

ACCIDENT

Aircraft Type and Registration:	Flight Design CTSW, G-CFAZ	
No & Type of Engines:	1 Rotax 912 ULS piston engine	
Year of Manufacture:	2007	
Date & Time (UTC):	8 October 2008 at 0855 hrs	
Location:	Saddleworth Moor, Lancashire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - 1 (Fatal)	Passengers - None
Nature of Damage:	Aircraft destroyed	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	41 years	
Commander's Flying Experience:	123 hours (of which 29 were on type) Last 90 days - 11 hours Last 28 days - 0 hours	
Information Source:	AAIB Field Investigation	

Synopsis

The pilot was flying from Manchester Barton to Shacklewell Lodge, a small private airstrip near RAF Cottesmore. To the east of Manchester the aircraft descended rapidly and crashed into the ground at Saddleworth Moor, probably as a result of a loss of control following an inadvertent entry into cloud. One Safety Recommendation is made, concerning baggage restraints.

History of the flight

The pilot prepared the aircraft for a solo flight from Manchester Barton to Shacklewell Lodge, a small private airstrip near RAF Cottesmore, and placed three shotguns, in cases, into the rear of the aircraft; no ammunition was loaded into the aircraft.

The pilot started the engine and taxied to the holding point, where the aircraft was seen to stop and the engine was shut down. The pilot walked back towards the hangars and told the Chief Flying Instructor of his flying club that the electronic flight display in the aircraft had been left on prior to flight, that he had shut the aircraft down to resolve a 'voltage problem', and that now, the engine would not start. The pilot obtained assistance from an engineer and re-started the aircraft.

The aircraft took off without further incident at 0842 hrs, and the pilot transmitted to the aerodrome flight information service officer (AFISO) at Barton that he was changing frequency to Manchester Approach. No transmission was made on the Manchester

Approach frequency (it was usual for pilots departing Barton to monitor the Manchester frequency, without transmitting).

Later in the day, a member of the pilot's family, who was expecting to meet him at Shacklewell Lodge, telephoned a local air traffic control unit to express concern that the aircraft had not arrived. Overdue action was taken, and Search and Rescue operations began.

At about 1530 hrs, two farmers found the wreckage of the aircraft, and reported it to the police. The wreckage was on Saddleworth Moor, high ground to the east of Manchester, at an elevation of about 1,540 ft amsl.

Accident site

The aircraft had struck the ground close to the A635 on Saddleworth Moor and had suffered significant disruption on impact, with the wreckage trail extending for 155 metres.

The first ground mark was made by the right wing tip and the nature of the groove indicated that the aircraft was in a bank of 45° to 55° to the right at impact. Beyond this mark there was a large area of disturbed ground which formed a shallow crater and, further on, several transverse slash marks characteristic of a rotating propeller.

The wreckage trail continued for approximately 150 metres beyond the crater on a bearing of 084°. Both the wing fuel tanks had been disrupted and there was a strong smell of fuel across the accident site, with significant areas of grass discolouration, indicating the spillage of fuel. The engine, its mounting structure and propeller were located 1.5 metres under the surface of the main impact point and the peat surrounding the engine was heavily contaminated with fuel. One propeller blade was found attached to the hub and the

remaining two blades were recovered separately, with one blade showing damage consistent with striking an object whilst rotating.

Three shotguns, which had been in the aircraft, were recovered from the wreckage by the police. After initial examination the wreckage of the aircraft was recovered for detailed examination.

The pilot

The pilot learnt to fly first on gliders and then as a member of a University Air Squadron in 1987-88, accruing 22 hours flying experience. He then did not fly for some years, but took flying lessons at Manchester Barton beginning in August 2006 and he obtained a National Private Pilots Licence in April 2007 following 27 hours of training.

Having obtained his licence, he bought a share in an Ikarus C42 aircraft, which he flew regularly until November 2007 when he sold that share. He then bought a share in the accident aircraft and began flying it in January 2008.

