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Aircraft Type and Registration :	RANS S-12 AIRAILE, D-MLAB
No. and Type of Engines:	One, Rotax 582
Aircraft Serial Number:	0892256
Year of Manufacture:	1992
Date and Time (UTC):	30 May 1998, 1810 hrs
Location:	West of Gibraltar Point, Sligo Bay.
Type of Flight:	Private
Persons on Board:	Crew - 1 Passenger - 1
Injuries:	Crew - Fatal , Passenger - Fatal
Nature of Damage:	Aircraft Destroyed
Commanders Licence:	UK Private Pilots Licence (Aeroplane)
Commanders Age:	58 Years
Commanders Flying Experience:	170 hours (of which approx. 40 were on type)
Information Source:	ATC Watch Manager, Shannon Airport. AAIU Field Investigation.

1. Synopsis

The aircraft was taking part in the Sligo Treasure Hunt 1998, which formed part of the annual Sligo Airport *"Fly In"* weekend.

The weather at Sligo was benign with no significant weather or cloud and a surface wind of 010º 10/15 kt. Runway 29 was in use. The aerial route allotted to D-MLAB took it via Coney Island towards Rosses Point and then eastwards towards Sligo town and defined points beyond the town . Maximum altitude was 2000 feet. The planned flying time for this route was 1 hour 45 minutes. The aircraft crashed some ten minutes after take-off, at 1810 hours approximately, into the tidal estuary of Sligo Bay, at a point about 1 km west of Gibraltar Point.

Witnesses reported that the aircraft struck the firm sand of the estuary in a near vertical attitude. The crash site was compact. ATC alerted the local rescue services of the accident and despite the difficult access across the sandy estuary, they were at the scene within minutes. They determined that there were no survivors. Shortly afterwards the Air Corps SAR helicopter from Finner Camp arrived and, with the tide, the Bundoran Inshore Rescue Boat. As the tide was filling there was only sufficient time to retrieve the bodies of the occupants before the aircraft itself was covered by the incoming tide. As a result, the initial technical investigation of the wreckage was delayed until low tide the next morning. The aircraft was then recovered to Sligo Airport after the next tide and subsequently to AAIU facility at Gormanston, for detailed examination.

Eye Witness Reports

Several eye witnesses saw the last moments of the flight. The immediate attention of the Air Traffic Controller at Sligo Airport was caught by a radio transmission from the pilot of D-MLAB on 122.1 MHz who said "Tower, D-MLAB, I'm having trouble with the wind....". The controller responded by asking him if he was returning to the field, but there was no further response. From his Tower position he said that he saw the aircraft, which had been flying in a SE direction, going vertically down to the ground. The tower is about 3 miles from the crash site.

A number of construction workers were working on the Rosses Point road, on the northern side of the estuary, about one mile from the crash site. They recall the aircraft flying low over their site so "that you could nearly touch the plane" as it flew eastwards in the direction of Ballincar House and then made a right turn out to sea. As the aircraft passed over them the engine sounded normal. As it continued eastwards the sound of their own welding equipment and generators drowned out any further aircraft engine noise. One construction worker, however, said that he followed the flight path of the aircraft out to the estuary and recalls seeing what looked like a "puff of smoke" before the aircraft nose-dived into the ground.

A resident in the Cummeen area, on the southern side of the estuary, observed the aircraft as it flew level over the estuary at about the same height as her vantage point. She saw it drop suddenly towards the sea. Her residence is about 200 feet above sea level, and less than one mile from the crash site.

Another witness, who was in Sligo on vacation, was walking in the old swimming pool area near Gibraltar Point around 1800 hours, when he sat down for a rest. Shortly thereafter he stated that he observed a plane that was not high in the sky. After casually observing it for a few minutes he heard a spluttering noise from the plane..... "it seemed to be in trouble", and then in his opinion, "the engine revved up..... sounded very loud..... and as the plane turned slightly right..... all of a sudden the engine cut out and the plane just dropped to the ground..... from about 70 ft, but maybe 100 ft. at most".

