

Slingsby T67C Firefly, G-BOXK

AAIB Bulletin No: 7/99 Ref: EW/C98/10/2 Category: 1.3

Aircraft Type and Registration:	Slingsby T67C Firefly, G-BOXK
No & Type of Engines:	1 Lycoming O-320-D2A piston engine
Year of Manufacture:	1985
Date & Time (UTC):	20 October 1998 at 1131 hrs
Location:	Mow Cop Castle, Staffordshire
Type of Flight:	Private (Training)
Persons on Board:	Crew - 2 - Passengers - None
Injuries:	Crew - 2 (Fatal) - Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	French Test Pilot's Licence and Commercial Pilot's Licence with CAA validation
Commander's Age:	39 years
Commander's Flying Experience:	3,280 hours (of which 18 were on type) Last 90 days - 22 hours Last 28 days - 14 hours
Information Source:	AAIB Field Investigation

Introduction

The accident occurred when the aircraft, which had been engaged on a training detail, was returning to its base airfield at low level and crashed into rising ground.

History of the flight

Flight planning

The instructor was a French test pilot who had been working since January 1998 as the chief pilot of a Woodford based test pilot school. His student was an officer in the Spanish air force who was about to complete a five week performance flight test course. The student's flying experience was 1,744 hours of which 200 hours were in flight testing. The day before the accident the instructor and student had travelled by road to collect the aircraft from the aircraft manufacturer's facility, since the one normally used by the school was undergoing routine maintenance. The flight back

to Woodford, which lasted a little over two hours, was used to conduct some climbing performance tests as part of the training syllabus.

The following morning the instructor briefed two of his students on the planned spinning performance exercises which were to be flown later in the day. This briefing included not only details of the spinning exercises but also safety considerations including aircraft egress, engine air starting and emergency landings. The instructor was to fly with his Spanish student in the morning and his other student that afternoon. The entry in the 'daily flight authorisation' record sheet showed that the flight had been authorised by the instructor with the flight detail entered as 'SPIN'.

After the briefing, which lasted approximately 45 minutes, the instructor asked one of the ground crew to refuel the aircraft to full tanks (fuel uplift 62 litres). This was carried out under the instructor's supervision who at the same time was seen to carry out a pre-flight 'walkround' check of the aircraft. Some time later the instructor and student were seen taxiing for take off with the instructor occupying the right hand seat and the student in the left.

The aircraft took off from Woodford and flew to the east of controlled airspace in the vicinity Gamston, Lincolnshire. Here the crew carried out the briefed spinning exercises before returning towards Woodford. The only information available on their progress was that provided by recorded radio and radar information until the aircraft was observed by witnesses in the area around the village of Mow Cop. The village is situated on high ground that forms part of the south-western 'Pennine Hills'. To the north and west of the village is the lower lying ground of the 'Cheshire Plain'.

Eye witnesses

A number of children (aged between 9 and 10 years) in the playground of a local school, approximately 2 km south of the crash site, stated that they saw an aircraft at about 1130 hrs on the day of the accident 'flying low' and manoeuvring above the school at low level. Their description of the aircraft matched that of the Slingsby T67, G-BOXK. Some described the aircraft 'bumping around in the turbulence' and carrying out three orbits of the school. Others saw it 'flying up and down' before disappearing in the direction of Mow Cop. Adults, supervising the children in the playground, did not pay particular attention to the aerial activity that day and were not witnesses to events.

One witness, positioned south of the crash site heard the aircraft as it approached him. He described it as 'flying straight and level at a height estimated to be 300 feet. As it flew from his right to left it carried out a roll to the right - with a high rate of rotation in the rolling plane. When it reached the level attitude again the wings 'waggled' and almost immediately the aircraft 'pulled up into a loop'. The witness estimated that 'at the start of the loop the aircraft was below the level of the top of the ridge. After almost completing the loop, which was inclined slightly to the left of the vertical, the aircraft hit the ground with 20° nose down banked slightly to the left'.

Two witnesses, positioned on ground close to the crash site, saw the aircraft as it flew towards them at an estimated height of 100 to 150 feet above nearby trees and the local church. They saw the wings of the aircraft rock from side to side before 'the aircraft pulled up into a loop'. They went on to describe the 'loop' as being off-set to the left initially followed by a vertical descent. The aircraft then disappeared from their view, moments before impact, pitched down by 15°.

A further witness, walking his dogs close to the ruins of an old monument (known as the 'Old Man of Mow') on highest point of Mow Cop, noticed the aircraft as it approached him from the south-east. He saw the aircraft pass close to trees and the local church in a slight descent. He estimated that the aircraft cleared the church tower by an estimated 25 feet. At that point the aircraft was heading directly towards him. The witness could 'clearly hear the engine; the sound was uniform; there was no coughing or spluttering and no indication of any engine malfunction' It then flew over nearby houses, narrowly missing electric cables standing some 12 feet above ground level then, within '0.5 to 1.0 seconds' it rapidly pitched nose up and rolled to the left before impacting with the ground in a right wing down attitude.

This witness arrived on the scene within 30 seconds. As he approached the wreckage the fuel ignited. Through the dense smoke from the fire the witness was able to see one of the pilots lying on the ground some 10 feet from the fuselage. He dragged the pilot clear of danger and, using his own jacket, extinguished the pilot's smoldering clothing. Unfortunately it soon became apparent to him that the pilot had already sustained fatal injuries. He did not see the other pilot because of the smoke and flames.

The emergency services were alerted at 1132 hrs by telephone from a member of the public. A paramedic, who lived locally and was alerted by pager, attended the scene almost immediately. The local ambulance, fire vehicles and police aircraft arrived on the scene by 1137 hrs. The second pilot was found fatally injured in the remains of the fuselage.

RT transmissions

Recorded RT transmissions of ATC Woodford and the aircraft showed that the commander made all the RT transmissions, commencing at 0930 hrs when he asked Woodford tower for taxi clearance. This was given and the QNH of 1018 mb was passed. The aircraft was later cleared for a left turnout after take off on a 'Congleton 1 visual (departure)'. At 0942:40 hrs the pilot reported at Congleton whereupon he was given the Barnsley QNH (Regional Pressure Setting) of 1013 mb, and asked to report ready for a rejoin. The pilot replied that he would call back in one hour.

At 1017 hrs the pilot called the Waddington Radar controller stating that he was to carry out some exercises west of Gamston between 5,000 and 10,000 feet. The Waddington controller, having verified that the aircraft's mode 'C' was indicating correctly on his radar, suggested that if the aircraft was to operate up to 10,000 feet it would be better to contact London for a service. On this suggestion the pilot left the Waddington frequency but returned to it two minutes later, at 1020 hrs, requesting to operate between 5,000 and 8,000 feet. At 1024 hrs the Waddington controller passed the Barnsley QNH of 1014 mb and cleared the aircraft to operate 'in the block 5,000 to 8,000 feet'.

There were no further transmissions from the aircraft recorded until 1057:30 hrs when the pilot contacted Waddington again saying 'xray kilo we are descending in low altitude; return to base and leave the area thank you for your co-operation.....'. The Waddington controller acknowledged this. There were no further transmissions from the aircraft recorded on any of the frequencies used by ATC service units in the area.

Radar information

Recorded radar information was analysed and the aircraft's position and height (± 100 feet) for both the outbound and inbound sector, corrected when required to take account of the variations in sea level pressure, were plotted.

Outbound

Position and height information (SSR mode 'C'), recorded from the Manchester radar, showed that the aircraft left Woodford, turned to the south and climbed to 2,500 feet as it reached the Congleton visual reporting point (VRP). It continued southwards climbing to 3,900 feet as it passed to the east of Stoke-on-Trent and 4,500 feet at a position 4 nm northeast of Stafford. From here it turned onto a northeasterly heading and descended to 2,500 feet. By the time it reached Uttoxeter it had descended further to 1,000 feet amsl and remained at this height as it passed three nautical miles to the south of the Trent VOR and below controlled airspace. At Mansfield it began to climb clear of controlled airspace, for the spinning exercise, operating at heights of between 4,000 and 8,000 feet. These manoeuvres were all carried out in an area to the north and west of Gamston.

Inbound

On completion of the spinning exercise the aircraft commenced its return flight to Woodford descending below radar cover. It reappeared, as recorded by the Claxby radar, at approximately 1101 hrs, one nm south of Gamston and at a recorded height of 400 feet (343 feet agl corrected). From here it flew to the south-west turning onto a heading of 315° as it reached Matlock. The Clee Hill radar recorded its progress from Matlock north-westwards towards Bakewell before turning south towards the Trent VOR. Three nautical miles before the VOR it turned west again, passing south of Leek and Biddulph, before turning northwest towards Mow Cop. The last recorded radar position, timed at 1129:04 hrs, was within approximately 200 metres of the crash site.

Throughout its return flight heights (mode 'C' corrected) of between 1,000 and 1,400 feet amsl were recorded by the radar. Study of the local terrain beneath the flight path showed that generally the aircraft was flying at 400 to 500 feet agl. On occasions however the aircraft was as low as 200 feet agl and, for a short period, only 100 feet above the local terrain. As it approached Mow Cop the recorded height at the last radar position, was 428 feet agl (mode 'C' corrected).

Weather

The synoptic situation at 1200 hrs showed a south-westerly airstream becoming established over England and Wales with a frontal system moving quickly north-east across Ireland. The weather was occasional rain with visibility approximately 12 km. There was scattered cloud with a base of 2,000 feet, scattered to broken cloud with a base of 3,000 to 4,000 feet and overcast cloud at 11,000 feet. The surface wind was 160°/10 kt with a surface temperature of +9°C while the wind at 2,000 feet was 220°/35 kt. The mean sea level pressure was 1018 mb.

Moist weather was being advected across Wales on the strengthening south-westerly wind and many high peaks would have been obscured with cloud. However, at the time of the accident it appeared that the more moist conditions had not reached the Manchester/Shawbury area. With pressure falling quickly in the west and a strengthening of the gradient wind, coupled with the high ground of Wales, turbulence may well have been experienced.