The club CFI (Chief Flying Instructor) described the pilot as being very proficient at handling the aircraft but had, on a number of occasions, expressed concern to the pilot about his judgement. The areas of concern included decisions on whether to fly in weather which was marginal or unsuitable, and instances of flight recorded as flown at unusually high speeds and power settings. Members of the group which owned the aircraft had also discussed concerns about the pilot's judgement, and whether he would continue as a member of the group.

The pilot's licence validity expired on 4 May 2008. The pilot did not hold a radio licence.

Aircraft description

The P&M Aviation/Flight Design CTSW is a two-seat, high-wing three-axis microlight powered by a Rotax 912 UL engine, with a cruising speed of 120 kt. The ailerons are operated through a series of rods and bellcranks, which pass from the control columns, under the cockpit floor and upward behind the rear cockpit bulkhead. The aircraft is equipped with electrically-operated flaps which have a range of -12° (cruise) to $+40^{\circ}$ (landing). The flaps are connected to the aileron system through a mixing unit which causes the ailerons to droop when the flaps are deployed, to improve the aircraft's short field performance. The rudder is operated by a pair of cables from the rudder bars and the elevator is operated by a 'push-pull' Teleflex-type cable. The elevator is fitted with a mass balance arm at its hinge point within the fuselage.

The fuselage is of carbon fibre/foam sandwich monocoque construction, without bulkheads or substantial fuselage frames. The manufacturer's Operator's Manual states that the aircraft has a maximum baggage weight of 25 kg, to be stowed in the rear fuselage immediately behind the rear cockpit bulkhead. Access is provided by a removable panel on either side of the fuselage immediately behind each cockpit door; the seatbacks can also be pulled forward to stow larger items. Any baggage is secured under two bungee nets (Figure 1).

The aircraft was fitted with basic VFR flight instrumentation, much of it integrated into an electronic multi-function (MFD) display which showed airspeed, propeller rpm and altitude. The aircraft had a magnetic compass but was not fitted with an artificial horizon or

direction indicator. The GPS fitted to the aircraft was capable of displaying a synthesised panel of 'flight instruments'¹ (though not an artificial horizon), but the club CFI believed that the accident pilot was not aware of this feature. The aircraft was fitted with an altitude-encoding transponder; the pilot often left it switched off during flight.

The Garmin GPS fitted to the aircraft was capable of displaying terrain and obstacles on its moving map. Terrain within 100 ft vertically of the aircraft's present GPS altitude was shown in red, terrain within 1,000 ft was shown in yellow.



Figure 1

G-CFAZ baggage restraint

Footnote

¹ Derived from GPS information; the device contained no gyroscopic instruments.

Recorded Information

A number of avionic devices were recovered from the aircraft cockpit, including the Multi-Function Display (MFD), hand-held GPS and a panel-mounted VHF radio. G-CFAZ's position was recorded on the Manchester Approach radar and the aircraft was also captured on CCTV prior to departing Barton Aerodrome.

GPS equipment

The pilot carried a hand-held GPS receiver which was powered throughout the flight, recording time, position and GPS altitude. This device was successfully downloaded at the AAIB and contained three flights within the track memory, the first two being a return trip to Mona in Anglesey and the third the accident flight. Also downloaded were a number of user-defined waypoints and routes. One of the routes was labelled 'BTN-SHACKLEWELL' consisting of a number of joined waypoints which made up a route from Barton Aerodrome to Shacklewell.

On the day of the accident, power was first applied to the GPS at 07:46:54 hrs. Over the next hour, the recorded track log showed G-CFAZ taxiing before finally stopping at the eastern edge of Barton Aerodrome. At 08:41:52 hrs, G-CFAZ taxied towards Runway 27R and began its takeoff run at 08:42:40 hrs.

After takeoff, the aircraft climbed to a GPS altitude of around 1,000 ft, turned to the right onto a true heading of approximately 050° and began tracking around the north of Manchester (Figure 2, with expanded final section in Figure 3). Groundspeed, derived from rate of change of position increased to around 110 kt.

