ACCIDENT

Aircraft Type and Registration:	CASA 1-131E Series 1000 Jungmann, G-JUNG
No & Type of Engines:	1 ENMA Tigre G-IV-A2 piston engine
Year of Manufacture:	1952
Date & Time (UTC):	24 May 2009 at 1413 hrs
Location:	Staunton Caundle, Dorset
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Fatal) Passengers - 1 (Serious)
Nature of Damage:	Substantial
Commander's Licence:	Private Pilot's Licence
Commander's Age:	63
Commander's Flying Experience:	Estimated 980 hours Last 90 days - Unknown Last 28 days - Unknown
Information Source:	AAIB Field Investigation

Synopsis

The aircraft struck telegraph cables during an attempted forced landing following an engine failure. On striking the cables, the aircraft pitched nose-down, struck the ground nose first and pitched over inverted. The pilot was fatally injured and the passenger suffered serious injuries.

History of the flight

The pilot arrived at Henstridge Airfield at around 0930 hrs with the intention of taking some friends flying. He had planned to make six flights; the first three were to be of around 30 minutes duration, followed by two flights of fifteen minutes. He then intended to make a further flight in the aircraft with a regular flying partner.

The pilot conducted a pre-flight inspection of G-JUNG whilst it was in its hangar. Another local pilot who was assisting him checked the fuel level and added about four and a half litres of Avgas to the tank from a plastic container. The pilot and his assistant then moved the aircraft out of the hangar, before attempting to start the engine by hand swinging the propeller. This proved difficult and it took some 40 minutes until it eventually started. The pilot then taxied the aircraft across the runway to a grassed area outside the clubhouse which was used for changing over the passengers between flights.

The first two flights were conducted with a 'running change' ie the engine was kept running as the passenger in the aircraft disembarked and the next passenger boarded. Following the second flight the pilot parked the aircraft by the fuel bowser; the pilot's assistant then refuelled G-JUNG with 63 litres of Avgas. He believed that he had filled the tank to full, as he observed fuel coming out of the drain mast on the bottom of the fuselage. A bucket was placed under the drain mast and the pilot and four of his passengers then had lunch, which took around an hour. When they returned, fuel had ceased flowing from the drain mast. It was reported that around two litres of Avgas had collected in the bucket.

The engine was hand-swung and, on this occasion, it started easily. The pilot completed a third uneventful flight of about 30 minutes duration before another 'running change' of passenger, after which the aircraft took off from Runway 07. The pilot made a climbing right turn, departing to the south-west. From passenger interviews, it is believed that the previous flights had been flown at a height of around 1,000 ft.

During the accident flight the passenger recalled looking forward at the 'float-type' fuel gauge, which she described as "bouncing up and down". Then, without warning, the engine ran down smoothly and stopped. The aircraft turned right, towards what the passenger described as a "big green lush field." The pilot transmitted a MAYDAY on the Henstridge frequency, reported the engine failure and gave his position as somewhere west of Stalbridge. He placed the aircraft in a glide and made an approach to a field near the village of Staunton Caundle. The passenger commented that the pilot appeared very calm and in control of the situation. As they neared the ground the passenger saw a set of telegraph cables and realised that they would not clear them. The aircraft struck the cables, causing it to decelerate rapidly and pitch nose-down. It impacted the ground nose first and then pitched over inverted.

Immediately on hearing the MAYDAY, the Air/Ground operator at Henstridge alerted the emergency services by telephone. A number of aircraft departed Henstridge to search for G-JUNG. It was located by the pilot of one of these aircraft after a short while and he passed the GPS coordinates of the accident site to the emergency services.

The pilot received instantly fatal injuries. The passenger, who had suffered serious spinal injuries, was trapped in the aircraft and had to be cut free by the emergency services before being airlifted to hospital by the Dorset Police Air Support Unit helicopter.

Weather

The METAR for Yeovilton (10 nm north-west of the accident site), recorded at 1350 hrs, gave the weather as: wind from 310° at 5 kt, greater than ten kilometres visibility, cloud overcast at 2,900 ft, temperature 19°C, dewpoint 14°C and a QNH of 1013 millibars.

