No: 10/89 **Ref: EW/C1125** **Category: 1c**

Aircraft Type and Registration:	Piper 28R-200, G-DANE
No & Type of Engines:	1 Lycoming IO-360-CIC piston engine
Year of Manufacture:	1969
Date and Time (UTC):	8 July 1989 at 0838 hrs
Location:	Downs Farm, Amberley, West Sussex
Type of Flight:	Private (Business)
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (fatal) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	41 years
Commander's Total Flying Experience:	530 hours (of which 480 hours were on type)
Information Source:	AAIB Field Investigation

History of the flight

On the morning of 8 July 1989 the pilot/owner of the Piper 28R aircraft, G-DANE, intended to make a private business flight from Goodwood to Ipswich and return. He arrived at Goodwood aerodrome at about 0800 hrs and re-fuelled the aircraft to capacity. It is reported that prior to his arrival at the aerodrome he had contacted the Flight Information Service (FIS) Controller at Ipswich by telephone at 0745 hrs, advised his intentions and an expected arrival time of 0930 hrs, and requested details of the current Ipswich weather. The Ipswich weather at that time was reported to be cloudy with the main base at 1200 feet. Visibility was 7 to 8 kilometres in haze. The pilot acknowledged the information. He did not file a VFR flight plan, thus his intended route is not known.

A recording of the radiotelephony (RTF) messages shows that at 0826 hrs the pilot requested taxi clearance from Goodwood ATC, reporting his destination as Ipswich with an endurance of 4 1/2 hours. He was cleared to the holding point of runway 14 and, at 0831 hrs, further cleared for take-off with a left turn onto course. The Goodwood weather at 0750 hrs was recorded as a surface wind of 060/05 knots, visibility 8 kilometres in haze, and 5 oktas cloud at 1200 feet with 8 oktas above. At

0836 hrs the pilot reported that he was overhead Arundel at 2000 feet, VMC, and that the cloud had cleared approximately over Fontwell and he was changing to the Gatwick Approach frequency. This was the last radio transmission from G-DANE. It was subsequently established that the pilot had changed to the Gatwick Approach frequency but did not call them.

Radar recordings available to the investigation positively identified G-DANE by a transponder code of 4331, but unfortunately the altitude read out was missing. The first radar return at 0831.30 hrs showed the aircraft at a position 1 nm south east of Goodwood aerodrome and turning onto an easterly heading. This heading was maintained until 0834 hrs when the aircaft turned north-east. At 0835.30 hrs it again turned right onto east but almost immediately (0836.14 hrs) turned back towards the north. This turn continued and progressively tightened until the aircraft had turned through approximately 540 degrees, when at 0837.30 hrs it disappeared from the radar picture. The aircraft's average groundspeed, as calculated from the radar returns, appears to have been constant at about 110 knots until 0836.14 hrs when it entered the steep turn to the left. Thereafter the average groundspeed increased to 140 knots within 30 seconds, however as the turn tightened further accurate speed calculations were not possible.

Shortly before the aircraft disappeared from the radar picture two witnesses, close to the scene, reported hearing the sound of a light aircraft in or above cloud. They reported hearing engine noises 'as if it was doing aerobatics'. They subsequently looked up to see the aircraft emerge from cloud in a steep left hand descent, closely followed by a large piece of white material. Other witnesses also reported seeing the aircraft descending vertically from cloud followed by a separated wing section. The aircraft crashed on high ground close to the South Downs Way, about 1 nm south-east of Amberley and 9 1/2 nm east-north-east of Goodwood aerodrome. The initial impact was at an altitude of 460 feet above mean sea level (amsl). There was no fire however the pilot died from multiple injuries.

Examination of wreckage

The outboard 5ft of the right wing was found approximately 400 yards north of the main impact area. Other items found close to the wing included pieces of the right hand stabilator tip fairing and a fragment of the fuselage tail cone. It was found that these items had become detached as a result of being struck by the right wing tip.

Examination of the ground impact marks indicated that the main part of the aircraft had struck the ground rolled approximately 130° to the right, ie almost inverted, and nominally level in pitch. Thus the first parts of the aircraft to contact the ground were the top of the fin, the right wing stub, the right hand stabilator, the propeller (but not the spinner) and the cabin roof, which was subsequently torn off. The aircraft then slid down a steepening slope before coming to rest some 100 yards from the point of impact. The impact track was 210° magnetic. The left wing suffered an inertial failure at its fuselage attachment during the initial ground impact and was remarkably undamaged. The pilot's left seat belt attachment was found to have failed in overload: the upper torso restraint was attached to the roof.

The right wing structural failure occurred outboard of the fuel tank; a large area of fuel staining on the grass around the impact point indicated that it had contained a significant quantity of fuel. In excess of 12 gallons of fuel were removed from the tank in the left wing. The fuel cock was found selected to the left tank. It was noted that the landing gear and flaps were retracted at impact. The flying control circuits were examined with no evidence of pre-accident failure being found. The magneto switch was found in the OFF position although the degree of damage sustained by the propeller suggested some power at impact.

Following an on site examination the wreckage was recovered to the AAIB at Farnborough for a more detailed analysis.

The failure of the right wing was found to be due to overstressing as a result of excessive up-load. Distortion of the main spar indicated a degree of torsion consistent with down deflection of the right aileron. This conclusion was reinforced by the absence of any compression wrinkles in the upper wing skin of the left wing; ie the lack of symmetrical damage suggesting that the failure occurred during the application of left roll, in which the right wing is subjected to higher loads than the left. A high load factor, due to application of up elevator, would also have had to be present to produce the failure. Information from the manufacturer indicated that previous structural failures involving this type of aircraft at relatively light weight and therefore forward c of g have shown evidence of stabilators being subjected to excessive download. In the case of G-DANE, the left hand stabilator bore evidence of compression wrinkling on its lower surface although it was not possible to decide whether this was attributable to aerodynamic or ground impact forces.