At 08:52 hrs, when located north-east of Manchester and tracking towards one of the waypoints on the

'BTN-SHACKLEWELL' route, G-CFAZ began to climb from a GPS altitude of approximately 1,500 ft (Point 'A', Figure 2). This climb continued with the aircraft initially tracking approximately parallel to the 'BTN-SHACKLEWELL' route before deviating to the left, ultimately achieving a maximum GPS altitude of 3,366 ft at 08:54:50 hrs (Point 'B', Figure 3).

After achieving the maximum GPS altitude, the recorded positions indicate a turn to the left followed by a descent. The derived average rate of descent between the maximum GPS altitude and the final recorded position was 2,800 ft/min. The final recorded GPS position was at 08:55:18 hrs at a GPS altitude of 2,043 ft and heading of 013°T. This position was a distance along the ground of 129 m from the initial ground impact mark. Terrain elevation of the initial impact was estimated at 1,541 ft, around 500 ft below the last recorded GPS altitude

Multi-Function Display (MFD)

The MFD was used to present information such as engine, fuel, airspeed and altitude data to the pilot using a liquid crystal display (LCD). This device also contained a number of alarms to produce stall and V_{NE} warnings where appropriate. It also recorded the maximum values of a number of parameters from the last 25 flights.

This MFD sustained significant damage in the impact but the circuit board containing the volatile memory was successfully recovered by the AAIB. The memory on this circuit board was a volatile type, requiring a battery power supply to maintain the memory contents. When measured, the battery charge was insufficient to maintain the memory and the data was therefore lost.

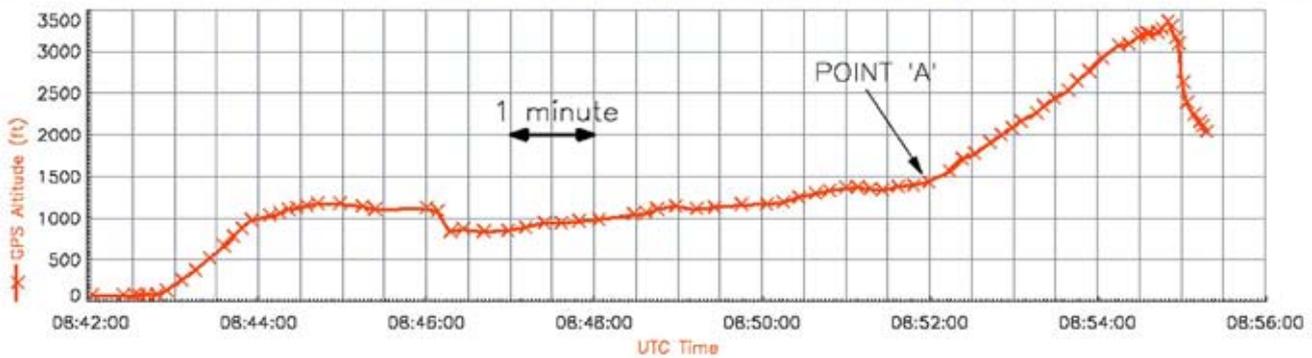


Figure 2

G-CFAZ GPS data – accident flight

Radar

Recorded radar data was provided by NATS, the UK air traffic services provider. The aircraft was identified by three radar heads with the Manchester Approach radar providing the most complete recording of the G-CFAZ track. The other two radar sites only identified fragments of the flight, possibly due to the low aircraft altitude. Only primary radar was recovered, indicating that the Mode C transponder was not operating.

Meteorology

The unofficial weather observation at Barton at 0826 hrs showed that the surface wind was 230/10 kt, visibility was 10 km or more with showers in the vicinity of the aerodrome, there were one or two octas of cloud base 2,300 ft above the aerodrome, the temperature was 11°C and the QNH was 1,015 mb.