Pilot's experience

The pilot had owned G-JUNG for over twenty years and as well as some flying on a range of other aircraft types, he is reported to have had several hundred hours experience on the accident aircraft. It was not possible to establish fully his recent flying experience, however, he had flown three flights on the previous day and a further three flights earlier on the day of the accident, all in G-JUNG.

The pilot had held a UK Private Pilot's Licence since 1975. His Single Engine Piston rating was valid until 13 August 2010. There was no record of the pilot holding a valid Radio Licence at the time of the accident.

Medical and pathological information

The pilot held a current Class 2 medical, with no restrictions. It was valid until 3 June 2009. Post-mortem examination revealed that he was a fit and healthy male who had suffered a single, significant head injury consistent with his head having struck the ground as a result of the aircraft pitching over inverted. Although he was wearing a helmet, it could not prevent the fatal injury.

The passenger suffered multiple cervical spinal fractures, requiring several weeks of hospitalisation and a prolonged recovery. The passenger had been firmly strapped in to the aircraft and was wearing a helmet designed to fit an aviation headset.

Aircraft description

The CASA 1-131E Jungmann was built under licence in Spain and was based on the original Bucker Bu-131 Jungmann. The construction of these Spanish-built aircraft began in 1941, with the aircraft then serving in the Spanish Air Force. The last CASA-built aircraft was manufactured in 1963.

G-JUNG was built in 1952 and was fitted with an ENMA Tigre G-IV-A2 in-line four-cylinder, air-cooled, piston engine. The engine had recently been fitted with an electric starter motor. This required an external power source and could only be used to start the engine with the engine cowls open. It was not routinely used to start the engine.

The fuel system incorporates a single fuel tank with a capacity of 82 litres. The tank is mounted in the forward fuselage, above and behind the engine. The tank has two outlets which can be selected by the pilot via a three-position selector, labeled 'CLOSED', 'AEROBATIC' and 'MAIN AND RESERVE'. When selected to MAIN AND RESERVE, fuel is fed from the lowest point of the tank, whereas in AEROBATIC, fuel is fed via a 'flop' tube which moves in response to 'g' forces, thus ensuring that the engine continues to be fed with fuel during aerobatic manoeuvres. Due to the height of the 'flop' tube inlet within the tank, the AEROBATIC setting should only be used when the fuel quantity is above approximately 20 litres. The fuel consumption of the engine is between 30 and 40 litres per hour, depending on power setting.

Fuel from either source is drawn to the engine by an engine-driven fuel pump, and is supplied from the fuel tank, via the fuel selector in the rear cockpit. The engine-driven fuel pump should produce a pressure of 150 gr/cm^2 (2.13 psi) at idle and 300 gr/cm^2 (4.26 psi) at 1,700 rpm. In the event of a failure of the engine-driven pump, a manually operated 'wobble' pump, located at the fuel selector, can be operated by the rear pilot to pump fuel to the engine.

The fuel quantity is indicated by a float-type gauge. The gauge is mounted on top of the fuel tank at the front of the aircraft. It consists of a float, which moves within an outer cylinder mounted inside the fuel tank. The float is connected to a bar which protrudes from the top of the fuel tank into a glass tube, enclosed by a cylindrical metal frame. The float moves in relation to the fuel level in the tank and the bar then moves respectively within the glass tube. The top of the bar is painted black. The height of the bar within the tube provides an indication of the quantity of fuel in the tank. When the tank is empty, the bar is out of sight. With the tank full, the bar is fully visible within the tube. For intermediate quantities, the fuel level is 'gauged' by reference to red lines marked on the metal cylinder.

A combined fuel and oil pressure gauge is installed in the rear cockpit. The fuel pressure gauge gives an indication of the fuel pressure at the engine-driven pump. The pressure is indicated in kg/cm^2 on a scale of 0 to 0.5 kg/cm^2 (7.11 psi) with 0.05 kg/cm^2 graduations.

The oil pressure gauge gives an indication of oil pressure in the engine oil system and is indicated in kg/cm^2. The gauge has a scale of 0 to 10 kg/cm^2 (142.23 psi) with 1 kg/cm^2 graduations.

