AAIB Bulletin No: 10/95 **Ref: EW/C95/7/5** **Category: 1.3**

Aircraft Type and Registration:	Slingsby T67M MKII Firefly, G-BUUH
No & Type of Engines:	1 Lycoming AEIO-320-D1B piston engine
Year of Manufacture:	1993
Date & Time (UTC):	12 July 1995 at 1015 hrs
Location:	Markham Moor, near Gamston, Lincolnshire
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	43 years
Commander's Flying Experience:	3,300 hours (of which 70 were on type) Last 90 days - 78 hours Last 28 days - 38 hours
Information Source:	AAIB Field Investigation

History of the flight

The accident occurred during a dual instructional sortie to teach spin entry, maintenance and recovery. Following a thorough pre-flight briefing, the instructor and student took off at 0925 hrs from RAF Barkston Heath for the exercise area to the north west. The weather was fine, with a clearly defined visible horizon in all directions and scattered patches of cloud between 3,500 and 4,000 feet. The aircraft was initially climbed to FL 45, where the student performed a number of steep turns and then continued the climb to FL 90 to begin the spinning exercises. The instructor had calculated the Minimum Entry Height for this exercise as FL 60. The student firstly performed two recoveries from incipient spins. The instructor then demonstrated a full spin with recovery. Next, at FL 70, the student completed a spin entry, at which point the instructor took control and taught the spin maintenance and recovery techniques whilst the student 'followed through' on the controls. The aircraft was then climbed back to FL 70, where the student was to enter a spin of up to four turns to the left, and recover from it on the instructor's commands. At this time, the aircraft's fuel contents was 10 gallons, evenly distributed in both tanks.

The student entered and maintained the spin satisfactorily, except for a slight aileron input which the instructor immediately corrected. At FL 57 the instructor ordered "RECOVER NOW" and the student

applied partial opposite rudder and simultaneously moved the control column about half way from the back stop to the neutral position. Then or shortly afterwards, the nose of the aircraft suddenly pitched down and the rate of rotation increased. The instructor said "I HAVE CONTROL" and, checking that the throttle was closed and the flaps retracted, applied full anti-spin rudder and moved the control column progressively to the fully forward position. The instructor states that this had no noticeable effect upon the apparent stability of the spin. As the aircraft descended through FL 45, he made another check of the configuration and confirmed that the attitude and rotation still showed no indication of recovery. Neither pilot has been able to recall the number of rotations accomplished by this time.

On this occasion, the height at which it was mandatory to abandon the aircraft, if spin recovery had not been achieved, was FL 40. Consequently, as the aircraft descended through FL 43 the instructor transmitted a truncated 'MAYDAY' distress call and, giving the order to abandon the aircraft, opened the canopy. He was seated on the outside of the spin, and subsequently commented that he had difficulty in standing up and that he had to crawl and fall over the side, rather than jump. The student, on the inside of the spin, was able to stand up and, putting his right hand on the 'D' ring, stepped onto the wing and jumped. Although the student had a delayed parachute deployment, caused by initially failing to pull the 'D' ring far enough out of its housing, both he and the instructor landed safely and without injury in a field within 400 metres of where the aircraft had crashed.

Flying orders relating to spinning exercises

The civil registered aircraft was being used by a civil contractor to train RAF student pilots. The instructors hold civil qualifications. Unlike the syllabus for a Private Pilot's Licence, the course calls for spinning exercises to be included and the training school's Instructor Handbook (Change 3 Spinning) defines those height parameters within which spinning exercises must be carried out. Although calculated by reference to Flight Levels, they are described as 'heights' for convenience and to avoid confusion. They are:

i) Minimum height for abandoning the aircraft (MAH). This is calculated by adding the maximum height of the local area ground (about 500 feet) to the Transition Level (TL). On the day of the accident TL was FL 35 and therefore the MAH was FL 40. (If the aircraft has not recovered from a spin by this height, it MUST be abandoned.)

ii) Minimum height to commence recovery (MHCR). This was calculated as MAH +1,000 feet and was FL 50.

iii) Minimum entry height (MEH) for a four turn spin is 1,000 feet above MHCR. On this occasion MEH was FL 60.

The instructor has stated that he chose to begin the final exercise at FL 70, rather than FL 90, because it conserved both fuel and time for the remaining part of the sortie whilst still providing a safety margin above the MEH.

Wreckage and impact information

The aircraft had come to rest in a bean crop slightly to the north of the junction of the A1 and A57, on a heading of about 350°. The whole airframe, complete with canopy and all panels and control surfaces, was contained within an area only slightly larger than the planform of the aircraft. The ground marks, damage to the crop, airframe and propeller damage showed that at impact the aircraft had little or no forward speed and was yawing rapidly to the left, with the left wing slightly low and the nose slightly down. The artificial horizon showed about 10° left wing down and a few degrees nose down, and it had stopped at this position due to impact forces. During the impact the main landing gear had collapsed and the wheels had passed up through the wing trailing edges. As a result the flaps were damaged and the left inboard flap had thrown off in the direction of the spin. The flap lever was in the takeoff position. The left aileron had also been dragged off and was underneath the left wing, which was consistent with yaw to the left.

The aileron, elevator and rudder linkages were examined for evidence of disconnection, jams or pre-existing failures. None was found. The rudder cables at the pedal ends were inspected for correct assembly and orientation of the bolts as there had been one recorded case of jamming of the rudder due to a combination of incorrect bolt orientation and excessive clearances. The cables and bolts were found to be correctly assembled. The flap lever was found in the takeoff position with the detent engaged. Two strong springs are fitted to the flap mechanism so that, without air loads, there is a strong tendency for the flaps to move down if the detent is released. It was evident from distortion of the left flap mechanism that impact forces had been applied in a direction which would tend to pull the lever towards the takeoff position. The detent slots and key were examined for witness marks, but only general wear was found. It was considered that if inertial impact loads had partially released the detent key, it could move out by a cam like mechanism under the spring and impact loads, leaving damage on the edges of the slots not unlike normal wear. In another spinning accident to a T67C, G-BLRE on 20 November 1988, it was observed that the flaps were found at the take-off setting after the accident. That AAIB report concluded that "the design of the flap operating mechanism was such that they could have moved to this position under impact forces". The elevator trim wheel was found to be just aft of neutral, ie slightly nose up. This would be a normal position for spinning, however due to the reversible nature of the teleflex cable and trim wheel mechanism, it cannot be assumed that it did not move in the impact. The trim tab had become detached from the elevator in the impact.

The propeller had stopped in less than one rotation, breaking one of the two wooden blades near the root. No direct evidence of rotation was found on the propeller, however the ground was quite soft and without stones. The propeller pitch change mechanism was found to be undamaged, with both blades in fine pitch. On this propeller, the blades are fined off by oil pressure against the action of a 'feathering' spring. Consequently the propeller was almost certainly in fine pitch in the air, with the engine turning. In view of the very low forward speed it is most likely that the engine was running

normally, at idle power, at impact. No evidence suggesting an engine problem has been found during this investigation, however the aircraft flight manual does indicate that the engine may stop during a spin, and should restart without pilot intervention during recovery. This aircraft has a history of fuel injector problems culminating in the injector being changed in January 1995. No further problems were recorded in the logbooks. No fuel was found in the left tank due to complete disruption of the tank cell. The right tank contained about 5 US gallons.

Additional information

It is a characteristic of some aerobatic aircraft that they can develop a high rate of rotation in a spin when incorrect or incomplete control application is made during recovery. Instructors normally prevent the development of such a situation by intervening on the controls as soon as an incorrect technique is apparent. The instructors handbook states "Whenever the student is practising spinning the QFI must follow through on the controls. If the student makes any critical error, the QFI should take control immediately, otherwise an unusual or high rotational spin may result."

Since the accident, the aircraft manufacturer has issued Temporary Amendment Leaflet (TAL) No 6 for the T67M Mk II, which is reproduced below.

In the light of this action further safety recommendations are not under consideration at present.

'SPINNING

3. 7. 2 Incorrect Recovery

A high rotation rate spin may occur if the correct recovery procedure is not followed, particularly if the control column is moved forward, partially or fully, BEFORE the application of full anti-spin rudder. Such out-of-sequence control actions will delay recovery, and increase the height loss. If the aircraft has not recovered within 2 complete rotations after application of full anti-spin rudder and fully forward control column, the following procedure may be used to expedite recovery.

a. Check that FULL anti-spin rudder is applied.
b. Move the control column FULLY AFT - then SLOWLY FORWARD until the spin stops.
c. Centralise the controls and recover to level flight, (observing the "g" limitations).

TAL 6/P.1 of 1
CAA Approved
August 1995
TP.T67M-MkII/FM'