ACCIDENT

Aircraft Type and Registration:	Rans S6-ES Coyote II, G-BZYL
No & Type of Engines:	1 Jabiru Aircraft Pty 2200A piston engine
Year of Manufacture:	2002
Date & Time (UTC):	14 February 2009 at 1424 hrs
Location:	Brimpton airstrip near Aldermaston, Berkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Serious) Passengers - None
Nature of Damage:	Aircraft destroyed
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	65 years
Commander's Flying Experience:	165 hours (of which 121 hours were on type) Last 90 days - 1:25 hours Last 28 days - 0:35 hours
Information Source:	AAIB Field Investigation

Synopsis

The pilot of G-BZYL was carrying out solo circuits at a small grass airfield. Following a 'touch-and-go', and at a height of about 180 ft, the aircraft appeared to stall. The left wing dropped and the aircraft entered a steep descent. It rotated left through approximately 310° and the pilot was unable to regain control before the aircraft hit the ground.

History of the flight

G-BZYL took off from a small grass airfield for a local flight. The pilot had conducted the majority of his flying in G-BZYL and from that airfield. The flight in the local area was uneventful, after which the pilot returned to fly some circuits.

The circuits and accident were witnessed by a number of people at the airfield. The first circuit was flown close to the airfield at a height judged to be lower than 800 ft, the usual downwind height. The second circuit followed a more normal pattern. When on base leg, the pilot was heard to transmit "FINAL 07 TOUCH AND GO" followed by further speech which, with hindsight, a witness believed might have been "EARLY TURNOUT". The approach, landing and 'touch-and-go' appeared normal and, as G-BZYL climbed away, at a point two-thirds of the way along the runway, it was seen at "between 30 and 50 ft, and in the correct attitude". The aircraft continued climbing and everything appeared normal to those watching.

According to the eyewitnesses, shortly after crossing the departure end of the runway, at a height of about 200 ft above the ground, G-BZYL "pitched nose-down and recovered, during which it also turned left, then pitched nose-down again with a wing drop to the left". A "fluttering of the wings" was "noticeable but not dramatic". There was no change to the sound of the engine to accompany this motion. When the left wing dropped, the aircraft "turned on its wingtip", during which the top surface of each wing was visible to the witnesses standing alongside the runway. G-BZYL descended steeply and rotated left through approximately 310° before impacting the ground. One witness stated "the wings started to level out slightly before impact". The aircraft came to rest 140 metres from the departure end of the runway and 90 metres to the left of the centreline.

The first witness to arrive at the aircraft turned off the electrical switches and ignition and lowered the flap lever to free the pilot. Later, he disconnected the stall warner from its battery supply because the horn was sounding continuously. The fire service and an air ambulance attended the scene, the pilot was cut free from the wreckage and flown to hospital.

Information from the GPS

Information from the GPS showed the ground speed was approximately 40 kt during the climb-out. Witnesses reported that there was a tail wind of "a couple of knots", suggesting an indicated airspeed of approximately 38 kt, or 44 mph.

Information from the pilot

The pilot remembered only parts of the accident flight but was able to remember more general information about how he operated G-BZYL.

While on base leg, the pilot decided the next circuit would be a "tight circuit" where he would climb to about 300 ft and execute a "sharp turn" downwind. He had flown such a circuit about 10 times before, although not recently, and the aim was to simulate a problem that necessitated a quick return to the runway in use. He vaguely remembered opening the throttle for the go-around but remembered nothing after that.

The stall warner would normally sound about 5 mph before the stall but the pilot did not remember whether or not it came on prior to the impact. In a power-off, flaps-up stall, the stall warner could be expected at 40 mph with a stall at 35 mph. Following a wings-level entry to the stall, the aircraft would "flutter down" substantially wings level and be controllable in roll using the rudder.

Takeoff was normally flown with flaps up but, occasionally, two stages of flap would be used. Carburettor heat would be selected to HOT on the downwind leg and three stages of flap would be extended on base leg. The pilot stated that the carburettor heat had negligible affect on the power delivered by the engine. During a touch-and-go, the flap lever would be lowered, retracting the flaps, the carburettor heat would be selected to COLD and the throttle would be opened. The pilot would rotate the aircraft at between 45 and 50 mph and climb at between 55 and 60 mph.