No forecasts were produced for Barton, but the Terminal

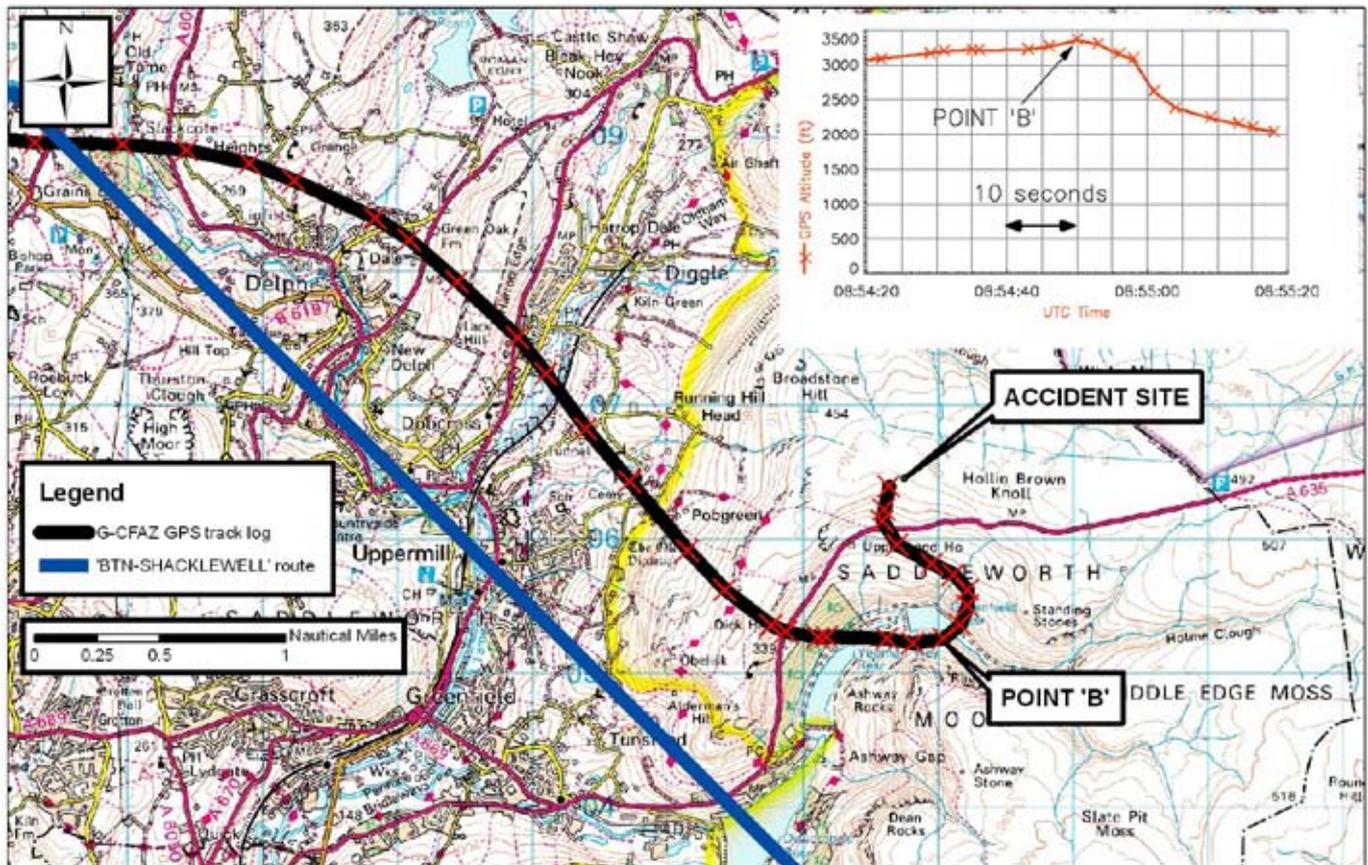


Figure 3

G-CFAZ GPS data – accident flight approaching Saddleworth Moor

Area Forecast (TAF) for Manchester International airport, some eight miles south-east of Barton, stated that between 0700 and 1600 hrs, the wind would be 270/10 kt, visibility would be 10 km or more, and there would be three or four octas of cloud base 2,500 ft above the airport.

The Met Office chart of forecast weather below 10,000 ft, issued at 0330 hrs and valid from 0800 hrs until 1700 hrs, indicated that low cloud in the area would consist of scattered or broken cumulus and stratocumulus with a base between 2,000 and 4,000 ft and tops at or above 7,000 ft. Isolated hill fog was also forecast.

