ACCIDENT

Aircraft Type and Registration:	Stolp Acroduster Too SA750, G-BUGB
No & Type of Engines:	1 Lycoming O-360-A1D piston engine
Year of Manufacture:	1997
Date & Time (UTC):	26 July 2008 at 1457 hrs
Location:	Near Farthing Corner (Stoneacre Farm) Airfield, Kent
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Serious) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	52
Commander's Flying Experience:	9,738 hours (of which 174 were on type) Last 90 days - 137 hours Last 28 days - 47 hours
Information Source:	AAIB Field Investigation

Synopsis

The aircraft departed from Runway 06 at Farthing Corner Airfield in Kent and was seen to climb to a height of 300-400 ft. The aircraft then turned back towards the airfield and flew in the direction of the hangar complex. As it approached the hangars, the nose pitched up and what appeared to be an aileron roll to the right was commenced. When the aircraft became inverted, the rate of roll appeared to slow or stop momentarily. The roll continued but the manoeuvre then appeared to become more of a barrel roll. The aircraft descended and struck tall trees before impacting the grass surface of an orchard.

Members of the public were quickly on the scene but were unable to release the pilot who received serious burns from the ensuing fire.

History of the flight

The pilot had flown from Rochester Airport to Farthing Corner Airfield to meet a friend and discus flying training. He was seen at Rochester earlier in the day working on his aircraft and met acquaintances in the airport café. He departed from Runway 34 at 1402 hrs and recorded his landing time on Runway 24 at Farthing Corner as 1410 hrs.

Having parked his aircraft near the hangars, the pilot met his friend and they went to the caravan clubhouse for tea. They were joined by three other pilots who were working on their aircraft and all remained outside. The pilot of the Acroduster was relaxed, in good spirits and after tea went to the hangar to look at an aircraft which was being maintained.

He had to return to Rochester to undertake a training flight with another pilot and started his aircraft and taxied to grass Runway 06 for departure. He was heard to carry out the engine power checks and then seen accelerating along Runway 06. The aircraft became airborne approximately halfway along the runway and climbed quickly to a height of about 300-400 ft agl. Some witnesses thought the aircraft turned left after takeoff and one person thought it turned to the right, but all agreed that the aircraft turned back towards the airfield and headed towards the hangars. Electricity cables suspended between pylons cross the airfield in a line to the west of Runway 06 and parallel to it. They are approximately 100 ft high and witnesses estimated that the aircraft was about 150-200 ft above the pylons when it crossed them. The aircraft then commenced what three witnesses described as an aileron roll and one witness thought was "an axial climbing roll to the right", which appeared to have an upward vector and was well executed. When the aircraft became inverted, that witness thought the roll stopped momentarily and all the witnesses agreed that the aircraft then entered a pronounced barrel roll type of manoeuvre in a nose down attitude. The aircraft was described as "mushing" downwards and disappeared behind the trees.

The occupants of a nearby farmhouse, the owner of which was an experienced pilot and owner of the airfield, were sitting outside having lunch with friends. They heard the aircraft coming and thought from the sound that it was performing an aerobatic manoeuvre but could not see it because of the high trees. The aircraft appeared in a nose-down attitude and struck the ground sliding into the orchard. A small fire ignited in the area of the aircraft nose. The people at the farmhouse ran to assist the pilot and were joined by the witnesses from the airfield, one of them a doctor. Some of those present fought the fire with fire extinguishers located nearby whilst others poured water over the pilot. The doctor released the pilot's five-point harness and attempted unsuccessfully to lift him from the cockpit. He thought that the pilot was trapped by his seat and despite exerting a level of force that would normally have raised him, he could not be lifted from the cockpit. The rescuers were unaware that a second lap strap was fitted in each cockpit. The fire spread to the forward cockpit and the rescuers, being unable to release the pilot, moved the aircraft tail through 45°, to allow the light breeze to take the flames away from the pilot. The fire was eventually extinguished and a doctor and paramedic arrived by air ambulance. Shortly after, the fire brigade arrived and the pilot was removed from the wreckage and transported to hospital in the air ambulance. He had suffered full depth burns to 55% of his body.