A single drain mast on the underside of the aircraft is used to drain away fluids from the engine and fuel system. There are four fuel drains that come together in the drain mast, from various parts of the aircraft: the fuel vent, the fuel filler cap area, the fuel pump housing and the inlet manifold.

The aircraft was equipped with a VHF radio, mounted in the aft cockpit, to the left of the magneto switches.

Accident site (Figure 1)

The aircraft had come to rest inverted just inside the hedgerow of a field of light crops to the north of the village of Stourton Caundle. The only ground mark had been made by the spinner of the propeller, which indicated an impact angle of 45° beyond the vertical.

A set of telegraph cables ran alongside the Stourton Caundle to Stalbridge road; this road ran parallel to the hedgerow boundary of the accident field. The cables consisted of several small wires wrapped in a black insulation material and supported by a steel rod; the diameter of the cable was 10 cm. Telegraph poles, spaced at 50 m intervals, supported two sets of the telegraph cables which were mounted on the poles at a height of 6.5 m (22 ft) above the ground. The cables were in parallel, with one wire in front of the pole and the other behind. When struck by the aircraft, the telegraph cables had separated from the pole closest to the accident site; this pole had remained standing. The telegraph poles, both north and south of the accident site, had been uprooted. The cables had stretched to the extent that they were found lying on the hedgerow that bounded the accident site field. There was visible damage to the cable insulation and the internal wires.

The aircraft's lower left wing and aileron had become distorted with damage to the left front upright between the upper and lower left wing, and damage to one of the wing bracing wires. Black marks on the left lower wingtip and the damage to the structural upright were consistent with contact with the telegraph cables. There was also transfer of telegraph cable insulation material onto the number 1 exhaust stub of the engine.

Both main landing gears had contact damage and insulation material transfer which matched the damaged areas on the telegraph cables.

There was very little smell of fuel on the accident site. Fluid was leaking from the main landing gear shock struts which had been damaged by contact with the telegraph cables. There was some oil staining on the lower engine cowls, and oil had leaked from the engine whilst it was inverted.

Once the aircraft was upright, it became apparent that the fuel gauge mounted on top of the fuel tank had penetrated into the ground and the glass inside the gauge had fractured. Digging down into the ground around the gauge revealed a faint smell of fuel, but there was no evidence of significant fuel leakage. The vegetation around the fuel tank was flattened but had not suffered the characteristic 'burning' associated with a fuel leak. The site was visited on a few occasions over the weeks