The Met Office provided an aftercast describing the weather conditions at the time of the accident which

broadly concurred with the forecast. It stated that a ridge of high pressure covered the area, with a moderate west to west-northwesterly flow, and that:

‘Given the data from cloud observations, radiosonde ascents, and satellite data, patches of hill fog are possible above ~780 FT AMSL, particularly on the windward (west facing) slopes of the moors’

and that visibility in this hill fog would be expected to be less than 200 m.

The aftercast described wind conditions in ‘free air’ away from the moors, and went on to state that the terrain may cause marked local variations in wind strength. The wind at 1,000 ft amsl was estimated

to have been 290/15 kt in free air, but 290/30 kt at Dovestones Reservoir near the accident site. The wind at 2,000 ft amsl was estimated to have been generally 300/20 kt, but 300/40 kt at the Reservoir. The 0°C isotherm was at 6,000 ft amsl.

The farmer who found the wreckage of the aircraft recalled that when he had started work that morning, at about 0700 hrs, “a gale” was blowing up the valley, and that the weather was misty with thick fog on the top of the Moor. He estimated that the visibility in the fog was approximately 100 m. The top of the moor was not visible from part way up the valley until after lunchtime.

A flying instructor was travelling by car in the area at the foot of Saddleworth Moor’s west side at between 0900 and 1000 hrs on the morning of the accident. He described that there was “a lot of low broken stratus” cloud in the area, some of it covering the hills.

Detailed wreckage examination

The engine’s fuel, ignition and induction systems could not be tested but examination confirmed that the engine had not suffered internal failure, partly due to the ‘slipper’ clutch designed to protect the engine crankshaft in the event of a propeller strike. The engine controls had become disconnected from the engine in the impact and no witness marks were identified to indicate the throttle control setting.

Examination of the flight control circuits showed that all the damage was consistent with the aircraft’s impact and no evidence of pre-impact defect or restriction was identified. The position of the flap actuator was found to correspond with the ‘cruise’ (-12°) position.

The possibility that the movement of the elevator had been restricted by one of the shotguns being carried was investigated, but no evidence of such obstruction was found. When the VHF radio recovered from the accident site was powered up, the primary frequency set was 118.575 (Manchester Approach) and the standby was 120.250 (Barton).

Pathology

A specialist aviation pathologist investigated the pilot’s medical history and carried out a post-mortem examination of the pilot. No medical cause for the accident was identified. Samples had been sent to a laboratory for toxicological analysis and the laboratory report stated that:

‘Toxicology revealed the presence of tetrahydrocannabinolic acid (THC-COOH in [the pilot’s] blood. This is an inactive metabolite of tetrahydrocannabinol (THC) which is the main active constituent of cannabis. THC concentrations generally fall below 5 mg/ml less than three hours after smoking cannabis, and are generally below the limits of quantitation within eight to twelve hours. In contrast, THC-COOH is excreted from the body over a period of days to weeks. Consequently, the results in this case indicate that cannabis had been consumed at some stage prior to the flight, but the absence of THC indicates that this would not have been within the few hours immediately preceding the flight.

‘While THC was not detected, this does not necessarily mean that the pilot would have been unaffected by cannabis. Effects have been demonstrated on attention, psychomotor tasks and short term memory during the 12 to 24 hours

following cannabis use, and an adverse affect on performance of complex cognitive tasks has been demonstrated for up to 24 hours after smoking cannabis.'

The toxicologist added that:

'whilst the possibility that the [TCH-COOH] findings are as a result of passive inhalation due to smoking by others in close proximity can not be entirely excluded it is unlikely that they have arisen from this route', and that 'the drug can have a detrimental effect on psychomotor control long after it has ceased to exert any of the euphoric effects for which it is taken and long after the user perceives that there is any effect.'

It was not possible to determine when the pilot might have consumed (or been exposed to) cannabis, in the days before the accident.

Airspace

The Manchester Control Zone (CTR) is Class D airspace around Manchester Airport from the surface to 3,500 ft amsl. Further Class D controlled airspace exists in the area of the accident site, with a base of 3,000 ft. A Low Level Route is also established, running north/south, to the west of Manchester Airport, to facilitate aircraft transiting through the CTR. Barton is on the east side of the Low Level Route, near its northern end.

