ACCIDENT

Aircraft Type and Registration:	ARV Super 2 (ARV1), G-TARV
No & Type of Engines:	1 Hewland AE75D piston engine
Category:	1.3
Year of Manufacture:	2001 (rebuilt)
Date & Time (UTC):	30 April 2005 at 1135 hrs
Location:	Naish Farm, Clapton in Gordano, Bristol
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Fatal) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	71 years
Commander's Flying Experience:	624 hours (of which approximately 33 were on type) Last 90 days - 3 hours Last 28 days - 1 hour
Information Source:	AAIB Field Investigation

Synopsis

The accident occurred during a takeoff from a private airstrip under light wind conditions. The aircraft struck the edge of a wood and then some power cables. There was no evidence of any mechanical malfunction. Examination of a Pilot Operating Handbook for the aircraft type showed that the airstrip was unsuitable for the operation of the aircraft and, with the existing meteorological conditions, the take-off distance available was less than was required for takeoff.

Aircraft information

The ARV Super 2 was designed in the early 1980s to create an affordable two-place light aircraft, built in the United Kingdom. From 1985 the aircraft was produced at Sandown Airport, on the Isle of Wight. There were several weight-saving innovations in the design, including the Hewland AE75 inverted three-cylinder two-stroke water-cooled engine and the use of superplastically-formed aluminium panels in the forward fuselage.

About 30 aircraft were completed and since then, a number of the aircraft have continued to be operated. G-TARV ceased flying in 1986 after an accident but had been rebuilt and flew again, in 2001, with the more developed AE75D version of the original engine but

with the same power. The aircraft was operating on a Permit to Fly, under the auspices of the Popular Flying Association.

History of the flight

On 16 April 2005 the pilot had flown the aircraft for the first time that year from his private airstrip, when he had completed a short local flight. At the end of that flight, he had reportedly commented that the aircraft was performing very well.

On the morning of the accident, he had decided to fly to Dunkeswell Aerodrome, near Taunton, and then return to his airstrip. Figure 1 shows the airstrip in the take-off direction. The pilot moved sheep from the airstrip, put up his windsock and positioned his aircraft at the eastern end. At about 1130 hrs, an eye witness heard an increase in engine noise and looked towards the airstrip. The eye witness watched the aircraft travel along the airstrip. She had previously watched the aircraft takeoff and had the impression that it was not going as fast as normal. It also appeared to lift-off later than normal and the witness saw the aircraft airborne and banked to the right before losing sight of it. Shortly after, there was a loud bang and the witness started to run towards the site of the crash. On the way, she alerted a neighbour, who telephoned for an ambulance. At the accident, the aircraft was inverted with the pilot still strapped in but motionless. The witness checked the pilot but could not detect any pulse.

The emergency call was recorded at 1144 hrs. By 1158 hrs, the first emergency vehicle was on the scene. Additionally the Air Support Unit helicopter was alerted at 1153 hrs and arrived overhead shortly after 1200 hrs.

Medical information

A Post Mortem examination was carried out on the pilot. This indicated that he had died from head and spinal injuries. Additionally, there was no evidence of any toxicological factor which could have contributed to the cause of the accident or to the cause of death. The pilot's weight was 93 kg.

Airstrip information

The airstrip is orientated 260º/080º and is approximately 600 m long. It is at an altitude of approximately 400 ft amsl and has a level grass surface, which was firm and dry at the time of the accident. The area is normally used for sheep grazing and the grass varied in length from no greater than two inches long in some areas up to four inches long in other areas. To the east, a road with a hedge bounded the end of the airstrip and there were power lines, on pylons, crossing north to south just beyond the airstrip boundary. Further 11 kV power lines, on wooden poles some 27 ft high, were located parallel to the northern edge of the airstrip and these diverged towards the northwest from a point approximately 420 m along the airstrip. At the western edge of the airstrip, there was a line of trees orientated north/ south; these were approximately 110 ft high. Entries in the pilot's log book indicated that G-TARV was the only aircraft that he had operated from the airstrip. He had first flown the aircraft into the airstrip in October 2001. His next recorded flight from the airstrip was in July 2003 and he had subsequently flown out of the airstrip on 15 occasions prior to the accident. There was no evidence that any other aircraft had operated from there. Witnesses commented that the pilot would only takeoff in a westerly direction. Figure 1 shows the layout of the strip in the direction of takeoff on the accident flight.