On recovering from the realisation of what had just occurred the witness dialled 999 on his mobile phone and, as he ran across the strand towards the downed aircraft, he saw a man standing near the aircraft and spotted a jeep coming from the direction of the airport.

He assisted in the recovery of the bodies and was subsequently interviewed on the national television news. He recalled that it was a beautiful calm evening with a blue sky. He commented also that the aircraft was flying very slowly, almost stopped, before it fell out of the sky.

The final witness interviewed was a local fisherman who was collecting shell-fish out in the estuary itself, off Gibraltar Point. He said that he was working the area for the past 15 years and was well used to observing aircraft coming and going from nearby Sligo Airport. In his statement he recalls seeing "a blue coloured aeroplane flying around very low when the engine stopped ..... there was no sound ..... suddenly it started, more of a roar, and stopped again ..... as I looked at it, it nose-dived straight down into the sand", and impacted within 20 yards of his position.

Thinking that he was about to be struck by the aircraft he dived to the ground, but recovered quickly, and ran to the aircraft within seconds. As there was a heavy smell of fuel in the air he tried unsuccessfully to lift the aircraft and pull the occupants from the cockpit area. When the crash rescue personnel arrived some minutes later he assisted them in their efforts.

Damage to Aircraft

The aircraft impacted onto wet firm sand, with the wings level, but in a very steep nose down attitude. The nose and cabin area of the fuselage collapsed. The tail boom broke just aft of the fuselage pod and the leading edges of both wings were impacted rearwards. The aircraft was effectively destroyed.

Other Damage

There was no other damage.

Aircraft Description

The Rans S-12 is microlight of conventional layout with a pusher engine. The general layout is shown in Annex A.

The wings consist of a leading and a trailing edge spars of round aluminium alloy tubes, separated by internal aluminium compression and brace tubes. The wing is covered in a single envelope of synthetic material. The airfoil section is provided by light pre-formed aluminium tube ribs.

Conventional push rod activated ailerons are fitted to the outer portion of the rear spar, and flaps are fitted to the inboard trailing edge. Each wing is supported by two lift struts, one attaching to each spar.

The forward fuselage consists of welded steel tubing, and is faired-in by light-weight panels. Side by side seating for two persons, with standard dual controls is provided.

The tail boom consists of an aluminium tube, running from the forward fuselage section to a conventional tailplane. The elevator and rudder are activated by push rods.

The engine is mounted on a support structure above the wing trailing edge, and drives a pusher propeller. The engine fitted to D-MLAB was a Rotax 582, two cylinder, in line, two stroke unit.

The propeller fitted was a three blade unit of composite material. The propeller could be varied in pitch by a torque tube inside each blade. These torque tubes were activated by an electric motor in the propeller hub. By use of an electric blip switch in the cockpit, the pilot could trim engine RPM for max. take-off or max. cruise RPM.

Two types of variable pitch propellers manufactured by Ivoprop Corporation can be fitted to this aircraft. One type is for in-flight pitch adjustment, using the electric pitch trimmer as fitted to D-MLAB. The other design is for ground adjustment only. The difference between the two is a reinforced activation cam which is fitted to the in-flight adjustable model. Fitting of ground adjustable blades to a hub fitted for in-flight adjustment can result in the cams becoming loose and a resultant effect on the pitch deflection of the affected blades.

D-MLAB was fitted with conventional tricycle undercarriage, fitted with large balloon tyres.

The aircraft had glass-fibre main fuel tanks in the root area of both wings, with a third collector tank fitted behind the cockpit. The fuel caps fitted to the main tanks were of a rubber plug expanding type.
The radio fitted to the aircraft was not a permanent installation. The previous radio, which was an installed type, was illegally removed from the aircraft at Sligo Airport. The owner thereafter used a portable radio which he removed from the aircraft at the end of each days flying.