Flight planning

In planning his flight south, the pilot had two primary options: to depart Barton to the north-east and fly to the north and east of the Manchester CTR, or to depart Barton to the west and fly south through the Low Level

Route. The former route would involve flying south down the east side of the control zone, where the base of controlled airspace above is 3,000 ft, with high ground to the east and controlled airspace existing down to the surface to the west. The latter would demand accurate navigation down the low level route but would avoid high ground.

Analysis

The purpose of the flight was routine and no technical cause of the accident was identified. The evidence from the accident site showed that the aircraft first struck the ground in a bank of 45° to 55° to the right and the degree of structural breakup, and the spread of the wreckage, indicated that the impact was at high speed and was not survivable. There was evidence of fuel on board and no evidence of failure within the engine, and the ground marks confirmed that the propeller was rotating at impact although the level of engine power at impact could not be determined. There was no evidence of pre-impact failure or restriction in the flying control circuits.

The visibility was good enough that the weather conditions over the Moors would probably have been apparent to the pilot before he took off from Barton, and certainly once he was flying towards the Moors. His choice of route necessarily involved flying towards high ground, and any cloud covering it. A decision to follow the Low Level Route southwards through the Manchester CTR would have enabled the pilot to avoid the combination of poor weather, rising ground, and adjacent airspace which the route over the Moors entailed.

The GPS evidence showed that the flight progressed unremarkably until shortly after the pilot began a climb above 3,000 ft just north of Delph. Once

above 3,000 ft, the aircraft was in Class D controlled airspace, but although the aircraft's radio was tuned to the relevant frequency, the pilot did not make contact with the Manchester Approach controller. The absence of a request to enter the airspace may indicate that the pilot was already in difficulties. The aircraft then entered a series of manoeuvres, the first of which was a tight turn to the left towards a reciprocal course. During this turn, the aircraft began a descent which ended when it struck the ground.

Although the controlled airspace may have been a concern for the pilot, an appropriate distress (MAYDAY) call to the Manchester Approach controller, whose frequency the pilot was monitoring, would probably have resulted in clearance being given to the pilot to head west into the controlled airspace, at least far enough to avoid the high ground and cloud. Therefore, although the controlled airspace was a factor in the pilot's choice of route, it is not considered causal.

Witness evidence, and the Met Office aftercast, showed that cloud was present over the moors, with strong winds and very poor visibility at the surface. This weather had been accurately forecast. It is likely that the aircraft entered this poor weather, and that control was then lost. Whether the initial turn to the left was intentional, and the pilot was attempting to manoeuvre out of the poor weather, or whether the turn was a result of loss of control, cannot be determined.

The accelerated wind over the rising ground of the edge of the moors, and rising air with it, may have had some effect. It is possible that the pilot flew into conditions where the aircraft was, to some extent, carried upwards towards cloud by the rising air, and this contributed to

its entry into cloud, simultaneously drifting the aircraft towards the high ground.

The pilot's behaviour, particularly with respect to his judgement of suitable weather conditions for VFR flight, had previously caused concern to the CFI and others. The pilot's lapsed licence, and the fact that he did not hold a radiotelephony licence, does not appear to have played a causal role in the accident.

The presence of THC-COOH in the pilot's blood did not necessarily reflect consumption in the 24 hours before the accident, and it is possible that consumption, active or passive, took place before that and the pilot's judgement was not affected by the drug at the time. However, without evidence to the contrary, the possibility remains that the pilot was under the influence of the drug at the time of the accident, and that his judgement may have been sufficiently impaired for this to have been a factor in the accident.

Safety Recommendation

The 'open monocoque' structural design of the rear fuselage in this aircraft would allow an unsecured item a significant range of movement, possibly to restrict aileron or elevator movement. While bungee nets may provide sufficient restraint of larger item they will not provide the same level of retention to thin objects. The following Safety Recommendation is made:

Safety Recommendation 2009-101

It is recommended that P&M Aviation/Flight Design review the design of the current baggage restraints in the CTSW design, to ensure that it provides effective restraint of all stowed baggage.