Aircraft performance

The Rans S6 Build Manual contains information for pilots on the operation and handling of the aircraft. The section on stalling states:

'Stalls have a warning buffet due to turbulent air from the wing root flowing over the elevator. The stall occurs with a definite break. Rudder may be needed to hold the wings level. Recovery is instant with the release of back pressure. Turning, accelerated power on and power off stalls all demonstrate the slight buffet and quick recovery.'

The manual states that, as each kit-built aircraft is unique, builders should expect their aircraft's performance to be unique. Flight test data was not available for G-BZYL but data for a similarly configured aircraft suggested that the use of full flap would reduce the speed at the onset of buffet, and at the stall, by two to three knots.

Stalling in the approach configuration

The stalling characteristics of a single-engine piston aircraft are typically more marked with flaps down and at high power settings. The airflow from the propeller can lead to a lower stalling speed but, when the stalling angle of attack is reached, the stall may be abrupt. In addition, the high engine power may cause the aircraft to yaw and a wing to drop. As the Jabiru engine rotates clockwise when viewed from the pilot's seat, the yaw and wing drop would tend to be to the left. G-BZYL was reported to remain substantially wings level during a power-off stall, which suggests it might suffer a left wing drop during a power-on stall.

Autorotation

When a wing drops at the stall, it meets the airflow at an increased angle of attack compared to the other, rising, wing. The increased angle of attack causes increased drag and the aircraft yaws in the direction of the lower wing. The dropping wing now moves more slowly through the air than the rising wing and its lift reduces further, which reinforces the original wing drop. The aircraft simultaneously rolls towards the lower wing and yaws in the same direction. This motion is autorotation and, if not arrested, will stabilise itself as a spin.

Examination of the aircraft

Impact conditions

The aircraft crashed onto soft ground adjoining the airfield at a position approximately 140 metres beyond the upwind end of Runway 07 and 90 metres to the left of its extended centre line. At impact, the aircraft was heading 120°, pitched approximately 30° nose-down and banked slightly to the left with a high rate of descent and negligible forward speed, consistent with it having been in a fully stalled condition. There was no evidence of significant momentum about the yaw axis, suggesting that the initial rotation reported by witnesses, and implied by the aircraft's heading at impact, had been stopped, but there was insufficient height to complete the recovery.

Wreckage examination at the site

Examination of the wreckage at the site established that the aircraft was intact at impact. All flying control surfaces were securely attached and free of restrictions, and all associated control circuits were intact and connected at impact. The flap control, a handbrake-type lever positioned between the two seats, was set to the first stage flap position. One of the rescuers had reported releasing this lever and lowering it somewhat (to prevent further injury to the pilot), suggesting that immediately post-impact it was in the 2nd, or possibly the 3rd stage position. There was some potential for the lever to have been driven upwards by impact forces, and the post-accident position of the lever alone did not therefore provide a reliable indication of the flap setting immediately before impact.

Fuel was present in both fuel tanks and the in-line filter in the supply line to the engine was substantially full. The fuel selector was in the OFF position but it was reported that it, together with the magneto switches, had been turned off by rescuers immediately after the accident. The throttle and choke controls were both found in the fully open position, and the carburetter heat control was in the HOT position. All operating cables and end-connections were intact. There was potential for these controls to have been disturbed from their pre-impact position by impact forces, and by people attending the injured pilot.

Fragments of broken propeller were spread over a wide area forward of the impact point. The degree of fragmentation and distribution of the propeller pieces, combined with the pattern of fracture exhibited by the broken propeller stubs, was consistent with significant power at impact.

Detailed examination of the wreckage

The wreckage was recovered to the AAIB facility at Farnborough for further, more detailed, examination.

Airspeed indication and stall warning

The pitot probe, which comprised a tube projecting from the wing leading edge, was clear of obstruction, the plastic tubing connecting it to the airspeed indicator (ASI) was intact and free of obstruction, and the ASI needle responded to pressure applied to the pitot port. There was a slight leak at the tubing's connection to the ASI; it was not possible to establish whether this leak was present prior to impact as it was insufficiently large to have had any material effect on the performance of the ASI. Function testing and strip examination of the ASI showed that the instrument itself was free of leaks and was mechanically serviceable, and that it performed satisfactorily throughout the relevant speed range.

The stall warning vane, mounted on the wing leading edge, moved freely but the vane itself was deformed in the impact and the airspeed at which it operated could not be determined. Rescuers had reported that the stall warner horn was sounding during their attempts to extract the pilot until its battery was disconnected.