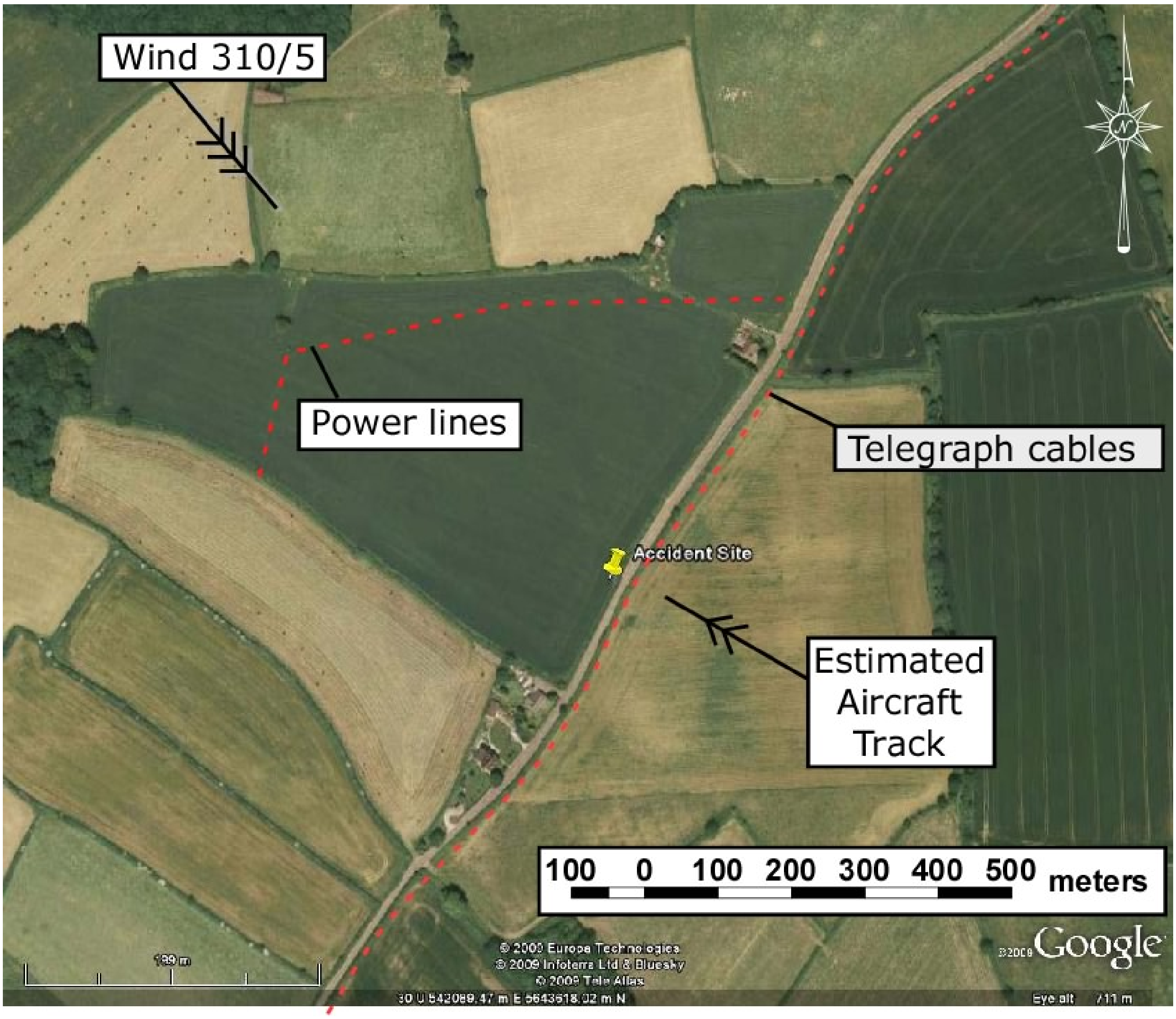

Figure 1

Accident location

following the accident and the vegetation remained unaffected. The fuel filler cap was found securely fitted.

The flying controls were inspected and found to be correctly installed, continuous and operated in the correct sense.

The upper wing structure had suffered damage as a result of the aircraft inverting. The upper wings had compressed against the top of the fuselage, with associated buckling of the wing to fuselage support struts and bending of the lower wings.

The propeller was undamaged, indicative of an engine that had stopped prior to the accident.

The damage to the aircraft was consistent with the aircraft being in a left sideslip as it approached the accident field, with the aircraft's first contact with the telegraph cables being at the lower left wingtip. This had caused the aircraft to yaw rapidly to the left, after which the cables caught on the main landing gear. This would have decelerated the aircraft, and once the stretch of the cables had reached their limit, its nose would have pitched down so that the aircraft struck the ground in an attitude beyond the vertical. The aircraft then continued to pitch over into the inverted position.

Aircraft examination

All the fuel lines on the aircraft were inspected for condition and security; no defects were found. All the fuel unions were tight and the fuel lines had not ruptured. The fuel tank was still intact and although its upper surface had been distorted during the accident, it had not ruptured. The tank was almost empty, with only 750 ml of fuel remaining in the bottom of the tank. The fuel pickups within the tank were free from obstruction and the tank was clean, with no debris or foreign objects. The fuel selector was found selected to the MAIN AND RESERVE position and operated correctly, as did the 'wobble' pump.

The engine controls were connected and continuous, the throttle was full open, the mixture was in rich, the carburettor heat was set to COLD and the magneto switch was in the OFF position.

A test of the fuel gauge showed that it would indicate the fuel level, although at fuel levels below about 20 litres, the float would occasionally stick. Above this amount, the float was free to move and when disturbed would return to a level representative of the fluid level in the tank. A test of the fuel pressure and oil pressure gauges was satisfactory.