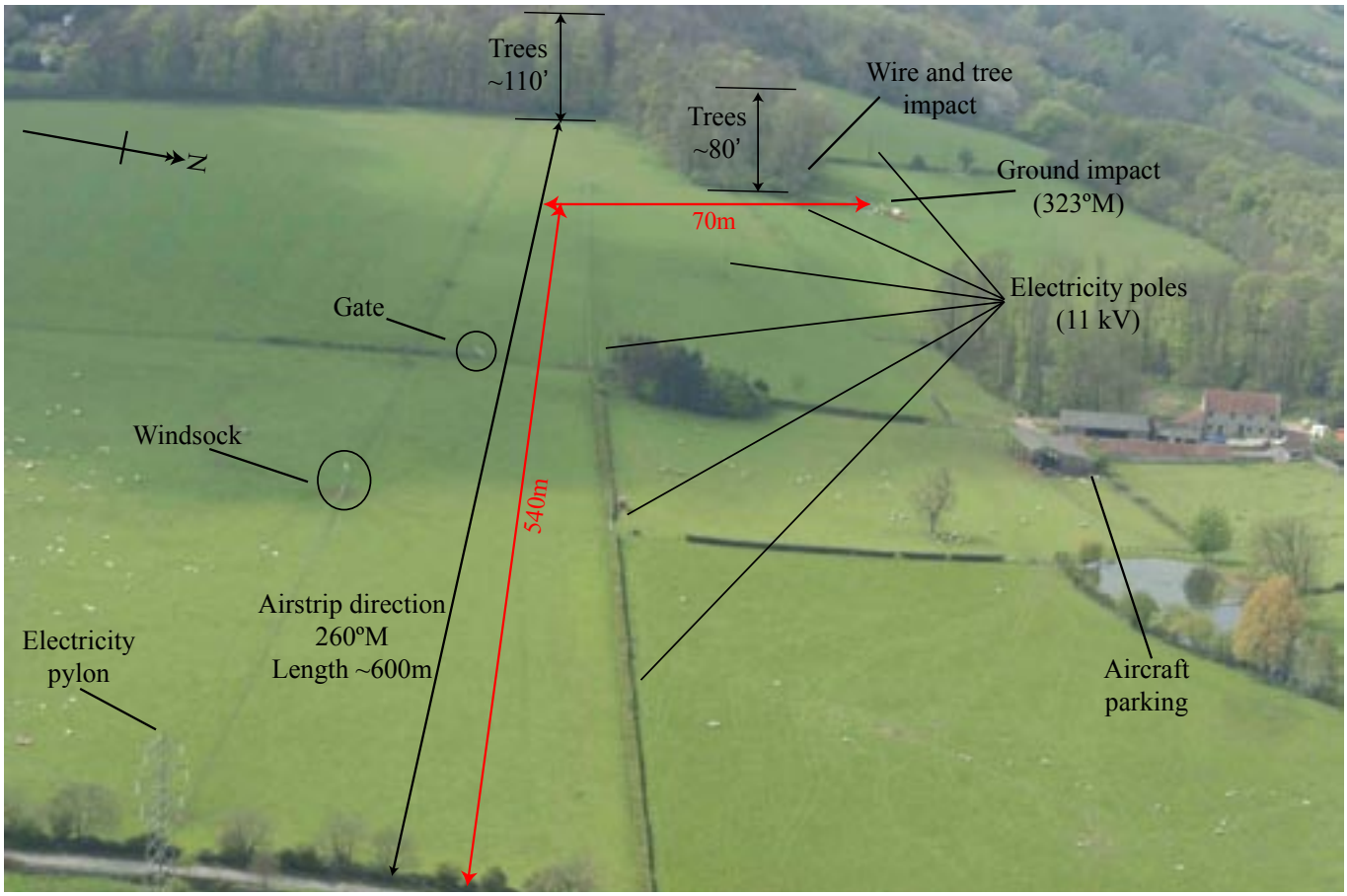

Figure 1

Airstrip at Naish Farm, 30 April 2005

Initial engineering examination

The aircraft had come to rest inverted, close to where a set of 11 kV power cables ran along the edge of the wood. The point of impact with the trees and cables was some 70 m to the right of the airstrip and abeam a point approximately 540 m from the eastern end. It was apparent that the aircraft had struck, and severed, all three of the cables, as well as bringing down some light branches from the edge of the tree line. It appeared that two of the cables had been cut by the propeller and the third by the main spar of the left wing, close to the wing root. The geometry of the impact with the cables and the ground indicated that, at the cables, the aircraft was close to being banked 90º to the right, travelling in a direction of 320º to 325ºM, and descending at about 10º below the horizon. The roll to the right continued after contact with the cables and the aircraft struck the ground inverted. The point of impact with the cables was some 10 to 15 ft above the elevation of the runway.

There had been no structural failure before the impact and there was no indication of any problem with the flying controls. The flaps were found set at the take-off position of 25º. Two features noted in the examination of the landing gear were the relatively small rolling radius of the tyres (six inches) relative to the grass length in some areas and a build up of corrosion on the brake discs, leading to a distinct drag on the rotation of the right wheel. Both of these features would have reduced the take-off performance of the aircraft.

Weather information

The witness who watched the aircraft travel along the airstrip stated that the weather was dry and sunny with a light surface wind. Prior to takeoff, the pilot had placed a portable windsock at the southern edge of the strip approximately 150 m from the eastern end. A review of the video recording from the Air Support Unit helicopter, which arrived on the scene within about 20 minutes, indicated that the surface wind was light and from approximately 170º/160ºM.

