ACCIDENT

Aircraft Type and Registration:	Piper PA-23-160, N100MC
No & Type of Engines:	2 Lycoming 0-320-B3B piston engines
Year of Manufacture:	1972
Date & Time (UTC):	16 December 2011 at 1500 hrs
Location:	Mount Airey Farm, South Cave, Humberside
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Landing gear and left wing extensively damaged. Both propellers bent and engines shock-loaded
Commander's Licence:	Private Pilot's Licence
Commander's Age:	44 years
Commander's Flying Experience:	374 hours (of which 12 were on type) Last 90 days - 31 hours Last 28 days - 13 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and subsequent AAIB enquiries

Synopsis

The left engine lost power during the approach to land when the aircraft was configured with the landing gear and flaps extended. The pilot decided to carry out a forced landing in a field and the aircraft was extensively damaged during the subsequent heavy landing.

History of the flight

The aircraft, which was US registered, had recently been returned to an airworthy condition after having been stored for four years. The last annual inspection had been completed approximately 13 flying hours and 12 flights prior to the accident and during this period it had been refuelled on a number of occasions with unleaded petrol (MOGAS) obtained from a garage forecourt. The pilot stated that he would test the MOGAS for the presence of Ethanol, which is a type of alcohol, before refuelling his aircraft.

Prior to the start of the accident flight, the pilot refuelled the aircraft with around 60 ltr of unleaded MOGAS, which he strained through a filter to remove any water. The engine power checks were carried out satisfactorily, with magneto drops of less than 100 rpm on each engine. The flight in the local area was uneventful and after approximately 35 minutes, the pilot commenced a descent from 2,500 ft (agl) to land on Runway 07 at Mount Airey Airfield. Carburettor heat was selected ON and at a height of approximately 600 ft the landing gear and flaps were lowered. The aircraft was now approximately one nm from the runway threshold and the pilot noticed that there was some low cloud between the aircraft and airfield. He therefore decided to reposition the aircraft for a landing on Runway 25. The carburettor heat was selected to OFF, power was increased on both engines and the pilot commenced a turn to the left. At this point the pilot realised that he had lost power on the left engine and, with full right rudder applied, he experienced difficulty in maintaining directional control and returning the wings to a level attitude. The pilot stated that he was aware that with only one engine producing power the aircraft would only be able to achieve a significant climb rate with the flaps and landing gear retracted. However, there was only one engine-driven hydraulic pump on the aircraft, which was fitted to the left engine that had just failed. As he was now very close to his asymmetric committal height[1], and there were a row of electrical pylons ahead of him, he decided to carry out a forced landing rather than attempting to improve the aircraft handling and performance by manually raising the landing gear and flaps with the hand-operated hydraulic pump. The pilot stated that he flared slightly high, which resulted in the aircraft stalling at a height of approximately six feet, and the nose leg and left main landing gear collapsed during the subsequent heavy landing. The pilot and passenger where uninjured and vacated the aircraft through the aircraft door.

Examination of the wreckage

From the examination of the wreckage it was determined that neither propeller had been feathered. The damage and score marks on the propeller blades was consistent with the left propeller wind-milling and the right propeller being driven at low power when they struck the ground. Both engines turned freely, the spark plugs on the left engine were within the expected colour range and there was fuel in both wing fuel tanks. However, it was noted that fuel drained from the carburettor fuel inlet pipe on the left engine did not have the blue tinge associated with AVGAS 100LL. The nose landing gear had detached from the aircraft and the left main landing gear had collapsed. There was also some structural damage to the aircraft nose section, flaps and left wing. All the damage to the aircraft was consistent with a heavy landing.

Authorised fuel

The aircraft Flight Manual and the engine Type Certificate Data Sheet (E-274) permit the aircraft and engine to operate on aviation gasoline with a minimum grade of 91/96 octane (AVGAS 91/96). AVGAS 100LL is considered to be a suitable alternative to AVGAS 91/96, which is no longer available.

The engine manufacture does not approve the use of 'automotive fuels in their engines'. However, for 'N' registered aircraft, Supplemental Type Certificates (STC) have been approved by the Federal Aviation Authority for automotive fuels that comply with ASTM D-4814 to be used on the Lycoming 0-320-B engine. These STC normally place restrictions on the operation of the aircraft and may require modifications to be carried out to the aircraft fuel system. While no such STC had been obtained for N100MC, an STC was available to permit this aircraft and engine combination to operate with unleaded and leaded MOGAS that met ASTM specification D-439 or D-4814.

Footnote

[1] Asymmetric Committal Height is considered as the minimum height from which an asymmetric approach may be abandoned to achieve a safe climb at V_{yse}(Single engine best rate of climb speed).