Accident site

The accident site was in a field on the south facing slope of an east west ridge rising to approximately 1110 feet amsl. The site was approximately 80 feet below the apex of the ridge. To the north and west of the site lies the Cheshire plain where the land is generally 110 feet amsl. To the south and east are the foothills of the Pennines.

Examination of the site showed that the aircraft impacted the ground at the southern edge of the field in an area where the ground had a 20° upward slope. The initial impact was made by the right wing tip followed by the leading edge of the right wing, the right landing gear and the propeller and engine. The front of the aircraft penetrated the ground to a depth of about 20 inches whereupon the uphill slope forced the wreckage upwards causing it to become airborne again. Following the initial impact the wreckage rolled to the left, yawed to the right and came to rest inverted approximately 70 feet further into the field. There was an intense post-impact fire.

Examination of the ground impact marks showed that the aircraft had impacted with the ground on a heading 345° Magnetic. The wreckage trail indicated a track of 330° Magnetic indicating that the aircraft was yawed to the left by 15° at impact. Impact marks on the ground indicated that the aircraft was banked approximately 25° to the right, pitched 5° nose down, yawed to the left, rolling to the left, descending at about 1,000 feet per minute, and travelling at about 60 kt.

There was evidence that the propeller was rotating under power. Evidence from the post-impact fire indicated the aircraft had a reasonable quantity of fuel onboard. All the major parts of the aircraft, including the flying control surfaces, the canopy and engine cowlings were found to be present at the accident site, indicating that no significant part that may have effected the airworthiness of the aircraft, had detached prior to the initial impact.

Wreckage examination

A detailed examination of the aircraft systems located within the fuselage was severely limited by the post-impact fire damage. The rudder and elevator trim control systems were found intact, however a detailed examination of the complete elevator and aileron control systems could not be carried out. The elevator trim was found to be set at approximately its mid position and both wing flaps were found to be retracted. Those parts of the flying controls that could be examined showed no evidence of pre-impact failures, disconnects or restrictions.

No pre-impact failures were found in the engine or its systems. The cockpit engine controls indicated that the throttle was at or near full power and that the carburettor hot air control was in the COLD position. The carburettor throttle valve and hot air flap were found to be in positions consistent with their cockpit controls.

The cockpit instruments were also severely damaged by fire. The sub-scale settings on the two altimeters were 1015 and 1012 mb but the altitudes indicated at impact could not be determined. Both vertical speed indicators indicated a descent rate of between 800 and 1,000 feet per minute. The engine RPM gauge was reading 2,100 RPM. The cockpit canopy lock mechanism was identified and it was found to have been correctly closed and locked at impact.

Pathology

Post-mortems carried out on both pilots did not find any conditions which may have caused or contributed to the cause of the accident. It was not possible, by pathological examination, to determine which crew member was flying the aircraft at the time of impact.

Operations manual

The test pilots' school published an operations manual which contained sections on 'organisation and responsibilities, operational control and supervision, and operating procedures'. It stated that

'the captain remains responsible for all operational aspects and for the overall safety of the flight. Paragraph 8.3.4 dealt with 'low flying'. It stated that 'no pilot shall fly a school aircraft lower than 1,000 feet agl during flight away from an aerodrome unless specifically authorised'. The instructor, as the Chief Pilot of the school, was entitled to authorise flights below 1,000 feet agl, but he had not recorded this, in writing, on the daily flight authorisation record sheet.

Aircraft handling

Discussions with the manufacturer's chief test pilot revealed that the T67 aircraft can be encouraged to 'flick' (ie pitch up and roll rapidly) by aggressive positive pitch demand. If this control input is applied the aircraft will tend to flick rapidly to the left as a result of engine torque reaction.

Discussion

The comprehensive briefing, given by the instructor to both his students before the first flight, covered all aspects of the spinning exercises which were planned to be flown that day. He covered the safety aspects but did not discuss low level flying. His entry in the authorisation documentation confirmed that, at the time of signing, he intended only to carry out spinning.

The departure from Woodford and the spinning exercises were apparently carried out successfully in a routine manner. The homeward flight to Woodford, however, included flying at lower than normal heights.

Reports from witnesses in the area of Mow Cop gave, in some instances, conflicting evidence. The school children described the aircraft as circling the school several times before departing towards Mow Cop. Recorded radar information however showed that, immediately before the accident, the aircraft turned onto a northwest track with no deviation. Several witnesses described the final manoeuvre before impact as a 'loop'. The time taken and the height reached during the manoeuvre however is more consistent with the execution of a flick roll which can be brought about, in this instance, by aggressive pitch control inputs.

There were no pre-impact failures or evidence of restrictions to the flying controls or aircraft systems of those parts of the wreckage that survived the post impact fire. The cockpit engine controls showed that a setting of nearly full power was set prior to impact and evidence from the propeller showed that it was rotating.

It could not be determined why the aircraft was flown at low level for some 28 minutes before the accident or why it was flown on a track towards the rising ground at Mow Cop.