Subsequent inspection of the rear cockpit showed that the second lap strap in the rear cockpit was undone. Neither the air ambulance crew, nor the members of the public who attempted to rescue the pilot, nor the fire crew members who released him, recalled undoing the lap strap.

Meteorological information

The weather for the flight was good and an unofficial observation was made at Rochester Airport shortly after the accident. This gave the surface wind as South Westerly at less than 5 kt, visibility greater than 20 km, a QNH of 1016 hPa and the outside air temperature (OAT) of +26°C. Witnesses at the scene described the weather at the time of the accident as a calm wind, bright and sunny with medium level cloud and good visibility. Photographs taken at the scene whilst the pilot was being extracted confirmed the conditions.

Aerodrome information

Farthing Corner is a private airfield 4 nm east-south-east of Rochester Airport. It has a single, bi-directional grass runway 380 m long and 20 m wide, orientated 06/24. There is a windsock located to the west of the runway about half-way along it. A set of electricity cables is supported on metal pylons approximately 100 ft high and runs across the field 140 m west and parallel to the runway. There are two hangars 200 m to the west of the runway and a private property 100 m west of the hangars. The airfield elevation is 420 ft amsl, six feet lower than Rochester Airport (elevation 426 ft).

Pilot information

The pilot started flying in 1980 and his PPL was issued on 30 March 1981. He worked as a Flying Instructor gaining his CPL on 19 August 1987 and began flying on commercial aircraft operations. His ATPL was issued on 11 April 1990 and he moved to airline operations on medium size jet aircraft becoming a Type Rating Instructor/Examiner (TRI/E) on the Airbus A319 aircraft. He held a valid Class 1 medical certificate with no limitations.

Whilst pursuing his airline career he continued to fly light aircraft and acquired G-BUGB on

Figure 1

23 December 1999. He performed basic aerobatics such as loops, rolls and wingover manoeuvres but always at altitude with a minimum recovery floor of 1,500 ft. There is no evidence that he had performed low level aerobatics prior to the accident flight. His initial introduction to aerobatics was on his instructor course. Some eight years later he received formal aerobatic training on the Tiger Moth which consisted of basic aerobatic manoeuvres with their associated recovery techniques. In addition, the pilot had also received formal check flights to carry out basic aerobatics on the Stearman and Harvard aircraft. When he purchased the Acroduster the pilot applied his previous aerobatic experience to developing his skills on that aircraft.

There were numerous examples of the pilot's attitude towards safety. He was fastidious with the maintenance of his aircraft which, as a capable engineer, he carried out himself. Equally, in the conduct of his flights, those who flew with him emphasised his strict adherence to following a cautious and safe approach to flying.

Safety and survival

The pilot normally wore a flame retardent flying suit, flying boots, gloves and a lightweight protective helmet. On the day of the accident, the weather was hot and he was wearing the light weight helmet, knee length shorts, trainers and a T shirt with his flying gloves placed to the left of his seat. During the impact the pilot received injuries which probably rendered him unconscious. His five-point harness was secured but it could not be positively established if his secondary lap strap was secured. The accident was survivable and had the aircraft not caught fire or had the pilot been able to extricate himself from the aircraft when the fire first started, he would not have suffered the serious burns. If the rescuers had been able to release the pilot on their arrival at the scene, the level of burns would have been significantly reduced.

Rolling manoeuvre

The aircraft was cleared to perform rolling manoeuvres. The minimum recommended entry speed to carry out an aileron roll is 120 mph but the pilot normally used an entry speed of 140 mph. This ensured a more rapid rate of roll with minimum nose drop. It should also be noted that the normal cruising speed for this aircraft is 120-140 kt.

