

Rans S4 Coyote, G-MWLY

AAIB Bulletin No: 7/2001 **Ref:** EW/G2001/2/04 **Category:** 1.4

Aircraft Type and Registration: Rans S4 Coyote, G-MWLY

No & Type of Engines: One Rotax 447

Year of Manufacture: 1990

Date & Time (UTC): 14 February 2001 at 14:37 hours

Location: Davidstow airfield

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: None. [Medical certificate valid until 30 November 2000]

Commander's Age: 72 years

Commander's Flying Experience: 70 hours

Last 90 days - .50 minutes

Last 28 days - .50 minutes

Information Source: AAIB Field Investigation

Background

On 13 January 2001 the pilot bought the accident aircraft, a Rans S4, G-MWLY. The previous owner, who had owned the aircraft for 21 months during which time he had flown some 15 hours in it, delivered the aircraft on a trailer with the wings and tail plane surfaces folded for transit. It was intended that the previous owner would help the new owner to rig the aircraft, but strong winds on that day prevented them from doing so. The previous owner reported that he had not experienced any difficulties with the aircraft and one minor technical defect with the ignition system had been rectified.

On the day before the accident the pilot asked the club owner to recommend a suitable pilot who could check that he had correctly assembled and rigged the aircraft and to carry out a short test flight. This was arranged and the inspection pilot met the aircraft owner and inspected G-MWLY, which he considered to be properly assembled. He also noticed that the fuel tank was full. Although he himself was not experienced on tailwheel aircraft, the inspection pilot was happy to undertake the flight. The visibility was excellent with clear skies and the surface wind estimated as easterly less than 5 kt.

History of the flight

The inspection pilot strapped himself in the cockpit and, following a lengthy taxi across the bumpy grass, lined up on Runway 12. He increased power carefully to full power and, as the tailwheel left the runway, he was surprised by a swing to the left which he estimated as 15° , but he was able to contain and correct this once airborne. Soon after leaving the runway he was aware that the control column was forward of the central position and a positive force was required to prevent the control column moving aft. By reducing power he was able to level off and the forward force on the column could be reduced. The inspection pilot carried out a number of turns in the vicinity of the airfield and then made two approaches to Runway 12 with a go-around each time to establish the feel of the aircraft. Apart from some difficulties with his harness, which restricted his movement due to being incorrectly fastened, he considered the aircraft to be airworthy. At no time during the flight did he detect any control restriction. He noted during his flight that conditions were smooth with no turbulence and the Air Speed Indicator (ASI) was working. He taxied the aircraft back to the area of the club and informed the owner that the aircraft had passed his ground and flight inspection.

The inspection pilot was aware that the owner was to undertake his first flight in G-MWLY and had understood him to be an experienced pilot of tailwheel configured microlight aircraft. The aft control bias was not mentioned to the owner.

The owner pilot was strapped into the aircraft by the inspection pilot and a friend. He sat on a cushion, which comprised a nylon document holder about the size of a brief case. They took care not to make the same mistake when fastening the safety harness as had been made earlier. The pilot had taxied the aircraft before but as stated previously had not flown it. The owner pilot taxied out to Runway 12 and the group of people who had strapped him in walked around the club buildings to the rear, which took them out of sight of the runway.

The aircraft was seen to line up on Runway 12 with engine power increasing. It accelerated along the runway and became airborne, maintaining the runway direction and with the wings level. At a height of about 70 feet the right wing dropped to about 30° but was immediately corrected to wings level. Shortly afterwards the right wing again dropped by about the same amount and was corrected to wings level. Almost immediately and, at a height of approximately 150 feet, the right wing dropped to about 45° . This was corrected but roll in the opposite direction continued with the left wing dropping and the aircraft entering a spiral dive to the left before striking the ground.

The only person to witness the accident was a telecommunications engineer working on an aerial mast some 500 meters from the departing aircraft. He had watched the earlier flight with interest, which had appeared quite normal. He did not watch the aircraft throughout the taxi phase and could not recall hearing any power checks prior to take-off but as soon as the engine note increased for take-off he watched the aircraft continuously until it struck the ground. Whilst the witness recalled the aircraft turning through approximately 360° he could not remember what attitude it was in when it struck the ground. He was clear that the engine note had not changed during the take-off and could be heard all the way to the sound of the impact.

The group of people who were behind the club buildings heard the sound of the impact and the propeller splintering. They immediately went by vehicle to the accident site and called the emergency services. They removed a number of pins holding wing struts in order to release the pilot from the wreckage and paramedics who attended the scene attempted rendering medical assistance but the pilot's injuries sustained in the crash had proved fatal.