Engine examination

The engine was removed from the aircraft and sent to a specialist organisation for testing and detailed examination. It was placed on an engine test bed and was fitted with its original propeller. Several attempts were made to start the engine using the electric starter that was already fitted to engine, but the engine proved difficult to start. It was eventually started, but could only be kept running by pumping the throttle and operating the electric fuel pump on the engine test rig.

During this short engine run there were no signs of fuel leakage from the engine-driven pump or the manifold fuel drain. For the next engine run the engine-driven pump was bypassed and the fuel supply from the engine test rig was connected direct to the carburettor fuel inlet. Once the fuel was selected on, fuel started to leak out of the fuel manifold drain, indicative of the carburettor flooding. The engine started after only a couple of attempts with the electric starter and the fuel leak from the fuel manifold then stopped.

The engine ran normally and during the run the magnetos were checked and both were operating satisfactorily. The fuel consumption measured with the engine at 1,250 RPM was about 18 litres/hour. When full throttle was applied, oil started to leak out of the oil filter housing and smoke emanated from the oil breather, indicative of the crankcase becoming pressurised. The engine run was stopped and the engine was strip examined.

Prior to the engine examination, the compressions on the four cylinders were checked and were found to be low for cylinders 1, 3 and 4, with no compression on cylinder 2. A subsequent examination revealed that three of the four piston rings for cylinder 2 were seized. All four cylinders had signs of wear on their piston rings and in their cylinder barrels. The pistons and valves all exhibited carbon deposits consistent with the age of the engine.

The magneto timing was found to be correct, and the condition of the plugs was satisfactory. The oil filter was removed and found to be clean.

The fuel pump was removed from the aircraft. Its driveshaft was still intact and the pump was free to move. When tested it only produced 1.5 psi at full rpm, whereas it should produce 4.26 psi. An examination of the pump identified wear on the rotating blades and also on the bush at the top of the pump.

The carburettor was removed and during its removal the fuel filter was checked and found to be intact and clean. The unit was then subjected to a test of the float and needle assembly. This test was carried out at both a normal fuel inlet pressure and at a higher fuel pressure; in all cases the float operated as expected and the needle valve reseated, preventing flooding of the carburettor. A subsequent examination found no anomalies with the carburettor, although the needle valve showed signs of wear consistent with its age.

Aircraft and engine history

The aircraft had accumulated a total of 2,754 flying hours. The fuel system had been modified in 2001 by the fitment of a wobble pump and a fuel selector from a Christian Eagle aircraft.

The engine had completed 1,734 hrs and was last overhauled by the Spanish Air Force in 1984. Since then it had completed 436 hours.

The aircraft was maintained by the owner and was subjected to an annual Permit to Fly renewal inspection. The last inspection had been carried out on the 19 May 2009 in preparation for renewal of the permit for the next year. During this inspection the compressions were not checked using compression test equipment and so no figures were recorded, although, the compressions were 'felt' whilst turning the engine over via the propeller. An LAA inspector carried out the inspection in accordance with the Permit to Fly renewal schedule, which included an engine run. The aircraft passed the inspection for its permit renewal; however a permit renewal test flight had not yet been carried out. The current Permit to Fly was valid until 30 June 2009.

As the aircraft operated under a Permit to Fly, there was no specific time between overhaul (TBO) specified for the Tigre G-IV engine. In Spain, the recommended TBO for the engine is 450 hours. When the aircraft was operated by the Spanish military, engine overhauls were carried out in the region of every 200 to 300 hours.

Fuel tests

The 750 ml of fuel drained from the bottom of the fuel tank on G-JUNG was taken to a specialist laboratory, along with fuel samples taken from the bowser at Henstridge airfield. The sample from G-JUNG was consistent with Avgas 100LL, although it failed on vapour pressure, distillation 10%, residue and existent gum – all of which would be expected from a sample taken from the remains at the bottom of a fuel tank.

The Henstridge fuel bowser samples complied with the specification for Avgas 100LL, with no evidence of contamination.

Fuel supply checks

Eyewitnesses stated that G-JUNG was refuelled after the second flight of the day. A fuel receipt for 63 litres of Avgas was in the airfield records. Although no time was written on the receipt, a comparison of the arrival and departure times for aircraft that had refuelled before and after G-JUNG suggested that the eyewitness timing was correct.