The Permit to Fly, Flight Test Schedule recorded the V_{NE} achieved of 200 mph at 2,400 propeller rpm. This was below the propeller rpm limit and confirmed that the safe entry speed for the manoeuvre could be achieved without exceeding the maximum propeller rpm limit of 2,700 rpm

Weight and Centre of Gravity (CG)

The maximum authorised takeoff weight for the aircraft was 1,800 lbs with the CG limits +20.5 inches to +26.5 inches aft of the CG datum. The aircraft weight at the time of the accident was approximately 1,346 lbs with a CG position of 22.12 inches aft of the CG datum. Therefore, the aircraft was being operated within the permitted weight and CG range.

Civil Aviation Authority (CAA) Safety Sense Leaflet

The CAA publishes a Safety Sense Leaflet Number 19a entitled *Aerobatics*. This document contains valuable information and guidance for pilots carrying out aerobatics. The following text is taken from the three areas which have a relevance to the accident.

*'**Personal Equipment and clothing***

Whilst there are no requirements to wear or use specific garments or equipment, the following options are strongly recommended.

- *Gloves help to protect against fire and abrasion in an accident. They also absorb perspiration, improving grip.*
- *Overalls made from natural fibres, with zippered pockets and close fitting ankles,collar and wrists also give protection, as do leather flying boots.*
- *Particularly when flying open cockpit aeroplanes a lightweight helmet gives protection whilst minimising discomfort under increased 'G' loading.*

Instruction

Ensure you learn the safest way of recovering from each manoeuvre if it goes wrong and be prepared to use it in the future. Continuing to pull is usually less safe than rolling to the nearest horizon.

Aircraft checks

Check that items of cockpit equipment, such as seat cushions and the fire extinguisher, are properly secured and check VERY carefully for any loose objects which might be present. Even the most insignificant item could lodge in such a manner as to restrict control movement. Dust and dirt from the floor, under negative 'G' situations, can get in the pilot's eyes.'

Engineering

Site examination

The aircraft had come to rest in a disused orchard close to the farmhouse witnesses. It had clipped the top of some trees, without incurring any significant damage, before impacting the ground heavily in a nose-down attitude on the main landing gear and engine, collapsing the former. The line between the tree and ground impact showed it had been travelling approximately on a heading of 180º, although it was found pointing 225º. Rescuers later explained that the aircraft had been dragged into this position to try and protect the pilot from the flames and had originally come to rest on a more southerly heading. Fire had consumed much of the aluminium and fabric structure forward of the rear cockpit.

Before it came to rest, the aircraft's wings had struck three apple trees which had severely damaged both upper and lower wings on both sides. This had a fortuitous effect since it had slowed the aircraft rapidly before the fuselage could have struck another tree. The total ground slide had been only three fuselage lengths. The propeller had shed about 30 cm of the tip of one blade as it struck the ground, indicating significant power at impact with the hard ground.

The pilot's five-point harness and secondary lap belt were found unfastened in the rear cockpit and several items (apparently from the small baggage compartment behind the pilot's head and covered with a fabric flap secured with velcro) were found scattered on the floor. The pilot appeared to have placed his flying gloves and map down the left side of his seat and, although they were rubbing against the left rudder cable, they did not appear to impede operation of the rudder.

In the front cockpit, the empty seat harness and lap strap were properly secure. The rear cockpit fuel selector was found selected to the No 2 tank (the fuselage tank in front of the front instrument panel). This was the position always used by the pilot, irrespective of the type of flight he intended to perform. This also ensured fuel supply to the engine during inverted flight. There was provision for a second fuel tank to be installed in the upper wing centre section but this was not fitted. The throttles were in the full power selected position, although disruption of the engine mountings meant this was not necessarily the pre-impact selection. The rudder and elevator control circuits were still connected and responded to pedal and stick movement: the aileron linkages were connected to the control stick in the fuselage. The disruption of the wings required a more detailed examination when the aircraft was transported to the AAIB hangar at Aldershot.

Subsequent examination

The severely damaged aileron control runs in the wings were reconstructed. No disconnections were found and all failures were consistent with impact. No obvious signs of control restriction by foreign objects were observed. The rear cockpit altimeter had been set to 1016 mb.

