Piper PA-28R-201T Turbo Cherokee Arrow III, G-DIZY

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Aircraft Type and Registration:	Piper PA-28R-201T Turbo Cherokee Arrow III, G-DIZY	
No & Type of Engines:	1 Continental TSIO-360-F piston engine	
Year of Manufacture:	1977	
Date & Time (UTC):	5 January 2004 at 1037 hrs	
Location:	Buckmore Park, Blue Bell Hill, Rochester, Kent	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Bent propeller, damage to fuselage and starboard wing	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	57 years	
Commander's Flying Experience:	677 hours (of which 494 were on type)	
	Last 90 days - 13 hours	
	Last 28 days - 0 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot.	
	Examination of the fuel system. Fuel pump test and inspection	

Synopsis

The aircraft suffered an engine failure shortly after takeoff. The terrain ahead of the aircraft was inhospitable but the pilot managed to find a small area of open ground into which to carry out a forced landing. The aircraft was damaged in the landing but there was no injury to the pilot. The cause of the engine failure has not been determined.

History of flight

The flight was planned for the purpose of positioning the aircraft to Coventry Airport where the aircraft was to undergo an annual inspection. Before departure the aircraft was refuelled and the pilot completed a pre-flight inspection. The weather conditions at Rochester were good with a surface wind from 200º at 6 kt and scattered cloud at 2,000 feet.

The engine was started with the auxiliary fuel pump selected to the 'LO' position and then once the engine was running the pump was selected 'OFF'. The aircraft was taxied to the holding area where power and pre-takeoff checks were completed satisfactorily. The takeoff was carried out from the grass Runway 20L, using a short field technique with two stages of flap (25º). At 250 feet above aerodrome level the pilot retracted the flap and then noticed that the aircraft was not accelerating as quickly as usual. He realised there was a reduction in power and was aware of a slight smell of fuel. There was then a complete loss of engine power at which point he made a radio call to ATC advising "ZULU YANKEE ENGINE FAILURE".

The pilot lowered the nose of the aircraft to achieve a glide speed of 95 kt and began to carry out the immediate actions, which included changing the selected fuel tank. Initially unable to identify a clear area ahead to land he scanned the area either side of the aircraft and noticed a small clearing in the woodland below, about 20º to his left. He turned directly towards this area, reduced speed to clear the trees and then, once confident of being able to clear the tops, selected the landing gear down. As the aircraft crossed over the trees the pilot turned to the right to line up with the clearing and landed. The aircraft touched down before the landing gear had time to fully extend and slid along the ground for some 40 metres on its lower fuselage before it came to rest.

The pilot was able to switch off the electrical system and evacuate the aircraft without external assistance. Witnesses to the accident were on the scene within a few minutes. The pilot reported that the slight smell of fuel in the cockpit noted earlier was still evident after the accident.

Aircraft fuel system

Either wing fuel tank can be selected as the source of fuel to the engine by a tank selector valve. Fuel is then supplied to the engine through an engine driven fuel pump. There is a combined fuel pressure and flow meter located on the instrument panel. The fuel system incorporates an auxiliary electric fuel pump which has three switch positions, 'HI', 'LO' and 'OFF'. The 'HI' position is for use in the event of an engine driven pump failure, and the 'LO' position is intended for vapour suppression. The auxiliary electric pump is also used for priming the engine before start but the switch is required to be in the 'OFF' position for takeoff. The Pilot's Operating Handbook contains the following information:

> *"The auxiliary pump has no standby function. Actuation of the HI switch position when the engine is operating normally may cause engine roughness and/or power loss."*

Examination of engine driven fuel pump

The maintenance organisation responsible for the aircraft had removed the engine driven fuel pump and conducted a rudimentary test on it in which the pump was manually spun up whilst connected to a container of fuel. It had failed to operate and so was forwarded to the AAIB for further investigation.

The pump was taken to an overhaul agent and subjected to a bench test in accordance with the manufacturer's specifications. It performed adequately, although the maximum RPM fuel flow was approximately 16% below the test schedule value. Two fuel flow adjustments are provided on the unit: - for maximum and idle rpm; and it is possible that these were legitimately altered from the factory settings when the pump was installed in the aircraft. The only untoward feature was a slight fuel seepage from a seal close to the mixture control lever. Subsequent disassembly of the pump revealed no evidence of corrosion, contamination, or any mechanical defect that would have affected the operation of the pump.

These findings clearly contradicted those from the earlier test. However, this type of pump will not operate unless it is fully primed with fuel. Although an attempt to prime the pump had been made, it is possible that not all the air had been purged from the unit during the first test.

Background

The engine was replaced in August 2001 and since then had flown 275 hours. The aircraft is fitted with a priming system for starting the engine. However the pilots found that the replacement engine was more difficult to start than the original. The priming system was checked by the maintenance organisation but was found to operate as required so a reason for this reluctance to start was never determined. To resolve the problem an additional start procedure was developed whereby the auxiliary electric fuel pump was set on 'LO' until the engine was running.

Analysis

The pilot achieved a landing from which he was able to escape unhurt in difficult circumstances. Given that the terrain ahead of the aircraft was largely inhospitable this illustrates the importance of concentrating on flying the aircraft and maintaining control as a priority.

When the engine lost power the pilot was unable to complete the immediate actions because he needed to concentrate on the control of the aircraft and find a suitable place to land. Thus it is not known if any of these actions would have re-established power but with the aircraft at approximately 300 feet agl there would have been little time available.

The cause of the loss of engine power has not been determined to date but it is unlikely that failure of the engine driven fuel pump was responsible. If fuel supply was the reason it is more likely to have been as a result of a loose fuel union in the system. However, after the accident the maintenance organisation checked the system and did not find any evidence of a loose connection. In view of the work that has already been carried out it was felt that any further investigation should be conducted by the maintenance organisation. Should a cause become apparent in the future the AAIB will publish an addendum to this Bulletin.

It is interesting to note that for the non-turbocharged variants of the PA-28R (Arrow) it is normal practice to select the auxiliary electric fuel pump 'ON' for takeoff, in case of failure of the engine driven pump. In contrast this is not the case with the turbocharged aircraft, for which the auxiliary fuel pump has no standby function. Therefore on the turbocharged aircraft failure of the engine pump shortly after takeoff is quite likely to lead to a forced landing.