The airfield fuel bowser was owned by a major fuel supplier. The accuracy of the dispensing equipment was confirmed at six-monthly intervals by a specialist contractor. The most recent calibration and maintenance visit was on 20 April 2009. At the end of this visit three samples of 20 litres each were drawn with no calibration errors. The calibration certificate was valid until October 2009. On 27 May 2009, an AAIB inspector observed two litres of Avgas being dispensed into a calibrated container. Although not as accurate as the six-monthly check, this would have shown if any gross errors had developed; no calibration errors were detected.

Pilot's choice of field

The field chosen by the pilot for the forced landing was of adequate size, in the light wind conditions prevalent, with a gentle upslope and low crop with a solid soil base. The only drawbacks to this field were the telegraph cables in the undershoot and a set of power lines transecting it 270 m further into the field, relative to the direction of approach.

Forced landings involving wire strikes

UK CAA occurrence databases were interrogated for wire strikes following engine failures to General Aviation fixed wing aircraft. A total of 14 events in the 19 years preceding this accident were found. This included three incidents during practice forced landing training which are included for completeness.

The accidents were grouped based on the worst injury sustained. Of these 14 accidents, five had resulted in no injuries and six in minor injuries at worst. One accident resulted in serious injuries and two involved fatalities.

Including this accident, a total of four accidents in 19 years involving forced landings into wires have resulted in serious or fatal injuries.

Analysis

General

The primary cause of the accident was the aircraft colliding with telegraph cables whilst carrying out a forced landing following an engine failure.

Engineering aspects

The engine did not stop because of a catastrophic failure, but one or more of a number of other possible factors may have been the cause.

When the engine was tested, the fuel pump was not able to deliver enough pressure to keep the engine running. It is possible that the engine had stopped due to insufficient fuel pressure caused by the wear in the fuel pump. Although the pilot could have theoretically kept the engine running by operating the 'wobble pump', this would have been impractical at such a low altitude. The difficulties encountered in starting the engine on the morning of the accident flight were most likely as a result of the low cylinder compressions.

At the accident site there was a lack of a smell of fuel and only 750 ml of fuel was drained from the intact fuel tank, leading to the possibility of engine stoppage from fuel starvation due to insufficient fuel on board the aircraft. However, the tank had been reportedly filled to full before the flight prior to the accident flight, and bowser records confirm that at least 63 litres of fuel were uplifted.

The reported fuel leak from the fuel drain shortly after refuelling could have been due to excess fuel in the filler cap and the loss of excess fuel from the tank through the vent line. However, this leak was not sustained and only two litres of fuel drained out over a period of about an hour. A siphon from the vent line would only be sustained whilst the rigid vent line remained in fuel, so it would have stopped as soon as it was exposed to air. Therefore, two litres is a reasonable volume to have come from the vent. Had the observed fuel been draining from the inlet manifold as a result of flooding of the carburettor due to an unseated needle valve, then the leak would probably have been sustained for longer and more than two litres of fuel would have been lost in an hour.

The total time that the engine was running, following the refuelling from the Henstridge fuel bowser, was estimated to be about one hour, and in that time the engine would only have consumed about 30 to 40 litres of fuel. One possible explanation for the apparent lack of fuel is an in-flight fuel leak, but no evidence of this was found. Also, had all of the fuel leaked out in flight then the fuel gauge would not have been readable by the passenger, as the black band would not have been visible. The description by the passenger of the fuel gauge "bouncing up and down" immediately prior to the engine stoppage suggests that there was sufficient fuel on board.

The lack of fuel at the accident site could be explained by the possibility that the fuel leaked into the ground through the fractured fuel gauge, effectively injecting the fuel into the ground. However, when the soil around the area in which the fuel gauge was imbedded was disturbed, there was only a faint smell of fuel. It is possible that by this time much of the fuel had leached away into the soil.

The magneto switches were found in the OFF position, but other engine controls and the fuel selector were in positions that were not consistent with the expected positions when an engine is shut down in preparation for a forced landing.