The aircraft was fitted with a recovery parachute, known as a Ballistic Recovery System (BRS). This was contained in a cylinder under the aircraft. This unit consisted of a rocket deployed parachute, and was designed to arrest the descent of an aircraft to earth in the event of a major failure. The system could be fired by a handle in the cockpit. This handle was fitted with a safety pin and a red "REMOVE BEFORE FLIGHT" tag, to prevent inadvertent deployment on the ground.

D-MLAB was manufactured in Germany in 1992, from a kit produced by the RANS Aircraft Corporation in the USA. It was purchased by its last owner, in Germany, in 1997, and was operated in Ireland under a permit issued by the German Aero Club (DAeC).

Aircraft Maintenance

The aircraft was maintained by the owner since it was imported into Ireland in May 1997. A flying time log book was maintained. This contained no maintenance history, and no maintenance log book was discovered during this investigation. An engine manual was found which included an engine check schedule. The 100 hrs schedule called for 9 items to be accomplished, and 7 of these had ticks (√) entered behind them. However there are no notations indicating by whom or when these items were accomplished. There were no ticks or marks against the next engine inspection, which was due at 125 hours. This was the original engine installed in this aircraft. From the aircraft flying log-book, the 100 hr inspection would have been due in July 1997, and the 125 hr inspection in May 1998.

Inquiries during the investigation revealed that an inspector, approved by the UK Popular Flying Association and the British Microlight Association, performed a cylinder head de-coking inspection on this engine, in Autumn 1997. He informed the investigation that the engine was in good condition at that time. The inspector recalled signing some form of record in the aircraft's paper work, but this was not found by the investigation.

During the investigation it was found that the aircraft had suffered damage to a propeller blade in 1997, when a fuel cap became detached and struck the propeller. The owner ordered a replacement set from Ivoprop Corporation, but did not specify that these were required for use with an aircraft fitted with the in flight adjustment pitch adjustment system, and he was shipped a set of the standard ground-only adjustable blades.

Wreckage and Impact Information

The aircraft was covered by the incoming tide shortly after the accident. The initial inspection was performed in situ at the next low water.

The wreckage indicated that the aircraft impacted with a nose down attitude of 80° to 90°, with the wings level. There was no spread of wreckage with the exception of light debris and pieces of the propeller. The direction of flight at impact was approx. 225°, heading towards Sligo Airport.

The forward fuselage section had completely collapsed. The engine had moved forward. The leading edges of both wings were crushed rearwards, and the tail boom had arched behind the wings. The propeller was shattered. The cockpit area, including the instrument panel, was destroyed. The fuel tanks had ruptured and there was extensive evidence of fuel in the wreckage area. Apart from two pieces of propeller, and some floatable items, all the wreckage was located at the impact site.

Detailed examination of the wreckage showed:

a) The recovery parachute system had not been deployed. Its safety pin and tag were still in the firing handle. The ring attaching the tag to the pin was elongated.

b) One propeller tip section, about 175 mm long, was not found.

c) The fuel cap of the LH fuel tank was not found. The tank filler neck was intact.

The wreckage was subsequently recovered and moved to the AAIU facility at Gormanston. Detailed examination of the fracture surface of the many broken tubes indicated that all the failures were as result of impact. No evidence of any other type of failure were found.

The engine casing had suffered impact damage, which precluded any attempt to run the engine. The engine also suffered severe corrosion due to immersion in the salt water shortly after the crash. The engine appeared in good condition and no evidence of failure was found in it. The propeller blades were broken into many pieces when the engine mountings failed, and the propeller came into contact with the fuselage structure.

In particular the engine was examined for failure of the big end bearings, which has been a problem on this engine type. No evidence of such failure was found. The UK agents for these engines has produced a special tool for the inspection of big and small end bearings, at a recommended frequency of 12.5 hrs. This company had no contact with the owner of D-MLAB and did not sell him such a tool.