Pilot training

The pilot had begun flying training at Davidstow on 20 March 1998 and had regularly attended the club flying on average three times a month. In the last three months prior to the accident, he had only flown once. This was a dual flight in a two seat Thruster microlight aircraft. His tailwheel experience was limited to the club Thruster aircraft and the two seat Rans S6 of which he owned a one third share from July 1999 until December 2000. Whilst he flew the aircraft dual, he did not handle the S6 aircraft during take-off or landing below a height of 200 feet.

The pilot's training on the Thruster aircraft had mostly been with one particular instructor. They had discussed the most suitable aircraft for the pilot to buy and the instructor considered that, given the ability and experience level of the pilot, a tricycle landing gear aircraft would be most suitable.

Having decided to buy the Rans S4, the owner of the club of which the unlicensed pilot was a member, informed him that he was only permitted to fly the aircraft when he had been cleared to do so by an instructor. [Note: The Air Navigation Order 2000 states that:

'a person may act as pilot in command of an aircraft for the purpose of becoming qualified for the grant or renewal of a pilot's licence or the inclusion or variation of any rating in a pilot's licence if:

(i) he is at least 16 years of age;

(ii) he is the holder of a valid medical certificate to the effect that he is fit so to act issued by a person approved by the CAA;

(iii) he complies with any conditions subject to which that medical certificate was issued;

(iv) no other person is carried in the aircraft;

(v) the aircraft is not flying for the purpose of public transport or aerial work other than aerial work which consists of the giving of instruction in flying or the conducting of flying tests; and

(vi) he so acts in accordance with instructions given by a person holding a pilot's licence granted under this Order or a JAA licence, being a licence which includes a flight instructor rating, a class rating instructor rating, a flying instructor's rating or an assistant flying instructor's rating entitling him to give instruction in flying the type of aircraft being flown;]

It was explained to the pilot that any clearance to fly would only be given when the weather was suitable and full differences briefing on the S4 was given. The club owner repeated these instructions to the pilot on 13 February 2001.

On site examination of the wreckage

The aircraft had crashed approximately 400 metres from the start of the paving of Runway 12. A mark made by the right wing tip was visible in the grass immediately adjacent to the left edge of the runway and it was evident that the aircraft nose had impacted the runway surface almost simultaneously. This placed the aircraft on a southerly track with the wings banked beyond the vertical. The impact speed was low, as the aircraft had come to an immediate halt. Extensive damage had occurred to the nose, forward fuselage and right wing. The final spiral dive to the left with a steep angle of bank seen by the witness could not be reconciled with the clear evidence that the right wing had struck the ground first with the aircraft having rolled just past the vertical. It is possible that the turn was reversed during the left spiral manoeuvre or just before the aircraft struck the ground and was not detected by the witness at his distance from the accident site, which was 800 meters from his position. He did not recall the actual impact.

The propeller had shattered on impact with the runway surface, with fragments being scattered over a wide area; this indicated that the engine had been rotating with considerable rpm at impact. The aircraft was equipped with interconnected fuel tanks in the fuselage aft of the cockpit and in the wing above the cockpit. The filler cap on the wing tank had detached in the impact, allowing fuel from both tanks to drain away.

Description of the aircraft

The Rans S4 is a strut braced, high wing monoplane constructed primarily from aluminium alloy tubes covered with sailcloth. The flying controls are of a conventional, three-axis layout. Trailing edge flaps are provided which have four settings.

The control column is connected at its base to the aileron torque tube; this runs longitudinally along the centreline of the aircraft beneath the pilot's seat. Two lever arms at the aft end of the torque tube are connected to teleflex type cables that operate the ailerons. The elevator operating tube is located concentrically within the aileron torque tube. A pitch trim lever is located on the throttle quadrant, which in turn is attached to the left side of the seat. The associated cable housing is cleated to the rear end of the aileron torque tube whilst the cable itself is attached, via a bungee cord, to the elevator operating link at the base of the control column. Operation of the trim lever thus inputs a bias to the elevator control system.

The seat consists of a tubular frame over which is stretched a 'sling' type fabric cover. The front of the seat is pin-jointed to the fuselage side tubes. A choice of holes is provided in the seat tube for this purpose, and allows for the seat to be positioned at various distances from the rudder pedals according to the leg length of the pilot. A 'hang strap' is attached to either side of the rear of the seat and passes through a fixture on the airframe located above and behind the pilot's head. The strap is made from the same nylon webbing as the harness and is provided with an adjustment buckle. Lengthening or shortening the hang strap causes the seat to pivot about its front mounting, thus providing a means of adjusting the height of the seat.