The Met Office provided an aftercast of the weather. The synoptic situation at 1200 hrs showed a light south-easterly flow covering the Bristol area. Cloud was FEW Cumulus base 3,000 ft amsl, surface visibility was 10 to 20 km and the air temperature was 18ºC with a dew point of 11ºC. The surface wind was 140ºM/06 kt. Using the CAA diagram from LASORS, moderate carburettor icing could have been expected at cruise power for the existing conditions.

The Met office also provided an aftercast of the wind conditions on 16 April 2005, which was the date of the previous takeoff by the pilot in G-TARV from the airstrip. This indicated that the surface wind at the time of takeoff (1440 hrs) was westerly at about 12 kt and that the air temperature was 10ºC.

Operational information

The Pilot's Operating Handbook (POH) for the aircraft type included information that the aircraft stall speed (power off) at maximum weight and 25º flap would be 49 kt with wings level and 73 kt at 60º bank. At less than maximum weight and with high engine power, these speeds would be slightly less. After the accident, the POH for G-TARV was not found.

In addition to that contained within the POH, the CAA provides information on aircraft performance and on operating from airstrips. This information is provided in LASORS Safety Sense Leaflet 7 (*General Aviation Aeroplane Performance*) and Safety Sense Leaflet 12 (*Strip Sense*). Leaflet 7 provides valuable information on the calculations required and recommended safety factors (1.33 for takeoff) for operating light aeroplanes and Leaflet 12 provides information on setting up a private airstrip and operating from it.

Performance calculations

G-TARV was weighed following the aircraft rebuild in 2001. A copy of the Weight and Balance Form was provided by the PFA. This showed an empty weight for the aircraft of 682 lb. The weight of the pilot was approximately 205 lb resulting in a total weight of 887 lb plus weight of fuel. The amount of fuel on board could not be positively determined but a full fuel load would have weighed 79 lb. It was probable that there was at least half fuel on board resulting in a fuel weight of about 40 lb. Therefore, the aircraft was estimated to weigh some 927 lb for takeoff. This was below the Maximum Gross weight of 1,100 lb.

