ACCIDENT

Aircraft Type and Registration:	Cirrus SR20, G-GCDA
No & Type of Engines:	1 Teledyne Continental IO-360-ES piston engine
Year of Manufacture:	2008 (Serial no: 1962)
Date & Time (UTC):	19 October 2018 at 1300 hrs
Location:	Turweston Aerodrome, Buckinghamshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Fire damage to 'bolster' switch panel circuit board and insulation
Commander's Licence:	Private Pilot's Licence
Commander's Age:	49 years
Commander's Flying Experience:	492 hours (of which 248 were on type) Last 90 days - 10 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and enquiries made by the AAIB

Synopsis

The aircraft owner was collecting his aircraft after its annual inspection. The pre-flight checks and takeoff roll were normal. However, just as the aircraft lifted off, the pilot became aware of smoke in the cockpit. He landed immediately and despite shutting down all the electrical equipment, the smoke persisted. With the assistance of an engineer, the source of the smoke and a small fire was identified and extinguished. It was caused by a 'circuit track' in a switch panel, which had been electrically overloaded because of an unidentified problem with a diode in the standby battery wiring harness. The aircraft manufacturer has taken several safety actions to ensure the significance of the diode is understood and have included an additional circuit protection device. The aircraft manuals and circuit diagrams have also been amended to clarify the circuit maintenance information.

History of the flight

The pilot was collecting his aircraft from Turweston aerodrome after its annual inspection. The pre-flight checks, engine-start and power checks were normal. The pilot then lined the aircraft up on the runway and started the takeoff roll. As the aircraft lifted off, smoke emanated from a switch panel in front of the pilot, near the primary instrument display. He called Turweston air/ground radio and reported smoke in the cockpit and advised of his intention to perform a brief circuit to land. There was no other traffic to conflict and the pilot

flew a low circuit and landed. On landing he switched all the electrical equipment off and opened the cabin door to clear the smoke. The smell of the smoke led him to believe that it may have been an electrical fire. He taxied the aircraft to the maintenance hangar and shut down. He noticed that despite all the electrical switches being turned off, the avionics still appeared to be powered. He then asked one of the engineers nearby for assistance. There was still a significant amount of smoke in the cockpit being generated from the switch panel. With assistance from the engineer, the engine cowling was removed and the main battery disconnected. Despite this, smoke continued to emanate from the switch panel which was then hurriedly removed. Material around the back of the switch panel had caught alight but was quickly extinguished.

Engineering investigation

Examination of the aircraft and switch panel, known as the 'bolster panel', found the fire had been caused in the circuit board behind the row of system master switches. One of the copper circuit tracks leading from the BAT 2 master switch had completely melted away and the heat generated had also damaged circuit board mounted components and tracks nearby. A small fire appeared to have taken hold in a fibrous insulation material below the circuit board.

System description

The Cirrus SR20 is fitted with two batteries to support the avionics system in normal and emergency situations. Cirrus aircraft are fitted with a ballistic parachute recovery system (BRS) known under the manufacturer's title as the Cirrus Airframe Parachute System (CAPS). The CAPS in this aircraft had been modified and is now electrically initiated, rather than the previous system in which a manual cable led from the cockpit to a percussion initiation device at the rocket. In the subject aircraft a diode was introduced as an integral part of the battery relay with the CAPS modification. This was fitted to suppress any possibility of a voltage spike on relay switch-over. When the relay manufacturer stopped including the diode within the relay, an external diode was introduced. It consists of a heat-shrink insulated diode with two spade connectors which connect it across the relay terminals. During the modification programme the aircraft circuit diagrams were updated by the manufacturer accordingly.

Discussion

During recent maintenance and prior to the flight, the No 2 battery relay was replaced to rectify a battery charging problem. Subsequent investigations suggest that a fault with the diode may have been the cause of the relay failure. It is also possible that its disturbance, during the relay replacement, could have led to a short within the diode and examination of the diode showed evidence of overheating. However, it is not clear exactly how or when the diode failed. Nevertheless, it appears to have allowed the No 2 battery load to pass through the relay coil and through the aircraft wiring to the circuit board track connecting the system to the BAT 2 switch. The circuit track was not designed to sustain an electrical load of this magnitude and subsequently overheated.

The awkward location and unremarkable look of the diode assembly meant that its significance could easily be overlooked.

Actions by the aircraft manufacturer

The aircraft manufacturer has examined the switch panel circuit and reviewed this sequence of events. The position and unremarkable look of the diode was understood by the manufacturer. In addition, they have also identified that there is a slight risk of mis-assembly. To address this risk and to inform owners, the following safety actions are being carried out:

An update to the parts catalogue, wiring manual and electric CAPS service bulletins have been released.

The addition of a fuse to the harness assembly to prevent damage. The engineering drawings for this are now released and will be used in new aircraft. Issuing new CAPS kits is planned but not released yet. Adding the fused harness will require another round of revisions for the service bulletins. The fused harness is field retrofittable and can be installed in existing aircraft and listed as the field spare.