It was found that the control stick aft (elevator UP) stop on the elevator push rod had failed. The elevator push rod moves in a slide bearing within the forward end of the fuselage tail boom. The stop consists of a short length of tubing fitted over the push rod, and secured by an aluminium pop rivet. In the wreckage, it was found that this tube was displaced along the push rod, away from its normal position. No trace of the pop-rivet was found. Metallurgical examination of the tube and push rod failed to determine if the rivet displacement occurred in the accident or previously. It may be noted, that due to its location within the tail boom, inspection of this stop is difficult in normal service.

It was found that D-MLAB was fitted with the incorrect type of blades, i.e. the ground-only adjustable type. When the owner ordered replacement blades following the previous incident with a lost fuel cap, he did not specify that the blades were to be used on an S-12 which was fitted with an in-flight adjustable hub. He partially described the type of blade required but did not specify the part-number. He may not have appreciated that aircraft fitted with in-flight adjustable hubs require a specially modified blade.

The activation cam on this blade type can became loose when used with the in-flight adjustment system, causing a variation in blade pitch and a loss of pitch control. The cams in D-MLAB were not loose, but due to the damage suffered by the propeller, it was impossible to determine if a slippage of pitch adjustment had occurred on any or all blades.

Survival Aspects

Because of the layout of this aircraft, and in particular the location of the pusher engine, allied with the light-weight construction of the fuselage cabin, there is very little protection for the occupants in the event of a crash into the ground at a steep angle, such as occurred in this accident.

Test and Research

Propeller:- a section of propeller tip, similar in size to the missing section, was tested, and found to be incapable of floating.

Recovery parachute:- The safety pin was removed in Gormanston, and the cockpit handle was pulled, and the system fired correctly, and pulled out the parachute as designed.

2. Analysis

Technical Items:

No evidence of structural or control failure, prior to impact, was found.

It is possible that the elevator back stop was displaced before the accident. This would permit the central stick to be pulled back further than normal, to a point where the pilots' or passengers body would act as a control limit stop. Because of the multiplicity of variables, including the size of the people on board, seat position, portion of cushions etc, it was not possible to determine what would have been the limit of elevator movement. The effect of such extra elevator movement would be to cause the aircraft to pitch up further and more quickly, on the application of full aft stick.

Given the location of the fuel tank filler, on the top of the wing root, the loss of fuel cap would result in a high probability of the cap striking the pusher propeller, and could cause a portion of the propeller, which is of very light construction, to detach. This would cause a loss of thrust, and severe vibration in the aircraft. The probable response of the pilot would have been to reduce engine RPM, and consequently engine power, in an effort to reduce vibration. It is significant that neither the missing blade section nor the cap could float and that they were not found in the estuary. Even though the three blades were badly shattered, the recovered segments constituted virtually the entire set of blades, with the exception of the mission tip section. This would indicate a strong possibility that the cap had become detached in flight, as had occurred previously, and, on this occasion, it struck the propeller and broke off a significant section of it.

During the investigation it was reported that the owner had lost a fuel cap in flight, on a previous occasion.

Given the loss of power, further exacerbated by the probable pilot's action of reducing RPM to reduce vibrations, the aircraft may have had to be flown close to its stall speed in order to maintain altitude. This slow speed and low altitude was borne out by witness statements. It is noteworthy that the manufacturer writes that the S-12 exhibits special characteristics due to its pusher configuration. It states, inter alia, "*that because of the high thrust line there is a tendency for the nose to pitch DOWN with the application of power. The tendency will be more noticed at low speeds.....a sudden brust of power to recover airspeed..... the tendency to pitch down will be the greatest".*

The elongation of the ring on the safety pin of the recovery parachute lever may indicate that there was a belated attempt to remove the pin, in an effort to use the parachute as the aircraft plunged earthwards. If the parachute was fired at 100 ft, it would not have time to fully deploy, but it is possible that it could have retarded the aircraft so as to reduce the severity of impact, possibly making the accident survivable.