Flap position

The flap operating system comprised a single push-pull cable from the flap control lever, running aft to a position behind the seats where it split into two separate push cables - one for each flap surface. The system was intact except for an impact-induced fracture through the end-fitting of the single cable section, at the point of bifurcation.

The selected flap position was maintained by a set of substantial detents in the control lever mechanism, into which a spring loaded retractable lock-bar, operated by a push button in the end of the lever, engaged. The geometry of the detents provided a substantial and positive stop preventing the lever from being lowered without first pressing the release button, but allowed the lock-bar to ride up out of its detent and snap into the next one if the lever was raised. Thus, the post-impact position of the lever was not a reliable indication of the flap setting prior to impact.

Impact deformation of the fuselage structure below and immediately forward of the flap lever suggested that the cockpit floor or parts of the control column layshaft could have been driven upwards during the impact, moving the flap lever, before relaxing back to a position clear of the lever. The flap lever mechanism was removed and studied in detail, both generally and microscopically, for any impact witness marks or other evidence. No positive determination of the flap setting prior to impact could be made, but it appeared on a

balance of probability that some flap extension was present at impact.

Throttle operating mechanism

The throttle cable was actuated from a layshaft mounted at floor level immediately forward of the seats, from which projected upwards and forwards a pair of long throttle levers, one to the left of each seat squab. Both throttle levers were thus susceptible to disturbance, both by impact forces and during attempts to extricate the injured pilot, and it was not possible to determine the throttle setting at impact.

Carburettor heat

The carburettor heat control comprised a conventional push/pull knob on the instrument panel, connected to a cable which moved a crank on the flap valve. This valve switched the carburetor air supply between COLD and HOT sources. An over-centre spring, attached to the crank, assisted the valve to snap firmly into either the fully HOT or fully COLD position, as appropriate, once it moved beyond the mid-travel position.

The control knob was found very close to the fully hot position. Its cable was intact and connected to the crank of the hot air valve, and the valve flap itself was fully seated in the HOT position. The valve-operating mechanism, and the related parts of the air-box, were undamaged and there was no evidence to suggest that the mechanism had been displaced during the impact. The nipple on the end of the operating cable at its connection to the crank was not fully in contact with the inner face of its clevis fitting, but its protruding end did abut the side face of the crank (Figure 1) consistent with the crank being 'over-ridden' by the operating cable during the final stage of valve movement into the HOT position. This could have occurred due to the inherent tendency of the spring to snap the valve onto its seat in advance of the operating knob and cable becoming fully retracted. Alternatively, it could , possibly, have been due to impact forces driving the valve crank into the HOT position.

Analysis of the geometry of these components within the engine compartment, and bench operation of the mechanism showed that the position of the carburettor heat control at impact could not be established with certainty, but on a balance of probability, the evidence pointed to it having been in the HOT position.

Analysis

Evidence from witnesses suggested that the aircraft stalled, with a left wing drop leading to autorotation from which there was insufficient height to recover. Evidence from the wreckage suggested the aircraft

Figure 1

Operating mechanism for engine carburettor heat

impacted the ground with low forward speed and high rate of descent, consistent with this analysis. It is probable that the flaps were extended and that the carburettor heat was set to HOT. The engine was delivering significant power and the aircraft appears to have been serviceable before it hit the ground.

It was not possible to prove the actual sequence of events but it was possible to suggest a plausible sequence. The pilot would have been thinking, on the previous circuit, about the early turn following the 'touch-and-go' and it is likely he transmitted his intention while on base leg. He carried out a 'touch-and-go', during which he would normally select carburetor heat to COLD and raise the flaps before applying power. It is probable that he carried out neither of these actions. It is conceivable that he was thinking ahead to the manoeuvre he was about to carry out, which he had not flown recently, and that this distracted him.

The GPS-derived climb airspeed of approximately 44 mph was lower than the usual climb speed of 55 to 60 mph and would have reduced the margin above the stall speed. It is possible that, when the pilot began his "sharp" turn downwind, he pulled the aircraft through the margin to the stall itself and the high power setting would probably have caused the left wing to drop and the aircraft to autorotate to the left. Evidence from the wreckage suggested the pilot managed to stop the yaw before impact but did not have sufficient height to un-stall the wings.