Aviation Gasoline (AVGAS)

General

Aircraft engines are designed to operate on a fuel with a specified octane rating. If a fuel with a too low an octane rating is used, then under an increasing engine power demand detonation may occur, which can cause damage to the engine and result in a loss of power. This detonation is also known as 'knocking' which is not always possible to hear above the noise from an aircraft engine.

Octane rating

The octane rating of a fuel is an indication as to how much the fuel can be compressed before it spontaneously ignites. There are four principal ways to measure Octane rating: Research Octane Number (RON), Motor Octane Rating (MON), Aviation Lean Mixture and Rich Mixture Rating. Motor Gasoline (MOGAS) is measured using the RON while Aviation Gasoline (AVGAS) is measured using the Aviation Lean and Rich Mixture Rating, which gives similar results to MON. As a result of these different ratings it is not possible to make a direct comparison between the published octane ratings for MOGAS and AVGAS. The equivalent minimum and typical octane ratings of AVGAS and MOGAS using the MON rating are shown in Table 1.

MOGAS

MOGAS is not intended for aviation use and in comparison with AVGAS has different physical properties and quality requirements. CAA Safety Sense leaflet 4 *'Use of Motor Gasoline (MOGAS) in Aircraft'* provides advice on the use of MOGAS, the additional quality checks to be carried out on the fuel, additional maintenance requirements and entries that have to be made in the aircraft and engine log books.

CAP 747[2] authorises the use of 4-star MOGAS, to BSI specification BS 4040: 2001, in low compression ratio non-supercharged engines provided it has been supplied from an airfield facility. The PA-23 and Lycoming 0-320-B aircraft and engine combination has not currently been approved by the CAA to operate on 4-star MOGAS, though they have approved the use in Lycoming 0-320-B engine on other aircraft. CAP 747 also permits[3] certain combination of aircraft and engines to operate with 4-star MOGAS obtained from filling station forecourts. Some aircraft types are also permitted to operate on unleaded MOGAS that meets BSI EN228:2004 (normal unleaded MOGAS) or BS7070 (leaded 4-star MOGAS). The PA-23 aircraft and Lycoming 0-320-B engine combination has not been approved to use either 4-star obtained from a forecourt or unleaded MOGAS.

Fuel	Minimum MON	Typical MON
AVGAS 100LL	99.6	101 to 103
AVGAS 91	90.6	93
High octane unleaded MOGAS	86	86.2
Unleaded MOGAS	85	85.2

Table 1

Footnote

2 CAP 747, Section 2, Part 4, GC2, GC 3, GC 4 and GC 5.
3 CAP 747, Section 2, Part 4, Schedule 1 to GC No3 and GC 5.

MOGAS can contain alcohol in the form of Ethanol, the use of which is currently prohibited in aviation. Therefore, even when an STC has been obtained, or the CAA has authorised its use, MOGAS must be tested for the presence of alcohol before the aircraft is refuelled.

Factors to consider when using MOGAS

In comparison with AVGAS, factors such as the stability of fuel in storage are not as good for MOGAS. Consequently, over time MOGAS may suffer a loss of octane rating and form gum deposits that can cause intake and exhaust valves, and fuel metering valves to stick. The additives in the fuels are also chemically different and can cause corrosion and increase the amount of water in the fuel. Alcohol in MOGAS can also adversely affect seals and elastomers, and the fuel's vapour pressure[4] such that there is an increased likelihood of vapour lock occurring.

Lead additives are normally used to control the rate of combustion and in unleaded fuels these have been replaced with other components, such as aromatics. If the engine is not designed to operate on unleaded fuel then the different speed of combustion can result in hotter exhaust gasses that can damage the crown of the pistons, the exhaust valves and their seats. Aromatics can also damage seals in the aircraft and engine fuel systems.

Comment

The pilot was faced with a loss of power on the left engine while at a relatively low height during the approach to land. His difficulty in maintaining straight and level flight was probably due to the drag from the left propeller, which had not been feathered and continued to windmill. A single engine go-around from a low height contains a significant level of risk and with the landing gear and flaps extended the PA-23-160 has minimal single-engine climb performance. Approaching his asymmetric committal height, and with electrical pylons ahead, the pilot made the decision to conduct a forced landing in a field. However, there was a large dip in the first part of the field which, with his difficulty in handling the aircraft, might have contributed to his misjudging the height of the flare. The damage to the aircraft was consistent with the pilot's account of stalling at a low height.

It cannot be determined if the use of unleaded MOGAS contributed to the engine failure. The use of this fuel can damage the seals in the aircraft and engine fuel system, and cause long-term damage to the engine. The engine is also more prone to carburettor icing, vapour lock and a loss of power due to detonation 'knocking'. The presence of alcohol in the fuel can also damage seals and cause a loss of power.

Footnote

[4] Vapour pressure can be thought of as the ease by which a liquid turns into a gas.