Detailed examination of the aircraft

Some inevitable disturbance of the wreckage had occurred when the emergency services were removing the pilot. For example, the seat hang strap adjustment buckle was found to be slackened off to the extent that the length of webbing on the right hand side considerably exceeded that of the left. This condition was unlikely to have existed in flight, as the unequal tension would have resulted in the webbing pulling through the upper fixture until the left and right sides were of equal length. It is thus probable that the buckle was partially undone after the accident having been mistaken for part of the seat harness.

The harness consisted of shoulder and lap restraints and it was found that the right side lap strap had failed at a stitched joint close to its fuselage anchorage. However, the impact attitude would have resulted in excessive loads being imposed on the lap straps and it was not considered that the failure made the accident any less survivable.

Examination of the aileron torque tube revealed that paint had been rubbed off due, it appeared, to contact with the underside of the seat, - see the photographs at Figures 1 and 2. It was apparent that most of the abrasion had occurred in the region of the pitch trim cable end swaging that attached to the bungee cord. It was not possible to judge how long the tube had been in this condition; however, the previous owner of the aircraft stated that to the best of his recollection the paint was intact at the time he sold the aircraft. Any significant contact between the seat underside and the aileron torque tube would tend to restrict aileron movement. The pilot who flew the aircraft prior to

the accident flight did not notice any restriction although, as he was lighter than the accident flight pilot, it was probable that there was less 'sag' in the seat and reduced elastic extension in the seat hang straps.

The degree of distortion of the airframe and seat meant that the potential for contact between the seat underside and the aileron torque tube could not be explored thoroughly. An intact aircraft was examined during the process of the investigation and it was apparent that, with the seat occupied, there was little clearance beneath the seat. On this example the seat front mounting was via the centre of three mounting holes. G-MWLY's seat was mounted in its fully aft position in order to accommodate the longer legs of the pilot. For a given hang strap length, this would place the aft part of the seat closer to the floor of the aircraft. The strap adjustment buckle, which was on the right hand side, had been partially undone after the accident. However the strap on the left side was considered more likely to be at its pre-impact length, as considerable effort was required to pull it through the upper fixture. Its length was found to be approximately one inch more than that measured on the intact aircraft, which, assuming that there were no significant dimensional differences between the aircraft, suggested the seat to be at a lower setting.

The design and construction of the aircraft provided no means of preventing the seat from dropping down onto the aileron torque tube in the event of slippage, maladjustment or failure of the hang straps. This omission has apparently not resulted in any reported occurrences of restricted controls. However, during the course of the investigation, a former owner of a Rans S4 stated that he experienced an elevator restriction on take-off as soon as the wheels left the ground. The restriction had not been apparent whilst taxiing. On this occasion the aircraft was landed immediately and the problem was apparently cured by shortening the seat hang straps. It was assumed that the elevator restriction occurred as a result of binding between the elevator push-pull rod and the aileron torque tube as the latter bent due to the seat sagging onto it. When this was tried on G-MWLY (the tube was made to bend by standing on it), it had little effect on fore and aft movement of the control column. However, it was observed that the elevator tube was liberally covered with grease. Although the condition of the incident aircraft is not known, it is possible that a comparative absence of grease could have affected elevator operation when the relevant assembly was loaded by the seat.

Elsewhere on the aircraft, it was observed that the flaps had been deployed to the first detented position (8°). The throttle was at approximately 70% of full travel, the choke was IN (i.e. normal running position) and the pitch trim was set at an aircraft nose down position.

Medical aspects

Post mortem examination of the pilot revealed evidence of a recent viral infection. It was also evident that he had previously suffered a mild heart attack. Toxicological examination revealed no evidence of alcohol, carbon monoxide or drugs of abuse. However diphenhydramine, an over the counter antihistamine commonly used in cold cures was detected in therapeutic levels. This coupled with the evidence of probable recent viral infection suggested that he might have taken the drug in order to combat the infection. The post mortem report concluded that it was not possible to state if any of the pilot's medical problems contributed to the cause of the accident. In the opinion of the pathologist, the pilot would not, however have been able to fly to the best of his ability because of his medical problems and the side effects of the antihistamine drug. The accident was not survivable and the pilot died of multiple injuries.

Analysis

The weather conditions at the time of the accident were good. The surface wind, at 5 kt or less, was aligned with the runway in use. There was no turbulence with good visibility and clear skies. The pilot had demonstrated an ability to fly the Thruster solo but he had not flown the S4 before. His instructor considered that he needed more training before he was able to fly any aircraft solo. Whilst the aircraft was being operated within the weight and C of G limits it was at maximum all up weight. The pilot was a 5' 8" tall, which fact when combined with the documents case filled with rubber foam sheets on which he was sitting would have caused his head to either be in contact with or very close proximity to the cockpit roof beam. The previous owner of the aircraft and the inspection pilot who flew it prior to the accident flight were both smaller in stature and did not need to raise their height in the seat. The inspection pilot commented that he had planned to wear a helmet but it was not possible as it contacted the roof beam.