Fire and survivability

The ground impact had been very severe and yet both cockpits seemed to have remained a viable space for survival; there was little distortion of the steel spaceframe structure aft of the engine firewall, although most of the engine mount tubes had fractured. The pilot's seat belt attachments had remained intact, although there was some evidence that his head had struck the instrument panel. The fuselage fuel tank was severely burnt in the fire but did not appear to have been ruptured by the impact: broken fuel lines and gascolator were probably feeding the fire with fuel at a measured rate, which is consistent with witness reports that the fire developed relatively slowly and was difficult to extinguish.

The fire damage to the rear cockpit was much less severe, due to the efforts of the rescuers who poured water over the pilot whilst attempts to extricate him from the wreckage continued. The rudder pedals for the rear pilot are located either side of the front seat. This was significantly affected by fire, resulting in the pilot's feet and lower legs being severely burned.

Analysis

The pilot was properly licensed to conduct the flight and held a valid medical certificate. The aircraft was properly maintained and no technical faults or failures connected to the aircraft structure or its systems were identified.

The accident manoeuvre

Whilst the pilot had demonstrated at altitude his ability to carry out aerobatic manoeuvres, there was no evidence of him having performed them at 300 ft, the estimated height at which he entered the accident manoeuvre.

There was no evidence from any of the witnesses who spoke to the pilot before he departed Rochester Airfield, or those he met at Farthing Corner, that he was going to perform a low-level aileron roll. At some point after departure, the pilot would have had to turn left to return to Rochester but the direct track would not have taken him over the hangars. It is therefore possible that the roll was an impromptu manoeuvre performed to pass over the witnesses at the hangar.

The pilot was aware of the electricity cables running across the airfield and, flying at a height of 300 ft, he was clear of them. His altimeter was set to the Rochester QNH of 1016 hPa and with the height difference in

airfield elevations between Rochester and Farthing Corner of six feet, misinterpretation of the height above the ground at Farthing Corner by sole reference to the altimeter was not considered a factor.

The aircraft was heard accelerating on its approach to the hangars and the entry into the barrel or aileron roll had an upward vector and appeared to be flown properly. The rate of roll described by the witnesses suggested the airspeed was between the 120 mph minimum entry speed and the 140 mph normally used by the pilot. Up to the point where the aircraft became inverted, the manoeuvre appeared normal. When the aircraft became inverted, the nose drop created a downward vector and the subsequent barrelling of the roll suggests that there may have been a loss of airspeed or some degree of disorientation, distraction or partial incapacitation of the pilot. The pilot appears to have attempted to correct the manoeuvre with coordinated use of rudder and elevator, rolling to the nearest horizon and attempting to raise the nose. There was insufficient height, however, for the aircraft to be recovered to safe flight before contacting the tree. There was some evidence of potential loose articles but none was considered to have distracted the pilot.

Safety and survival

The accident was survivable but the pilot suffered life-threatening burns as a result of the fire. Wearing a flame retardant flying suit with gloves and boots, as recommended in the CAA Safety Sense Leaflet, may have reduced the severity of his burns.

The fire did not ignite immediately and had it been possible to extract the pilot without undue delay, he would only have suffered impact injuries. Being trapped in the cockpit may have been due to the aircraft structure pressing on his legs or the secondary lap strap harness holding him in his seat or a combination of both. The fact that the rescuers were not aware of the secondary harness was considered a significant safety issue. The Light Aircraft Association estimate that there are about 200 aircraft which may have dual restraint harnesses.

Safety Recommendation 2009-046

It is recommended that the Civil Aviation Authority and the Light Aircraft Association consider introducing a requirement to install a placard adjacent to the cockpit, advising potential rescuers that the aircraft seats are fitted with more than one restraint harness.

Conclusions

The accident occurred when the aircraft struck the tree as it descended during recovery from a low-level rolling manoeuvre. The pilot had not flown low-level aerobatic manoeuvres previously and had not stated any intention to perform such a manoeuvre. Therefore it could not be established whether this manoeuvre was intentional.