The aircraft was equipped with two Nav and two Comms radios; the selections were as follows:

Comm 1	125.87 MHz	- Gatwick Approach
Comm 2	122.45 MHz	- Goodwood Tower
Nav 1	114.75 MHz	- Goodwood VOR
Nav 2	1??.90 MHz	- radio damaged in impact. (NB Mayfield VOR is 117.90 MHz)

The station box was found to have Comm 1 and Nav 2 selected, although impact damage meant that these indications could not necessarily be regarded as reliable.

The artificial horizon was found to have suffered some impact damage; however once this was rectified the instrument performed satisfactorily on a bench test, although the gyroscope bearings were noted to be rather worn. The last inspection stamp was dated 1974. The directional indicator and turn co-ordinator were also found to function correctly after due allowance had been made for impact damage. The engine driven vacuum pump (which applies suction to the artificial horizon and the directional indicator) was subjected to a strip examination and found to be in good condition.

The aircraft was fitted with an autopilot which had two modes; a basic "wing leveller" mode and heading hold, the latter enabling the aircraft to be flown according to the heading bug selected on the directional indicator. The system operates via a servo motor in the aileron circuit; but there is no longitudinal control function provided by the autopilot. The control box/amplifier was subjected to a bench check where it was found that (a) there was no heading information and (b) the unit would not correct a roll to the left. Both these faults were traced to a split tantalum capacitor. In addition it was observed that the switches (which were were found in the OFF positions) were somewhat worn. Apart from a small amount of damage on the front of the box, it was otherwise intact. The electronic components inside had suffered no mechanical damage, hence it was considered probable that the observed defects existed prior to the accident. It was subsequently established that the pilot had been aware that the autopilot was defective. The serial number of the unit showed it had been fitted to the aircraft when it was built. The servo motor and electrical sensor in the artificial horizon were checked and found to be satisfactory.

Meteorological information

At the time of the accident weather conditions were generally poor. An aftercast produced by the Meteorological Office, Bracknell, describes the synoptic situation as a shallow low pressure area that was slow moving over the Brest Peninsular with a trough extending north-eastwards to Lincolnshire. Surface winds were light north-easterly, and the weather was cloudy with some local drizzle. The cloud comprised stratus patches between 800 and 1000 feet, broken strato-cumulus between 1800 feet and 2400 feet with thin layers between 6000 feet and 9000 feet. There was no reported thunderstorm activity in the Goodwood area at the time of the accident. Further confirmation of the weather conditions was provided by the commander of a police helicopter which arrived at the accident site within 15 minutes of the impact. He reported an in-flight visibility of about 5 kilometres with the main cloud base at 700 feet amsl with patches covering the tops of the hills. There was no turbulence.

Pilot experience

The pilot held a valid private pilot's licence with a current medical certificate. The post mortem examination revealed no medical condition that could have contributed to the cause of the accident. He did not hold either an Instrument Rating or an Instrument Meteorological Conditions rating. His flying log book does not record any training in instrument flying since he completed his initial flying training in October 1982. The privileges of the holder of a Private Pilot's Licence are detailed in Schedule 9 to Article 20 of the Air Navigation Order 1985. One requirement of this Schedule is that the holder of a Private Pilot's Licence, unless his licence includes an instrument rating or an instrument meteorological conditions rating, shall not fly as pilot in command of such an aeroplane - "out of sight of the surface".

The pilot's log book indicated that he had been flying this aircraft out of Goodwood since May 1984, although it had remained on the Danish register, as OY-RPD until May 1989.

Spatial disorientation

Following an accident to a light aircraft in 1987, the AAIB requested the Flight Skills Section of the RAF Institute of Aviation Medicine to provide a description of some of the causes of disorientation that are frequently experienced by pilots. Extracts from this description, which was originally published in the AAIB Aircraft Accident Report 4/88, are included below.

"Spatial disorientation is a well known phenomenon during which a person loses their sense of balance, attitude, and direction in space relative to the surface of the earth.

The perception of orientation is governed by cues derived from the visual, somatasensory (body posture), and vestibular (inner ear) systems. In the absence of strong visual information, false impressions may be generated by misleading vestibular cues. For example, during a balanced banked turn, the vestibular system will, in time, settle and respond as though the aircraft was in a straight and level attitude. If the aircraft is then returned to the horizontal, the sensory system is again disturbed and will signal this as a bank away from the horizontal.

In addition, if an aircraft is subjected to linear acceleration such as occurs during a go-around, the rotational resultant of the weight and acceleration vectors on the pilot can induce the perception that the nose of the aircraft is pitching up, or is pitching up even further than the desired attitude.

Any pilot flying in cloud conditions without good visual cues may become subject to these factors which are conducive to spatial disorientation. Those with no training in instrument flying are especially vulnerable.

It is only through comprehensive and supervised training that the ability to recognise an aircraft's attitude, speed and direction is gained by sole reference to its flight instruments, coupled with an understanding of their inter-relationship. Instrument flying training also instills the necessity, under such conditions, for the application of moderate, smooth and accurate control inputs in order to reduce the rate-of-change of aircraft attitude, thereby minimising those effects which can induce spatial disorientation."