ACCIDENT

Aircraft Type and Registration:	Letov LK-2M Sluka, G-MZOT
No & Type of Engines:	1 Rotax 447 1-V piston engine
Year of Manufacture:	1999
Date & Time (UTC):	6 August 2006 at 1525 hrs
Location:	On the edge of North Coates Airfield, Lincolnshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - Nil
Injuries:	Crew - 1 (Fatal) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	62 years
Commander's Flying Experience:	450 hours (of which 16 were on type) Last 90 days -12 hours Last 28 days - 3 hours
Information Source:	AAIB Field Investigation

Synopsis

Whilst on a flight from Bucknall to North Coates, the aircraft was nearing its destination when the pilot transmitted a radio call indicating that he had an elevator control problem. He attempted an immediate approach to the airfield, but, as he was too high, carried out an orbit before making a second approach. On short finals, at a height of around 150 feet agl, the aircraft was seen to suddenly pitching nose-down and impacting the ground in a near-vertical attitude.

The investigation revealed that a nut and bolt attaching the tailplane bracing wires to the fin had come undone, resulting in what was effectively a structural failure of the tailplane.

History of the flight

The pilot had completed a return flight to a local airfield prior to departing on the accident flight and did not report any problem with the aircraft or flying conditions. After lunch at his home airfield, Bucknall, he decided to fly to North Coates together with a Thruster microlight which had landed at Bucknall earlier that day. He was observed refuelling his aircraft prior to this flight. At 1445 hrs he took off behind the Thruster and the two aircraft tracked north-west towards North Coates at approximately 1,500 feet amsl. The Thruster, having a faster cruising speed, arrived at North Coates several minutes ahead of the Sluka and landed on grass Runway 05 at approximately 1520 hrs.

As the Sluka approached the airfield boundary, the pilot transmitted[1]

> "I HAVE HEARD SOMETHING SNAP, I HAVE PARTIAL ELEVATOR FAILURE AND CANNOT FLARE. I AM THREE MILES OUT. CAN I HAVE CLEARANCE TO COME IN FOR AN EMERGENCY LANDING?"

This message was relayed by another microlight pilot in the circuit at North Coates who was able to witness the aircraft's flightpath, along with several others on the ground. As the Sluka crossed the threshold of Runway 05 it was still at approximately 500 feet agl and the pilot commenced a descending right hand orbit, transmitting "GOING ROUND I'M TOO HIGH", before rolling out on the centreline at about 200 feet agl. As he rolled out of the turn, he transmitted: "I'M STRUGGLING TO GET FULL ELEVATOR TRIM, I CAN'T GET THE STICK FORWARD". The aircraft was then seen either to climb or experience some lift for a few seconds before the nose rapidly pitched down and the aircraft impacted the ground in an almost vertical attitude. One witness believed he heard the engine increase in power as it appeared to climb. The pilot was fatally injured in the ground impact.

Meteorology

The surface wind at North Coates was reported as 120º at 8 kt with a high cloudbase and excellent visibility. The temperature was 22ºC and thermal-type turbulence was reported in and around the airfield circuit. This was particularly apparent over the field where the Sluka had experienced lift, or commenced a climb, just prior to the accident.

Footnote

[1] In the absence of any RT recordings, these radio transmissions are based on witness recollections.

Pathology

The pathologist's examination of the pilot revealed that he died from multiple injuries and that the accident was non-survivable. No evidence was found of any disease in the pilot or of alcohol, drugs or any toxic substance which could have caused, or contributed to the cause of, the accident.

Description of the aircraft

The Sluka is a high-wing, single-seat aircraft in the Microlight Category; a photograph of an intact example is presented at Figure 1. The tail surfaces are of fabric-covered, tubular construction, with upper and lower vertical fins rigidly attached to the rear of the aluminium alloy fuselage boom. The horizontal stabiliser comprises left and right tailplanes that are pin-jointed to the boom, with structural rigidity being provided by upper and lower bracing wires attached respectively to the upper and lower fins. A bolt and stiff nut are used to secure the upper wires, although a castellated nut and a split pin are used for the lower wires. This is to allow the lower wires to be readily detached so that the two tailplane halves can be folded up against the fin for storage.

The elevator operating cables are attached to horns on the left elevator. A simple clutch mechanism connects the two elevators together, but allows them to disconnect when the tailplanes are folded against the fin. Although there is no conventional elevator trim system, an elastic bungee cord, with knots tied at intervals along its length, is attached to the floor at the front of the cockpit. Forward control force can be off-loaded by means of inserting one of the knots in a key-shaped slot in a plate attached to the control column.

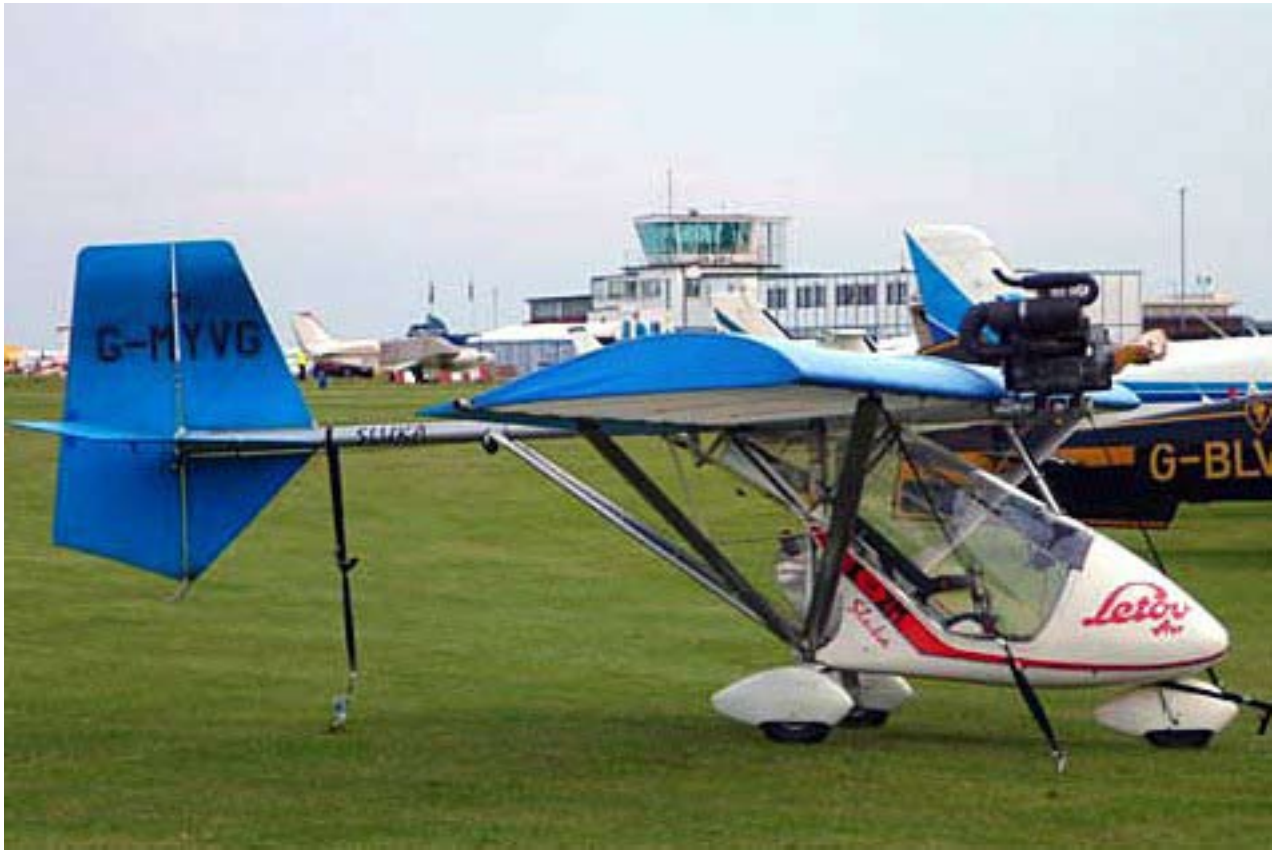


Figure 1

Aircraft history

The pilot acquired the aircraft in May 2005 and transported it by road from its previous base in Scotland. It was subsequently kept in a shed at Bucknall. A note in the aircraft log book states that the wings and tail were refitted, with a check flight being carried out in June 2005; this was conducted by an Inspector from the Popular Flying Association (PFA).

During the next few months, the aircraft was not flown as the owner became involved with a modification on the aircraft that addressed a potential fatigue crack problem at the forward wing hinge attachment to the boom tube. This work was completed in the spring of 2006 and on 15 April the aircraft was inspected and check flown, for the purpose of renewal of its Permit to Fly, by the same PFA Inspector as before. The aircraft had achieved 323 flying hours at this time. By the time of the accident it had accumulated a further 15 hours over 27 flights. The only maintenance activity recorded in the aircraft log book since Permit Renewal was the fitting of the original propeller on 30 April, and adjustment of the rudder bar stops on 7 July. Both actions were the subject of dual signatures by the pilot and the PFA Inspector. In fact the owner, who was an engineer by profession, invariably discussed any matter relating to his aircraft with the Inspector.

Accident site details

The aircraft had crashed approximately 100 m from the threshold of Runway 05, some 10-12 m inside the airfield boundary fence at North Coates and on a heading of around 062º(M). It had come to rest lying inverted, with the engine detached. The disposition of

the wreckage indicated that the aircraft had struck the ground in a near-vertical attitude, with the main force of the impact being borne by the engine and propeller, the cockpit area and the wing leading edges. It was possible to discern marks on the ground that had been made by the wing leading edges; the damage to the wings was symmetrical, indicating there had been no significant roll or yaw at impact.

Examination of the empennage revealed that the bracing wires that secured the left and right tailplanes to the vertical fin had become detached from the upper part of the fin. The tailplanes each had a pair of wires anchored at the approximate mid-span points of the leading and trailing edges and these wires were attached to a small steel bracket, or tang. The tangs were attached to each side of the upper part of the fin by means of a bolt and stiff nut. However, it was apparent that the nut was missing, which had allowed both tangs, together with their associated wires, to become detached. The bolt was found loosely inserted in its hole in the tang that was attached to the left wires. Figure 2 shows the bracing wires as they were found at the accident site.

Following an on-site examination the aircraft was recovered to the AAIB's facility at Farnborough for a detailed examination.

Detailed examination of the wreckage

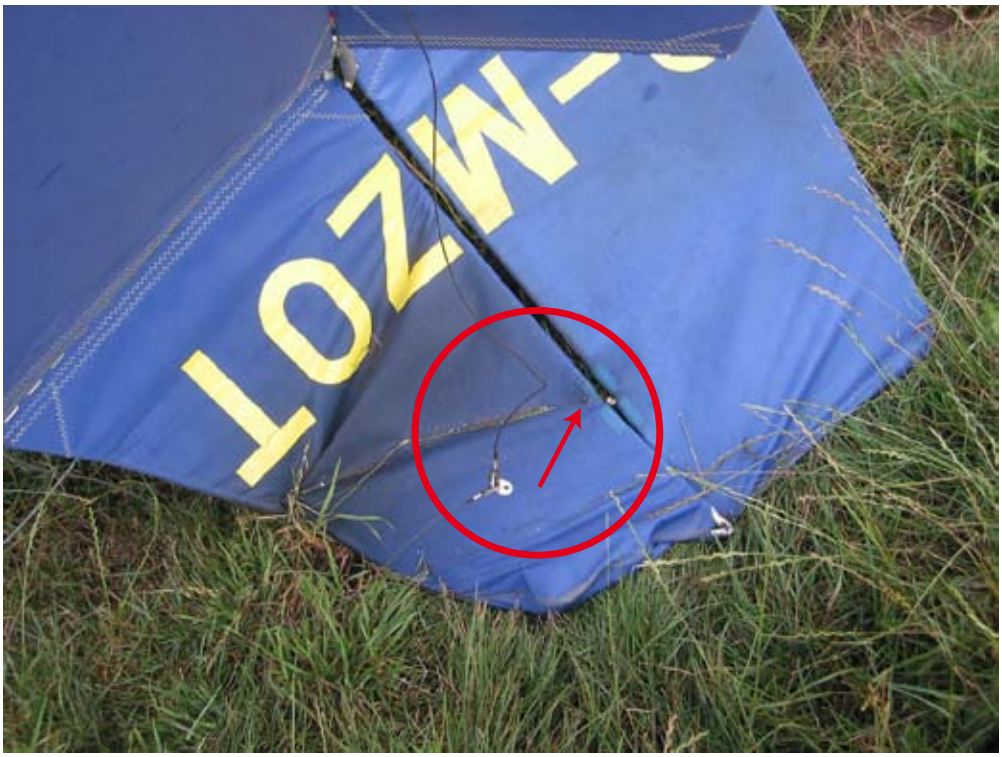
Tailplane and elevators

As found, the right tailplane was significantly drooped relative to its normal position, with its associated elevator disconnected. As a result of the distortion, principally to the fin and rudder, resulting from the impact, the right tailplane could not be reinstated to its normal position until the rudder had been removed. This indicated that the right elevator had been in the drooped position, with its elevator disconnected, prior to the impact. With the tailplanes held in their normal position by the bracing wires, the two elevators had been connected by a simple clutch, as noted earlier, which consisted of a short length of rod on the right elevator that meshed with a similar length of channel section on the left elevator. These components meshed snugly together, with no visible distortion, which indicated that the elevators had disengaged cleanly when the right tailplane drooped.

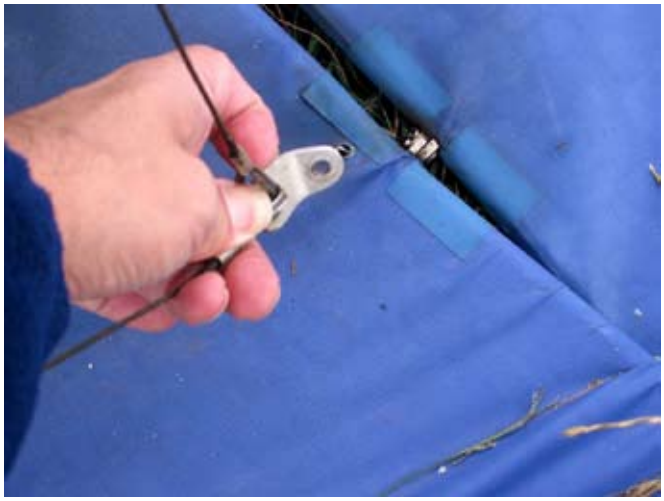
Bracing wire attachment hardware

The bolt that had attached the tailplane upper bracing-wire tangs to the fin was identical to that removed from an intact aircraft during the investigation. It was thus established that the bolt was of sufficient length to accommodate the stiff nut safely (referred to in the manufacturer's build manual as a 'Lock Nut'). Similar components were used elsewhere on the aircraft. It was noted that removal of the tang necessitated the use of 9 mm and 8 mm spanners for the nut and bolt respectively. A photograph of a stiff-nut is shown at Figure 3, where it can be seen that it has been manufactured with a saw cut extending across approximately half the diameter of the nut, just above the hexagonal section. The top half of the nut has been slightly bent over, in a manner that tended to close the saw cut. This process results in the axes of the threads in the two halves of the nut being at a slight angle to each other, which is how the 'stiff' function is achieved. However, one feature of this type of nut is that when it is turned onto a bolt, no 'stiffness' is encountered until the threads in the upper portion become engaged.

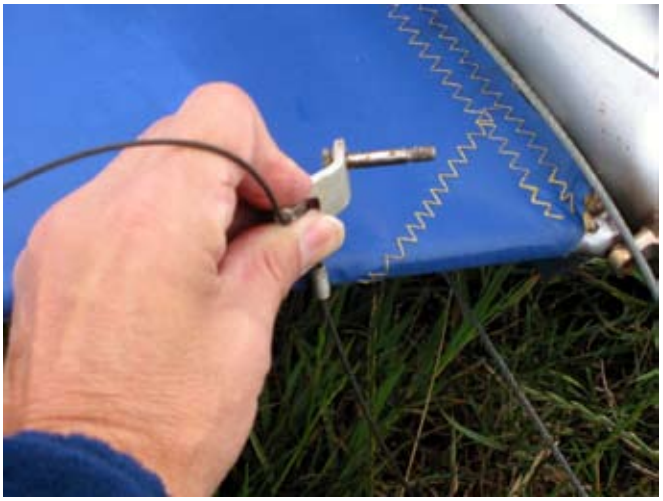
There was no nut to examine in the case of the accident aircraft, so it was not possible to establish that the correct type had been used, although the components elsewhere on the aircraft were correct. Typical assembly



As-found tailplane bracing wires: arrow indicates attachment point on fin



Right tang



Left tang with bolt

Figure 2

Detached tailplane bracing wires, as they were found

torque values were found to be around 30 lbf in. The aircraft build manual did not specify a torque figure for the upper bracing-wire attachment other than to state that it should be *tightened until just tight*.

The bolt threads were examined under a microscope and were found to show no evidence of any distress caused by, for example, excessive load or a wrongly sized nut. Similarly, the holes in the tangs attached to the bracing wires also showed no evidence of distress.

Figure 3

Whilst examining the intact aircraft it was noted that the tailplane wire attachments to the upper fin were approximately at eye level and thus easy to check on a walk-round inspection. In the event that the nut should back off a significant amount, the tangs would no longer lie flush with the surface of the fin, a feature that would be readily visible. The PFA Inspector commented that he had visually checked the attachment prior to the Permit renewal check flight in April.

Analysis

The accident sequence

The available evidence indicated that what was effectively a structural failure of the horizontal stabiliser occurred in two stages. Following the loss of the nut from the fin attachment bolt, the right tailplane would have folded downwards under the influence of the aerodynamic load, accompanied by the disengagement of the right elevator from the left.

The loss of download and elevator authority would have had an immediate effect on the aircraft, which most probably prompted the pilot's radio call, in which he mentioned elevator problems, as he approached North Coates airfield. As the elevator operating cables were attached to the left elevator, control would have been retained, albeit with more aft stick applied, so long as the bolt that attached the left tailplane bracing wires remained in the hole in the fin. The tension in the wires would have acted both axially and downwards on the bolt, with the latter force generating friction between the bolt threads and the bore of the hole, thus contributing to the retention of the bolt. It is probable that this tenuous condition persisted until after the aircraft had performed an orbit and was making its second approach to land. At this point the witness evidence indicated that the aircraft 'ballooned', possibly as a result of a thermal. This being the case, the pilot may have checked forward on the control column to regain his descent rate, which would have had the effect of aerodynamically off-loading the remaining tailplane, thus releasing the bolt and leaving the aircraft without an effective horizontal stabiliser. The absence of down force would have allowed the aircraft to pitch nose-down into a near-vertical dive.

With the benefit of hindsight, it is considered that there may have been an opportunity to avoid a fatal outcome if the pilot, after experiencing the initial elevator problem following the loss of the nut, had immediately attempted to land the aircraft in the nearest open area. Had he glanced over his shoulder, he would have been able to see the drooping right tailplane; however, regardless of whether or not he looked, it is likely he did not appreciate the seriousness of his predicament and wished to avoid possible damage to his aircraft that could occur in a forced landing. He therefore elected to continue to his

destination, which, although it was nearby, involved extending the flight time by performing an orbit, thus giving more time for the bolt to migrate out of its hole in the fin.

Loss of the bracing wire attachments

The loss of the stiff nut could not be explained; indeed it was not even possible to establish whether the correct component had been installed. However, the remaining nuts and bolts on the bracing wires and elsewhere were correct and properly secure. It is possible that the tailplane upper bracing wire tangs were reattached to the fin in May/June 2005, when the aircraft was reassembled following its road journey from Scotland. However, there would have been no reason subsequently to disturb this attachment as the aircraft was housed, fully assembled, in a shed, thus negating any regular requirement to fold the tailplane sections out of the way. Had such a requirement arisen, this could have been accommodated by undoing the lower wires, which were attached to the fin by means of a bolt, castellated nut and split pin.

Other potential explanations for the in-flight loss of the nut could include the use of a plain nut, perhaps intended as a temporary measure until a correct item could be obtained, or that the stiff nut had become worn as a result of excessive re-use.

The location of the tailplane wire attachments on this aircraft is such that the pre-flight inspection process is simple and whilst the pilot may have had a low expectation of finding a defect, perhaps leading to an increased risk of missing it on one occasion, it is difficult to explain why he would not have noticed it. This might logically suggest that the nut came undone over a short period. Other 'short term' scenarios could include a mechanical failure of the nut, which, on such a low stress application, must be considered to be extremely remote, or tampering by a third party, for reasons unknown, which is also considered unlikely.

The use of stiff nuts in vital points throughout an aircraft structure is not uncommon in general aviation aircraft, although their re-use is discouraged. Any attachment that is regularly undone should not have a stiff-nut; this philosophy was embodied on G-MZOT in that the lower bracing wires attachment to the sub-fin used a castellated nut and split pin.

Conclusion

The accident occurred as a result of the loss of the nut on the tailplane upper bracing wire attachment to the fin. The nut was not recovered and no reason for its detachment was established.

The PFA has indicated that this accident will feature in a forthcoming issue of its magazine, which will also reiterate guidance on the use of stiff-nuts in aircraft structures.