The POH for the aircraft type included information on take-off performance. The figures assumed that the engine was operating at full throttle and with flaps selected to 25º. The aircraft would be rotated at 50 kt IAS and would have accelerated to 65 kt at 50 ft agl. The basic take-off distances up to 50 ft agl were shown in metres for an aircraft at maximum weight on a hard dry runway and were dependent on temperature and runway altitude. This indicated that, at an air temperature of 18˚C and at an altitude of 400 ft amsl, the aircraft at maximum weight would have achieved a height of 50 ft in a take-off distance of 771 m. This distance would be reduced by 17.5% to take account of the actual aircraft

weight and then increased by 20% for short dry grass. The result was that G-TARV would have been at a height of 50 ft some 763 m after the start of the take-off run. On the day of the accident, the wind was light and generally appeared to be directly across the runway. Although this would have resulted in no change to the take-off distance, any wind would have made a difference to the performance. The effects of a headwind would have been to reduce the distance by 14% for every 10 kt and that of a tailwind would have been to increase the distance by 24% for every 10 kt.

On the day of the accident, the required take-off distance was 763 m without any safety factor. Calculations for the previous flight on 16 April 2005, assuming the same pilot and fuel weight, resulted in a basic take-off distance of less than 742 m. **Note:** The POH does not give take-off distances for temperatures of less than 15ºC. Factoring in the effect of a 12 kt headwind would have resulted in a take-off distance of less than 617 m.

Engineering information

The engine was examined in detail by the AAIB at an agency with extensive experience of this unconventional design of engine. The examination showed no evidence of any mechanical failure or distress within either the engine or the gearbox. The evidence from the engine spark plugs and the crowns of the pistons indicated that the engine had been operating correctly.

A sample of fuel was taken from the fuel tank during the aircraft recovery and this was analysed. According to the Engine Manual, the fuel should be 100LL, with a 40:1 mixture of fuel with a particular two-stroke oil. The analysis indicated that the fuel from G-TARV matched the specification for 'four star' auto fuel, with a 20:1 mixture of fuel to a different two-stroke oil. However, the engine examination did not show any evidence that this had had any effect on the engine. Airworthiness Notice 98 from the CAA specified those aircraft approved for the use of 'four star' and 'unleaded' auto fuels and the ARV Super 2 did not appear on either list. The Popular Flying Association confirmed that they had not issued an approval for the use of auto fuel in the Hewland AE75 engine.

Analysis

The examination of the aircraft after the accident did not show any evidence of a technical defect which would have contributed to this accident. Although the engine was not in a condition to be tested, the fact that the pilot initiated and continued the takeoff indicated that he was satisfied with the engine's performance; the possibility that there was a degradation of engine power which the pilot did not detect or judged to be acceptable cannot be wholly discounted. However, the slight brake drag would have adversely affected the take-off performance. Environmental factors, which would also have had a detrimental effect on take-off performance would have been the lack of headwind and the length of the grass, allied to the tyre size. Additionally, it was not possible to determine if the pilot had used carburettor heat prior to take off but the conditions were not particularly conducive to carburettor icing at high engine power.

While these factors would have reduced the take-off performance, an examination of the aircraft POH showed that the airstrip was not suitable for the operation of an ARV Super 2. With the right wind and temperature conditions, it was possible to take off from the airstrip as the pilot had achieved on 16 April 2005 and on occasions over the previous two years. However, calculations for 16 April 2005 indicated that the aircraft would have been very close to the departure trees. There was no doubt that the pilot was aware of the performance limitations of the airstrip as evidenced by his always using the same

direction for departure. It was also possible that he may have normally used a right turn shortly after takeoff to avoid the line of trees directly ahead. With lower ground to the right, this track, while visually tempting, would have reduced his available take-off distance and would still have required an initial climb to avoid the end of the trees and the power lines. At the time of impact, the aircraft attitude was assessed to be close to 90º right bank and would indicate that the pilot was trying to turn to the right. This may have been his usual procedure or may have resulted from the pilot becoming aware that G-TARV would not clear the trees directly ahead. However, the POH target speed of 65 kt at 50 ft agl was close to the stall speed once the pilot had started to bank the aircraft and it was likely that G-TARV stalled shortly before contacting the cables.

Conclusion

Even without using the recommended CAA safety factor, information within the POH showed that the airstrip was not suitable for the operation of G-TARV.