When taxiing the S4 the nose obscures forward visibility and requires pilots to weave the aircraft from side to side in order to see ahead. As with other tail wheel aircraft, once airborne and in level flight, the nose lowers and forward visibility improves. In trials using the documents case it was found that with a pilot 5' 10" tall it caused his head to contact the roof beam. This required him to move his head to the left or right to prevent contact. It was also noted that due to the slippery nature of the material it slid forward in the bucket seat of the aircraft although not far enough forward to impede control or leg movement. The case had been provided by another member of the Rans S6 syndicate to raise the pilots eye line and improve visibility as well as comfort when flying that aircraft. It is probable that the owner pilot of the S4 used the documents case on the accident flight, as much out of habit as his need to improve visibility.

In the absence of a structured transition onto a different aircraft type the accident pilot was faced with a degree of unfamiliarity. Nevertheless the following three factors were contributory causes of the accident:

1. The pilot's medical condition

The medical condition of the pilot had been noted with some concern by a number of witnesses in as much as physical exertion by the pilot had brought on his breathlessness. The decrease in the performance of the pilot in the stressful situation of carrying out a first solo flight on the S4 given the circumstances described cannot be accurately assessed. Although outwardly confident there would have been some level of concern about what he was about to undertake and as he encountered difficulties his stress levels would have increased significantly along with his heart rate causing the effects previously described. The overall effect would have been to reduce his ability to cope with the deteriorating situation.

2. Reduced engine power necessitated by the aft GC of the aircraft

The evidence provided by the position of the throttle and carburettor slide gave an approximate setting of 70% power selected at the moment of impact. The witnesses detected no discernible change in engine note up to when they heard the aircraft impact the runway. The witness who watched the take-off described the angle of climb as normal and similar to that of the aircraft earlier that day. On the earlier check flight, the pilot had been surprised by the amount of forward pressure on the controls needed to prevent their rearward movement. He considered that if he had relaxed his forward pressure the aircraft would have pitched rapidly nose up but reducing power had allowed him to relax the forward pressure on the controls. There was no evidence of the aircraft having pitched nose up, but maintaining the same angle of climb with reduced power could have caused air speed to decay to the point of the stall with the associated wing drop.

3. Flying control restriction

The witness marks of metal to metal contact on the aileron torque tube showed that the end swaging to which the pitch trim rubber bungee had been attached had been trapped between the underside of the seat and the aileron torque tube. Due to the disruption of the cockpit area it was not possible to measure exact forces needed to move the controls with such a restriction. Some movement would have been possible providing sufficient force was applied to the controls. The fact that in the calm conditions the witness saw the wing drops described earlier suggest these were as a result of control movements or in response to the effects of the air speed approaching the stall.

Conclusions

The examination of the wreckage revealed the potential for an aileron control restriction, although it cannot be stated with any certainty that this occurred. Any restriction is likely to have manifested itself as an increase in control forces, as opposed to a jam. However, given the pilot's limited level of experience, any airborne control problem would have presented him with an additional challenge that was perhaps beyond his competency.

Regardless of whether a control restriction had occurred in this case, the investigation highlighted the potential for the seat underside to come into contact with the aileron torque tube in the event of maladjusted hang straps.

It was concluded that whilst a major factor in the accident was the fact that the pilot did not receive a proper structured transition to the S4, it is probable that a combination of the three factors outlined in the analysis led to the loss of control. The degree to which each factor contributed to the accident is not known but a control restriction in roll would have been alarming and may well have distracted the pilot from maintaining a safe airspeed. Any relaxation of the control column with the reduced power (if that was what was set) would have allowed the airspeed to decay. The pilot's attempts to maintain the wings level may have been as a result of wing drop at the stall being corrected with rudder, or his inability to move the controls effectively. Probably the most difficult factor to assess is that regarding the medical condition of the pilot. What is certain is that the serious nature of the rapidly deteriorating situation would have been apparent to him and the stress this must have imposed combined with the effects of the antihistamine drug would certainly have reduced his level of performance in controlling the aircraft.

Safety recommendations

The Popular Flying Association, (PFA), had delegated responsibilities from the CAA for the airworthiness for this aircraft and, under CAA authority, issued, subject to satisfactory inspections, the annual Permit to Fly. The following Safety Recommendation is therefore addressed to the PFA:

Recommendation 2001-48

The Popular Flying Association should ensure that all UK registered Rans S4 Coyote aircraft are modified in a manner that, in the event of a maladjustment, slippage or failure of the seat hang straps, the seat will be prevented from collapsing onto the aileron torque tube, thus avoiding the possibility of a control restriction.