FINAL REPORT

AAIU Report No: 2010-006
State File No: IRL00909070
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In accordance with the provisions of SI 205 of 1997, the Chief Inspector of Air Accidents, on 9 August 2009, appointed Mr. Paul Farrell as the Investigator-in-Charge to carry out a Field Investigation into this Accident and prepare a Report. The sole purpose of this Investigation is the prevention of aviation accidents and incidents. It is not the purpose of the Investigation to apportion blame or liability.

Aircraft Type and Registration:	Stampe SV4A, EI-CJR	
No. and Type of Engines:	1 x Renault 4PO5	
Aircraft Serial Number:	318	
Year of Manufacture:	1953	
Date and Time (UTC):	09 August 2009 @ 16.00 hrs	
Location:	Craughwell, Co. Galway	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - 0	Passengers - 0
Nature of Damage:	Substantial	
Commander's Licence:	Private Pilot Licence (Aircraft)	
Commander's Details:	Male, aged 65 years	
Commander's Flying Experience:	720 hours of which 150 hours were on type	
Notification Source:	Passenger	
Information Source:	AAIU Pilot Report Form submitted by Pilot, AAIU Field Inspection	

SYNOPSIS

On climb out, at between 100 ft and 150 ft above the ground, the engine stopped. The aircraft made a forced landing into an agricultural field adjacent to the airfield. There were no injuries. The aircraft suffered substantial damage. The Investigation found that the accident was probably due to carburettor icing. The Report makes three safety recommendations.

1. FACTUAL INFORMATION

1.1 History of the Flight

The aircraft was operating from a private airfield at Craughwell, