircraft's operating height well within the region where serious carburettor icing at cruise power can be expected in that class of engine.

This information, coupled with the satisfactory operation of the engine on the subsequent test, makes it reasonable to conclude that the rough running and loss of engine power resulted from a progressive build-up of ice in the carburettor throat. With the challenging flight conditions, the pilot may have been distracted from the need for frequent use of carburettor heat control in the high humidity conditions, leading to increasingly rough engine running.

ACCIDENT

Aircraft Type and Registration:	Bell 206B Jet Ranger, G-NEWS
No & type of Engines:	1 Allison 250-C20B turboshaft engine
Year of Manufacture:	1978
Date & Time (UTC):	16 July 2006 at 1730 hrs
Location:	Cambridge Airfield, Cambridgeshire
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Major damage to airframe, main and tail rotor blades
Commander's Licence:	Private Pilot's Licence
Commander's Age:	46 years
Commander's Flying Experience:	2,421 hours (of which 235 were on type) Last 90 days - 29 hours Last 28 days - 11 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

An instructor pilot and his student were conducting a training flight as part of the student's type conversion. The instructor decided to complete the flight by having the student perform an Engine Off Landing (EOL). The touchdown was slower and heavier than normal and the aircraft bounced approximately 3 to 4 ft. On the second touchdown, the tail strike protector struck the ground, the tail rotor gearbox detached and the main rotor blades contacted the vertical stabilizer.

History of the flight

The student pilot was undertaking a 5-hour type conversion on the Bell 206B Jet Ranger; the training was being shared between two instructors. The same helicopter had been used for all of the training; it was fitted with a high-skid landing gear. The operator encouraged instructors to keep run-on landing speeds to a minimum during EOLs in order to reduce the nose-down pitching moments that may be generated by the high-skid landing gear if the touchdown is mishandled.

On the Friday preceding the accident the student had undertaken a 0.9 hour training flight with the first instructor. On Saturday, the second instructor carried out two training flights of 1.2 hours and 0.9 hours respectively. The first flight on the Saturday concluded with autorotations and an EOL demonstration by the instructor. The second flight on the Saturday included practice force landings (PFLs) and an EOL; these

manoeuvres were performed by the student with the instructor assisting on the flight controls. The student then performed two further EOLs with verbal prompts only from the instructor. The flight was completed with three EOLs from the hover.

On Sunday, the day of the accident, the weather was good with a light surface wind, generally from 060º at 7 to 9 kt, CAVOK conditions and a surface temperature of 29ºC. The instructor planned to carry out two flights; the first was to be an instructional flight and the second was to be a revision prior to the Licence Skills Test (LST). At the end of the first flight, the student performed two PFLs and two EOLs; all of these manoeuvres were unassisted and were flown to a satisfactory standard. On the second flight the necessary training was completed and the final exercise was to be an EOL.

The aircraft was positioned for the EOL onto a grass surface in the south helicopter training area, on a heading of 280º, at a height of 700 ft and an IAS of 90 kt. At a suitable distance, the instructor initiated the exercise and the student entered autorotation, the instructor then closed the throttle to idle. The student turned into the wind and at about 300 ft the instructor confirmed that it was safe to continue the EOL. The height and approach angle ensured that the EOL area would be achieved, the IAS was approximately 65 mph and the Rotor rpm (RRPM) was about 100%.

The student commenced the flare at the normal height and the rate of descent reduced. As the aircraft decelerated, the instructor called for the student to level the aircraft, which he did. At that point the skid height was about 8 ft with very little forward speed. As the aircraft began to descend the student raised the collective pitch control lever to cushion the landing. The instructor who was monitoring the collective thought the rate of application seemed normal. The aircraft touched down heavily in a level attitude but bounced back into the air to a height of about 3-4 ft and the instructor took control. As the aircraft was climbing the 'LOW RRPM' warning horn sounded and the instructor attempted to cushion the second touchdown. He managed to control the aircraft to a skid height of approximately 2 ft in a stable attitude but had no further control below that height as the aircraft dropped. On contact with the grass surface the aircraft shuddered briefly for about two seconds then settled back to a normal vibration level. The instructor shut down the engine, applied the rotor brake and notified ATC of the situation. He then switched off the electrical system and once the main rotor had stopped, both he and the student vacated the aircraft through the normal exits. The airfield Rescue and Fire Fighting Service attended the scene within two minutes.

Engineering

From discussions with the repair agency it would appear that on the second touchdown the tail strike protector struck the ground. The force was such that it bent the tail pylon upwards at a point approximately 12 to 14 in aft of the pylon to fuselage attachment. The tail rotor gear box detached and the main rotor blades impacted the vertical stabilizer. The main rotor gearbox mounting plate had evidence of forward movement and the front left cross tube showed signs of a heavy impact.

Analysis

The EOL exercise had earlier been fully briefed and demonstrated by the instructor, and the student had successfully completed the exercise on the previous flights. The EOL was entered at a safe height, permitting adequate time for the student to stabilise the aircraft and position it for touchdown. Up to the point of raising the collective lever to cushion the touch down, the EOL appeared normal. The rate of upwards movement, whilst

not cushioning the touchdown also appeared normal. It is possible that following the heavy touchdown, the student continued to raise the collective which may have contributed to the height of the bounce. With the high collective pitch applied, the RRPM decayed rapidly limiting the effects of the flight controls as described by the instructor. The tail-first landing and contact of the tail rotor blade with the ground or airframe probably caused the tail rotor gearbox to separate.

Conclusions

The instructor considered that two possibilities existed which may have led to the accident. The student may have made an inadequate collective input to reduce the sink rate; however, the instructor considered that the movement of the collective lever was appropriate and he believed that a normal touchdown should have followed. Alternatively, they may have encountered some form of windshear created by the light and variable surface wind which, when combined with the high ambient temperature, may have contributed to the accident. The high-skid landing gear fitted to the helicopter was not considered to be a factor in the accident.

ACCIDENT

Aircraft Type and Registration:	Robinson R44 Astro, G-RONN
No & type of Engines:	1 Lycoming O-540-F1B5 piston engine
Year of Manufacture:	1996
Date & Time (UTC):	6 June 2006 at 1515 hrs
Location:	Netherthorpe Airfield, Nottinghamshire
Type of Flight:	Training
Persons on Board:	Crew -1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Twisted airframe; engine and main rotor gearbox oversped
Commander's Licence:	Student
Commander's Age:	33 years
Commander's Flying Experience:	38 hours (of which 38 were on type) Last 90 days - 30 hours Last 28 days - 9 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The student pilot lost control of the aircraft whilst attempting to recover a map which had fallen onto the floor during takeoff. The student tried to land the aircraft whilst it was rotating rapidly to the left resulting in damage to the airframe and engine controls; this in turn resulted in the engine and gearbox being oversped.

History of the flight

The student pilot was about to undertake the second leg of a solo cross-country navigation exercise. He occupied the right pilot's seat and prior to takeoff had stowed his map between the side of the seat and the door. On lifting into the air the map fell into the footwell and the student instinctively bent forward to pick it up. This resulted in an unintentional input on the flying controls lurching the aircraft to the right, forcing the map further forwards under the pedals. The student stated this made him panic and push down on the left yaw pedal, subconsciously as though he were applying the brake in a car in order to stop. The aircraft then rotated rapidly to the left through at least one complete rotation and, as he could no longer control the aircraft, the student decided to attempt to land. In doing so the aircraft remained upright but the rear of the right skid dug into the ground, twisting the airframe. The student reported that he then found he was unable to close the throttle so he closed down the engine by selecting the

mixture to CUT OFF, but not before both the engine and rotors had oversped. The pilot was uninjured in the accident and after completing the rest of the shut-down checks, he was able to vacate the aircraft unaided.

Post-accident examination of the helicopter revealed that the pilot was unable to close the throttle because distortion to the airframe had damaged the engine controls.

Comment

Previous accidents have occurred where pilots have tried to recover objects or attempted other actions such as re-closing doors during inappropriate phases of flight. This student stated that his actions on this occasion were all instinctive.

His frank and open report serves to reinforce the need to resist such actions until they can be conducted safely.

ACCIDENT

Aircraft Type and Registration:	Robinson R44 Raven II, G-PROG
No & type of Engines:	1 Lycoming IO-540-AE1A5 piston engine
Year of Manufacture:	2006
Date & Time (UTC):	2 May 2006 at 1700 hrs
Location:	Yeoland Conyers, Carnforth, Lancashire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to fuselage, tail cone, main rotor blades, main rotor head, gearboxes and engine
Commander's Licence:	Student Pilot
Commander's Age:	43 years
Commander's Flying Experience:	110 hours (of which 10 were on type) Last 90 days - 20 hours Last 28 days - 10 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The student pilot was carrying out the start-up and shut-down procedure in his recently purchased helicopter at private premises. While the engine was warming up with the rotor speed at 60%, the helicopter yawed to the left. The pilot reported that he corrected with right tail rotor pedal and the helicopter rolled on to its right side. He was uninjured and there was no fire.

History of the flight

The student pilot reported that he was carrying out the start-up and shut-down procedure on his recently purchased helicopter at private premises. He stated that he meticulously carried out the pre-flight checks, as laid down in the manufacturer's Pilot's Operating Handbook (POH), leaving the ground handling wheels attached to the skids but in such a position that they were not supporting any of the helicopter's weight. The pilot commented that the wheels were left attached to the skids because no flight was intended.

After boarding G-PROG, the pilot carried out the *Starting Engine and Run Up* procedure, as detailed in the POH, to the point where the rotors were turning at 60% and he was waiting for all engine gauges to indicate in the green arc. Suddenly the helicopter yawed left and he immediately countered this movement with right tail rotor pedal. He reported that this control input caused an immediate correction of about 15º yaw to the right

but that in doing so the helicopter rolled on to its right side. In the process the engine stopped, so the pilot made the helicopter safe by switching off the electrics and he exited via the front left door. He was uninjured. G-PROG suffered substantial damage and fuel leaked from the filler cap, but there was no fire. The pilot stated that there was no damage to other property or other people involved.

The pilot reported that, since purchasing the helicopter in March 2006, he had carried out the start-up and shut-down procedure several times, using the manufacturer's published procedures, and had experienced no previous problems. He stated that during the start-up the governor was off, the collective was in the down position, both cyclic and collective frictions were on and that he had his hands and feet on the flying controls throughout the period that the helicopter yawed. In concluding that the accident was the result of overcorrection with the tail rotor control, the pilot was unable to recall what happened during the two or so seconds that it took for the helicopter to roll over on to its side. He considered it possible that he may also have made a cyclic input.

G-PROG had been parked on a dry, level, smooth tarmac surface, on a northerly heading, 25 metres clear of buildings and 100 metres from the nearest road. The weather was reported as being fine with a surface wind from the south-west at 8 kt. The possibility of the helicopter yawing right during rotor acceleration, as cautioned in the POH, was opposed to an extent by the potential for G-PROG to weather cock to the left in the prevailing wind. However, it is not clear what forces existed, with the rotors stabilised at 60%, to create the sudden yaw to the left.

Discussion

With the collective fully down, a cyclic control input would most probably have been required to initiate a roll to the right. This could have resulted from the transfer of a learned skill from driving a road vehicle, where an unintended turn to the left would be corrected by a movement of the steering wheel to the right. Since the student pilot had a driving licence and was a current driver, the sudden, unexpected yaw to the left may have prompted a movement of the cyclic control to the right, as well as the reported right tail rotor input.

Civil Aviation Publication (CAP) 393, entitled *Air Navigation: the Order and the Regulations*, Section 1 The Air Navigation Order (ANO) 2005, Part 14, Article 155 (Interpretation) defines an aircraft as being in flight;

> *...in the case of a piloted flying machine, from the moment when, after the embarkation of its crew for the purpose of taking off, it first moves under its own power until the moment when it next comes to rest after landing*

The student pilot reported that he was not intending to take off, therefore, by definition, from the moment that the helicopter moved under its own power until it next came to rest did not constitute the ANO meaning of flight. As such, there was no requirement for the presence of a qualified flying instructor. However, once the rotors were engaged, G-PROG had the potential for becoming airborne, one way or another, subject to any control inputs and the wind. This accident illustrates the value of starting a helicopter with it facing into wind.

ACCIDENT

Aircraft Type and Registration:	Gemini Flash IIA, G-MYJB
No & Type of Engines:	1 Rotax 503 piston engine
Year of Manufacture:	1993
Date & Time (UTC):	29 April 2006 at 1450 hrs
Location:	Talybont, north of Tywyn, Gwynedd
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 Passengers - None
Nature of Damage:	Damaged beyond economic repair
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	47 years
Commander's Flying Experience:	46 hours (all on type) Last 90 days - 5 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Whilst taking off from a small airstrip in strong, gusty wind conditions, the pilot was unable to maintain control, the aircraft struck trees and fell to the ground.

History of the flight

The pilot and his 11 year-old son had flown from Aberporth, where the aircraft was kept, to a private landing strip at Talybont. Although the weather conditions were generally good, the pilot noticed before he took off for the return flight that the wind was strong, gusty and of variable direction. However, he reasoned that, since he had landed there in similar conditions, he would be able to take off safely even though he estimated that the gusts were easily reaching 20 mph and the two windsocks, only some 100 metres apart, seldom seemed to agree on wind direction.

Having judged that the wind was predominantly from the north, and therefore about 30° off the runway heading, the pilot started the takeoff run during what he perceived as a lull in the wind strength. The takeoff roll and initial climb were smooth but, at a height of about 25 feet, the aircraft encountered a gust which dropped the left wing and yawed it left. The pilot recovered to wings level with difficulty but was now aware that they were heading towards a hill to the north of the strip and not climbing due to a downdraught effect. He also became concerned about the proximity of some power cables in the fields

below but was reluctant to attempt to turn the aircraft away from the obstacles for fear of stalling so, with the rising ground approaching, he decided to perform a forced landing in a patch of gorse, which appeared to offer the possibility of a cushioned arrival. The aircraft was then hit by another large gust which almost stalled it, causing it to lose some height and turning it violently to the right towards a copse of trees. The aircraft struck the trees at a height of about 15 feet and a speed which the pilot estimates at 30 to 40 mph, whereupon it dropped straight to the ground.

The engine was still running at full power until the pilot switched off the ignition. Both occupants were trapped in the wreckage, since the control bar and compression strut had wrapped themselves around the pilot, and this prevented his passenger from extricating himself from behind him. Fortunately, some passers-by had witnessed the accident and the pilot was able to instruct them in releasing the control bar so that he could move himself and his passenger. The emergency services also attended promptly. The passenger suffered only a bruise to his leg but the pilot had a broken finger, badly bruised ribs, a bruised groin (from the lap belt buckle) and a small cut to the bridge of his nose.

In a frank and detailed statement, the pilot castigated himself for getting airborne in such marginal conditions and risking not just his life but also his son's. He also provided an information sheet promulgated by Talybont airstrip which contained the warning "*This is a short field which can suffer from rotor in N and NW winds*". The pilot is convinced that it was this phenomenon he encountered.

ACCIDENT

Aircraft Type and Registration:	Mainair Blade, G-MZKO
No & type of Engines:	1 Rotax 503-2V piston engine
Year of Manufacture:	1997
Date & Time (UTC):	19 July 2006 at 0915 hrs
Location:	Headon Microlight Field, Nottinghamshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Minor) Passengers - N/A
Nature of Damage:	Substantial
Commander's Licence:	Private Pilot's Licence
Commander's Age:	49 years
Commander's Flying Experience:	105 hours (of which 13 were on type) Last 90 days - 13 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The pilot landed heavily, collapsing the front wheel and causing the microlight to bounce. The wing then caught some crops adjacent to the landing strip resulting in the microlight hitting the ground.