The weather conditions at the time were such that carburettor icing could have been a possibility with moderate icing at cruise power and serious icing at descent power, Figure 2. The carburettor heat control was found in the COLD position.

Operational aspects

The weather conditions for the flight were ideal and the pilot was properly licensed, experienced and current on the aircraft type. The status of the pilot's radio licence is not considered relevant to this accident.

Wires are a recognised hazard to aircraft conducting forced landings. Telegraph and some power cables in the UK are mounted on wooden poles treated with a preservative, giving them a dark brown colour. In addition, they are often positioned in hedgerows and field boundaries, where the lack of contrast with natural flora makes them harder to see. Wire strikes during forced landings are, however, rare. In the UK, records show that only four such events have resulted in serious or fatal injuries in the last 19 years.

Conclusion

The accident was caused by the aircraft striking telegraph cables during an attempted forced landing following an engine failure. No single cause could be determined for the engine stopping. The hazards of unplanned off airfield landings are considerable, however, wire strikes during forced landings are fortunately relatively rare occurrences and therefore no Safety Recommendations are considered appropriate.

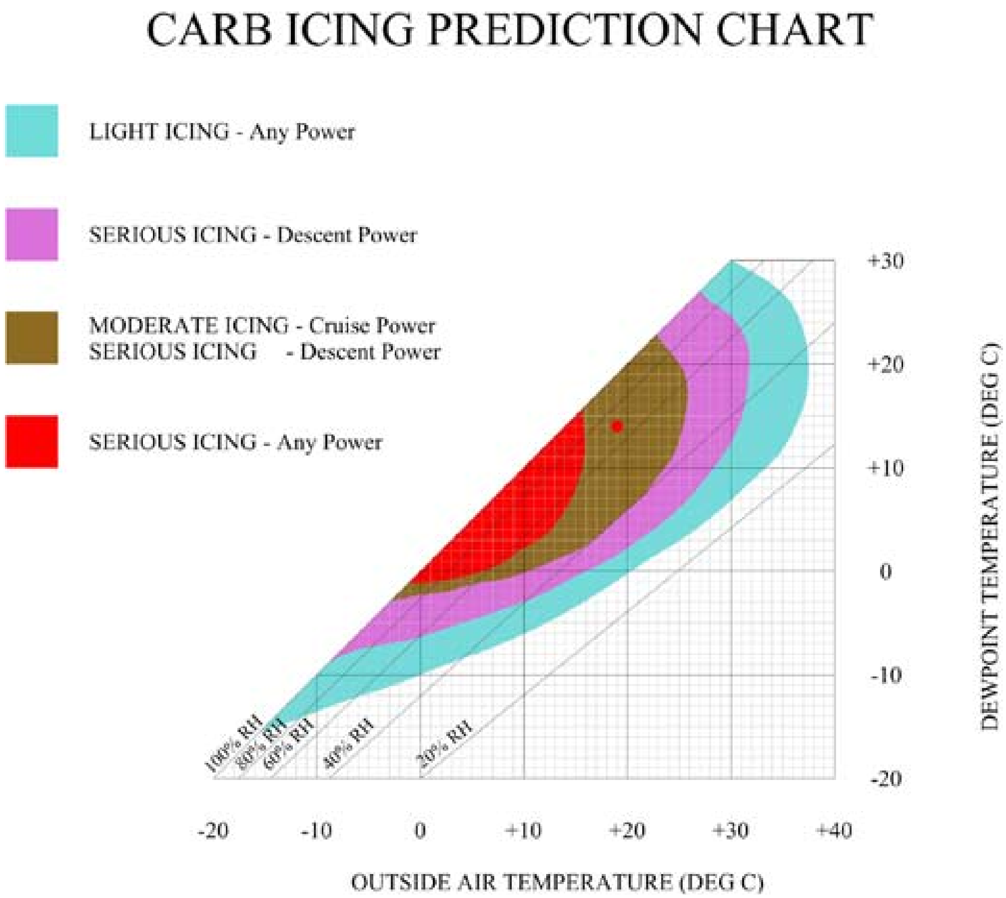

Figure 2

Carburettor icing prediction chart