Kolb Twinstar Mk III, G-MZKB

AAIB Bulletin No: 12/98 Ref: EW/C98/7/6 Category: 1.3

Aircraft Type and Registration:	Kolb Twinstar Mk III, G-MZKB
No & Type of Engines:	1 Rotax 582 piston engine
Year of Manufacture:	1997
Date & Time (UTC):	26 July 1998 at 0900 hrs
Location:	Near Louth, Lincolnshire
Type of Flight:	Private
Persons on Board:	Crew - 1 - Passengers - 1
Injuries:	Crew - Fatal - Passengers - Fatal
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence (Microlight Aircraft)
Commander's Age:	33 years
Commander's Flying Experience:	194 hours (of which 9 were on type)
	Last 90 days - 9 hours
	Last 28 days - 3 hours
Information Source:	AAIB Field Investigation

Aircraft history

The aircraft, in a partially built condition, was purchased by the pilot in May 1997. It was a side by side two seat microlight with the engine mounted behind the wing and cockpit. The pilot completed the building work over a period of five months. Test flying was carried out by an approved certification pilot in October and November 1997, leading to the issue of a Permit to Fly on 20 November 1997. The aircraft was then put away for the winter and was next flown in May 1998 by the pilot, accompanied by the test pilot, so that he could become familiar with the controls.

This aircraft had a conventional three axis control system and was fitted with dual controls. There was no requirement for a stall warning system to be fitted to the aircraft and during the test flights it was noted that there was no natural pre-stall buffet. At the time of the accident the aircraft had flown a total of 21 hours.

History of flight

On the morning of the accident the pilot with his father, who was to be the passenger, drove the aircraft on a trailer from his home to Manby Airfield Lincolnshire, a disused aerodrome two miles distant. The flight was his father's first trip in the aircraft and the intention was to fly to a nearby farm strip and meet some friends there. The father had flown several times before with his son in a different aircraft but he was not a pilot himself. On arrival at Manby they assembled the aircraft and the pilot assisted his father to strap in before carrying out a walkround inspection. The pilot's normal practice was to use part of the old taxiway, a hard surface, for his take-off run. On this occasion the taxiway was in use by motor vehicles so he used an area of grass nearby and was able to take off directly into wind.

The weather at the time was fine with scattered cloud above 2,500 feet, a southerly wind, good visibility and a surface temperature of 17°C. A meteorological soaring forecast for the day indicated stable air conditions could be expected.

The take off was observed by several people and was described as normal with full power and some flap. The aircraft was then seen to cross the airfield boundary at a height of 40 to 50 feet by an observer who remarked that it appeared slow, estimating the speed over the ground at 40 mph. He also commented that the pilot and his passenger looked to be cramped in the cockpit. The aircraft was next seen when it was one mile from the airfield at an estimated height of 400 to 600 feet flying in a straight line. It was described as both flying and climbing more slowly than usual by a witness. This witness had seen the aircraft fly past on several previous occasions. He was standing on the roof of his house at the time and heard the engine noise reduce for a moment and then increase again, a few seconds later he saw the left wing drop a little. He then saw the wing drop further and the aircraft enter a steep nose down spiral to the left and hit the ground left wing tip first.

The witness called the local emergency services who were on the scene within 15 minutes, there was no fire but both occupants sustained fatal injuries in the crash.

On-site examination

The aircraft had impacted a field of ripe oil-seed rape in a steep nose-and-left-wing low attitude. It had then cartwheeled a few metres further before coming to rest The impact had completely disrupted the tubular fuselage structure, buckled the tail boom and caused severe damage to the leading edges of both wings. The engine, being mounted behind the cockpit, was remarkably lightly damaged and, it appeared, could possibly be run with a few minor component changes (see 'subsequent examination'). Damage to the propeller was also fairly light, with little splintering of the composite structure or heavy damage to the leading edge. The tip damage, however, coupled with witness marks on the flap and aileron torque tubes indicated that the propeller had been rotating as the engine moved forwards on impact but the overall lack of heavy damage suggested that it was probably under low power.

The aircraft was fitted with two plastic fuel tanks each of some 5 gallons capacity, and the aircraft's maximum placarded fuel load was 40 litres. One of the tanks had been gashed by the impact and was empty but the other had only suffered a small hole towards the top and was found, removed from the fuselage by the rescue services, to be roughly half-full of fuel.

The aircraft was complete on the accident site and there were therefore no indications that any form of structural failure had occurred.

Subsequent examination

The aircraft was removed from the accident site and transported to the AAIB at Farnborough for further examination. Here, the covering was stripped and the major structural components further examined for evidence of any pre-impact failure. No such evidence was found. Although the fuselage was effectively destroyed, it was possible to verify that there were no pre-impact disconnections of any of the flying controls. The degree of disruption did, however, render meaningful examination of the flying controls in the cockpit for evidence of jamming by foreign objects almost impossible. Several potential loose items were found: in particular two cameras, a mobile telephone and a hand-held air-band radio (although this may have been mounted in some way as the aircraft was equipped with an intercom system and headsets were found in the wreckage). It was not possible to verify that the seat belts had been routed correctly, which has been mentioned by other Twinstar owners as a possible source of interference with the controls.

The engine was only lightly damaged and was taken to the UK agent for Rotax engines for assessment and possible running. After replacement of a spark-plug cap, some straightening and repair of the cooling system and fitment of a test propeller, the engine was successfully started and run in a test stand. It delivered full rated power using both the test fuel and the fuel recovered from the accident aircraft, and extended running did not result in any misfiring or loss of power.

However, during the testing it was noted that, with the engine shutdown, a distinct fuel leak could be discerned at the inlet to the mechanical fuel pump. This pump is driven by crankcase pressure pulses and is actually mounted on the engine mounting frame, delivering to the twin carburettors via rubber hoses. The same rubber hose was used at the inlet to interface with the airframe fuel supply. The pump used was the one from the accident aircraft and the inlet and outlet connections had not been disturbed.

The reason for the leak appeared to be that the hose connection to the pump inlet metal nipple was insufficiently tight, and in fact all three connections could readily be rotated by hand. At the inlet, rotation of the hose relative to the nipple varied the leak rate from a definite run of fuel to no leakage at all. With the engine running there was no leakage of fuel from the joint because it is operating at a negative pressure as the pump draws fuel from the tanks (which were lower than the pump both on the test stand and in the aircraft). The converse of this is that, with the engine running, a leaking connection can potentially draw air into the stream of fuel. To test this, a piece of clear plastic tube was inserted into the rubber hose between the pump and the carburettor and the engine run to full power. With the inlet hose rotated into a 'non-leaking' condition the fuel stream was perfectly transparent but when rotated into a 'leaking' condition, it immediately became opaque white due to entrained air and a large static bubble tended to form in the high point of the tubing loop. Despite this observation, extensive running in this condition did not cause any apparent misfiring of the engine, but the test did show that a significant quantity of air was being inducted into the fuel flow.

The method of securing the rubber hose to the pump nipple was achieved using 'O' clips. These are widely used in the automotive and other industries and provide a quick, permanent, method of making such connections. Unlike some other methods, however, the clip cannot be removed without destroying it, as it has to be cut and there is no way to retighten it if it becomes loose. The accompanying photographs show that the clip, as supplied, is essentially a ring with two partially formed 'ears'. It is slipped over the hose, which is then engaged on the metal nipple. The two 'ears' are then squeezed using a special tool resembling pliers. This causes the ring to tighten around the whole assembly.

On the accident aircraft installation, the rubber hose used was identified as '1/4" SAE 30R7KX'. This was correct to the installation drawing and has an external diameter of 1/2". The 'O' clips used, however were oversized and clearly marked 9/16". Examination of the quality of the joint showed that the clips had been formed into an oval cross-section, as opposed to the ideal circular section. The accompanying photographs illustrate the effect of using the oversize clips: they show two connections made using a correct 1/2" clip and the incorrect 9/16" clip. The upper photograph is of the inlet pipe from G-MZKB cut back to the clip to show the effect. The lower photograph shows a connection made by AAIB using the correct clip size. The degree of ovality on the former is immediately apparent as is the consequential gaps occurring at each side. The reason why rotation of the connection affected the leakage rate is apparent in the upper photograph showing that the inlet pipe turns through a 90° bend close to the connection and there is some buckling of the tube which is itself no longer circular. Depending on the orientation of the hose with respect to the inlet pipe bend, the effect of the gaps will be increased or decreased. Joints made using the correct-size clip were also noticeably tighter and difficult to rotate by hand.

Pilot's flying experience

The pilot attended a flying training course in 1992 and 1993, leading to the issue of a Private Pilot's Licence (Aeroplanes) Microlight on 19 May 1993. The training was carried out on a weight shift control type microlight and after issue of his licence the pilot acquired a Gemini Flash II, another weight shift control type. From this time until July 1997 he logged a total of 160 hours on this aircraft. There is no record of the pilot having carried out any conversion training to a 3-axis control system aircraft other than 5 hours of familiarisation flying with the certification pilot. At the time of the accident he had logged a total of nine hours flight time on the aircraft.

There is no requirement for conversion training for a microlight pilot converting from one type of control system to another. The guidance given to pilots by the CAA in publication CAP 53, *The Private Pilot's Licence and Associated Ratings* is as follows:

> "Microlight pilots converting from weight shift to 3-axis control systems, or the reverse, should undertake adequate conversion training and pass the Additional Control System Test (ACST) conducted by an appropriately qualified microlight examiner."

Pathology

Post mortem examination and study of the medical records revealed no medical condition that would have influenced the accident in either the pilot or the passenger. The pilot weighed 92 kg and the passenger 90 kg.

Flying characteristics

The aircraft was found to have an indicated stalling speed of 42 mph in the clean configuration during the certification flying and the stall was described as very docile with a negligible wing drop. The manufacturers in their Builders Manual highlight the following information for pilots :

"More important than all else - keep up your airspeed"

The manual also makes the following statement :

"Through the stall you will have roll control with the ailerons."

Discussion

There were no indications from the wreckage that the construction of the aircraft was at fault or that there was any pre-impact failure of the structure or flying controls. It therefore seems probable that the accident occurred as a result of a loss of control by the pilot.

The aircraft was observed by several witnesses to be flying slowly and the engine was heard to falter. Unless the pilot was quick to lower the nose when this occurred the airspeed would have reduced rapidly and the aircraft would have stalled. It is likely that the pilot either failed to recognise the stall, or that he applied an inappropriate corrective action, causing the wing to drop and a steep nose down attitude to develop. An incorrect control input may have occurred as a result of the pilot's lack of training and experience of the control system, or as a result of inadvertent restriction of the controls by one of the occupants.

The question of a possible engine malfunction as a contributory factor influencing the loss of airspeed remains. The testing did not manage to reproduce a power loss, although a potential problem was identified. The possible effect of air induction into the flow of fuel, although not reproduced during the test, could well lead to a reduction in power as opposed to a complete power loss. The degree of power loss could also be influenced by the attitude of the aircraft since, with the fuel tank/engine relative positions in this installation, a nose high attitude should help somewhat to reduce the depression (and hence tendency to induct air) whilst a nose-low attitude will have the converse effect.

Safety recommendation

98-62 This accident may have resulted from a loss of control by the pilot. The pilot had no training and limited experience on the type of aircraft control system that he was using. Given the fundamental differences between weight shift and 3-axis control systems, notably the diametrically opposed control movements for pitch and roll, it is recommended that the CAA should consider making the guidance contained in *CAP 53* , *Chapter 2 paragraph 2.2 and Chapter 1 paragraph 2.2* , a mandatory requirement.