History of the flight

The pilot was flying circuits to Runway 05. The weather was good with a crosswind from the right of about 6 kt.

The pilot stated that he landed heavily, collapsing the front wheel of the 'trike' and the aircraft bounced back into the air. He stated the wing dropped to the left, catching some crops in a field adjacent to the runway, causing the microlight to hit the ground and come to rest inverted. The trike was badly damaged in the impact but the pilot, who had been wearing a lap strap and helmet, received only minor injuries.

ACCIDENT

Aircraft Type and Registration:	Mainair Blade 912, G-CBGY
No & type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	2002
Date & Time (UTC):	23 April 2006 at 1741 hrs
Location:	New Mixon Hay Farm, Onecote, Leek, Staffordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Serious) Passengers - 1 (Serious)
Nature of Damage:	Trike and wing severely damaged
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	47 years
Commander's Flying Experience:	127 hours (of which 127 were on type) Last 90 days - 4 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Whilst attempting an unplanned landing at a farm strip, the pilot lost control in a strong gusting crosswind and struck a stone wall.

History of the flight

The aircraft was on a local flight from Calton Moor airstrip with a planned duration of one and a half hours, remaining within about 20 miles of the departure airfield. On the return leg, the pilot decided to land at New Mixon Hay Farm strip, partly for a toilet break and also because he had spotted an interesting aircraft on the ground there. The pilot knew the owner of the strip, had performed several touch-and-go landings there in the past and remembered that the strip, marked 34, was often cross-wind and had a steep rise in the first section. Accordingly, he intended to land just past this point.

The approach was normal and stable until, at a height of about 50 feet, the left wing dipped violently. The pilot recalls trying to level the wings and applying power, but this was his last clear recollection before regaining consciousness to find that the aircraft had struck a dry stone wall and that he had a broken leg. His passenger had suffered two broken ankles and a broken arm. There were no witnesses to the accident and his passenger remembered even less than he, but the pilot believes they had struck the ground and bounced into the wall. The emergency services, including an

air ambulance, attended and the two occupants were evacuated to hospital.

In the pilot's opinion, the accident was caused by a strong gusting cross-wind and disturbed air, coupled with his relative inexperience in these conditions. By his own admission, his decision to continue was unwise, bearing in mind that he did not have to land at that strip.

ACCIDENT

Aircraft Type and Registration:	Mainair Sports Pegasus Quik, G-OKEM
No & type of Engines:	1 Rotax 912-UL piston engine
Year of Manufacture:	2004
Date & Time (UTC):	4 April 2006 at 1240 hrs
Location:	Private airstrip near Almondsbury, Gloucestershire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passenger - 1 (Minor)
Nature of Damage:	Minor damage to cockpit fairing
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	Not known
Commander's Flying Experience:	210 hours (of which 138 were on type) Last 90 days - Not known Last 28 days - Not known
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Whilst abandoning a takeoff, due to poor aircraft performance, the aircraft ground looped.

History of the flight

The Pegasus Quik is a tandem-seat microlight aircraft, controlled by weight shift. During the takeoff ground run the pilot felt that the aircraft was taking longer than normal to become airborne and decided to abandon the takeoff. While decelerating, the aircraft ground looped. The pilot assessed that the reasons for the longer than normal take-off ground run were the soft ground and a possible loss of aircraft performance.

ACCIDENT

Aircraft Type and Registration:	Solar Wings Limited Pegasus XL-Q, G-MWKZ
No & type of Engines:	1 Rotax 462 HP piston engine
Year of Manufacture:	1990
Date & Time (UTC):	30 July 2006 at 1300 hrs
Location:	Ledbury Airfield, Herefordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Minor) Passengers - None
Nature of Damage:	Aircraft moderately damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	29 years
Commander's Flying Experience:	4,440 hours (all on type) Last 90 days - 13 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot.

Synopsis

The aircraft landed heavily, causing the front suspension to collapse, pitching the aircraft onto its nose.