There is considerable evidence that the pilot of the aircraft was well organised, and meticulous in his affairs with a high degree of general engineering skills, and was highly self reliant. He was also a member of the Irish Society of Amateur Aircraft Constructors. However, the operation of such an unique type of aircraft, which features some unusual flying and technical aspects, at a site where no aircraft, even remotely similar to the S-12, were operated, resulted in a situation where the pilot was deprived of direct support resources in flying and maintaining such a unique aircraft, such as a cadre of fellow micro-light pilots and maintainers of such aircraft.

Other Information

High performance two stroke engines, such as fitted to D-MLAB, are likely to produce significant puffs of smoke from the exhaust when power is applied rapidly. This could account for the puffs of smoke seen by witnesses.

Medical and Pathology

The pilot successfully completed his UK CAA Medical Examination on 23 October 1997, and met the required standard for a UK Private Pilots Licence.

A post-mortem examination revealed no pre-existing medical condition which would have contributed to the accident.

3. Findings

3.1 The pilot was properly licensed and qualified for the flight.

3.2. The pilot was medically fit for the flight.

3.3 A post mortem examination of the pilot revealed no pre-existing medical condition which could have contributed to the accident.

3.4 The aircraft was certified by the German Aero Club (DAeC) who are responsible for the certification and licensing of German registered aircraft. The DAeC records show that the aircraft's annual inspection (Certificate of Airworthiness) was valid until 30 April 1998. There is no evidence of a C of A extension sought nor that was one granted after 30 April 1998.

3.5 The Ballistic Recovery System (BRS) fitted to the aircraft is triggered by pulling on the activation handle in the cockpit. On the ground a safety pin is installed to prevent accidental deployment. This pin has a tag stating *"Remove for Flight"* . The pin was not removed for the final flight of D-MLAB.

3.6 The pilot's only radio transmission was heard by Sligo ATC but not tape-recorded. The airport had normally closed at 1730 hrs to commercial traffic and the tape recording system switched off. Thereafter ATC kept a monitoring brief of the progress of the Treasure Hunt. The absence of a recording of this transmission hampered the investigation.

3.7 The many eye-witnesses to the accident, located as they were to the North, East, and South of the accident site, give an independent and consistent description of the last minutes of the flight of D-MLAB. The nearest witnesses to the crash site spoke of the aircraft slowing down, the sound of the engine back-firing, a cloud of smoke, followed by a severe nose down attitude and silence before the impact.

3.8 The subsequent detailed technical examination of the wreckage was hampered by the severe impact damage to the aircraft and its components.

3.9 The incorrect propeller blades fitted to D-MLAB could have resulted in a loss of pitch control on some or all of the propeller blades. This in turn could have caused a loss of engine thrust and a marked increase in vibration in the aircraft.

3.10 It is possible that the missing fuel cap became detached in flight, and struck the pusher propeller, causing a significant portion of one blade to break off. The resultant vibrations could have distracted the pilot.

3.11 The pilot had an unspecified problem, as his unfinished radio transmission to ATC indicated. This call appears to have been made at or during the sudden nose drop of the aircraft and even the duration of
this short call may have prevented the pilot from concentrating on attempting a controlled engine-out landing in the broad estuary.

3.12 No final conclusion can be reached as to the cause of this accident.

4. Safety Recommendation

4.1 The manufacturer of the Rans S-12 should issue a Service Bulletin which would require all such aircraft to be fitted with positive-lock fuel tank caps. **(SR 28 of 1999)**

The Manufacturer subsequently notified the AAIU that they had developed a new fuel system in 1995 which uses a screw-on fuel cap with a safety chain. This was notified to owners at the time.

4.2 The Irish Aviation Authority (IAA) should review the operational procedures at airports equipped with recording facilities so that when organised activities such as 'fly-ins' are occurring, the recording facilities will be operational. **(SR 29 of 1999)**

The IAA agrees with this recommendation.

ANNEX A