History of the flight

The pilot reported that after a normal approach, the aircraft touched down moderately hard on its main wheels. As the front wheel contacted the ground, the front suspension forks collapsed, causing the aircraft to pitch over onto its nose.

Both occupants were wearing helmets and lap and diagonal restraints. The pilot sustained a minor injury, but the passenger was unhurt. The aircraft suffered damage to the airframe, including the front suspension forks, steering mechanism and cockpit. Also, the sail was torn.

ACCIDENT

Aircraft Type and Registration:	Solar Wings Limited Pegasus XL-R, G-MTWA
No & Type of Engines:	1 Rotax 447 piston engine
Year of Manufacture:	1988
Date & Time (UTC):	31 May 2006 at 1108 hrs
Location:	Near Sittles Farm, Fradley, Staffordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to the wing, propeller, engine and nosewheel
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	52 years
Commander's Flying Experience:	63 hours (of which 54 were on type) Last 90 days - 3 hours Last 28 days - 0 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and subsequent engine testing

Synopsis

Shortly after takeoff in blustery conditions and whilst on an extended crosswind leg, the microlight began to descend. The pilot turned in-to-wind but, despite having the throttle fully open, was unable to stop the descent and was forced to land in a field. During the ground roll, the aircraft's nosewheel dug into an area of soft ground, causing it to turn over. The pilot was uninjured and climbed from the wreckage unassisted. Tests of the engine failed to reveal any defect which may have contributed to the accident.

History of the flight

After taking off in blustery conditions from Runway 27 at Roddige Airfield, G-MTWA climbed to a height of approximately150 ft before turning crosswind. The pilot reported that despite the engine running at maximum speed, he began to descend. Due to a tailwind component (the wind was reported as 300º/8 kt), the crosswind leg of the left hand circuit became extended and he was now too far from the airfield to land back. The pilot turned the microlight in-to-wind, but could not arrest the rate of descent, so decided to land in a large field directly ahead. Shortly after what he described as a firm touchdown, the nosewheel dug in to soft ground and broke off, and the microlight turned over. The pilot was uninjured and was able to make his escape without assistance.

Investigation

The pilot reported that there had been no evidence of rough or uneven running of the engine during the short flight; therefore, carburettor icing was not considered likely as a factor in the apparent loss of the microlight's performance.

After a replacement propeller had been fitted, the engine was test run, under the supervision of the AAIB, and no abnormalities were observed with its performance. Also, no restriction or binding of the engine control cables was found. In the absence of any technical defect being apparent, it is considered that the blustery nature of the wind during the flight, possibly associated with a downdraught, prevented G-MTWA from gaining height, leaving the pilot no option but to carry out an immediate forced landing.

BULLETIN ADDENDUM

AAIB File:	**EW/G2006/04/29**
Aircraft Type and Registration:	Replica SE5A, G-BMDB
Date & Time (UTC):	22 April 2006 at 1325 hrs
Location:	Boscombe Down Airfield
Information Source:	Aircraft Accident Report Form and a follow-on report submitted by the pilot

AAIB Bulletin No 7/2006, page 89 refers

Following the accident to this aircraft reported in AAIB Bulletin 7/2006, it was repaired and given an annual maintenance inspection in preparation for its Permit to Fly renewal. Whilst carrying out this inspection it was found that there was excessive backlash in the throttle operation. Investigation of the problem found that the bracket that holds the outer sheath of the carburettor end of the throttle Bowden cable was loose on its mountings. The bracket is attached to a 5/16th inch stud that projects downwards from the right rear engine mounting. The plain nut and shake-proof washer were loose and had backed off by 1/8th inch allowing the Bowden cable and the carburettor butterfly arm, to which it is attached, to move. This would have allowed the throttle to open a small amount even though the cockpit lever was locked. The plain nut has been replaced by a Kaylock type stiff nut. The pilot considers that this was the reason that the aircraft started to taxi after he had removed the wheel chocks rather than the original explanation that he gave just after the accident.

FORMAL AIRCRAFT ACCIDENT REPORTS ISSUED BY THE AIR ACCIDENTS INVESTIGATION BRANCH

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.

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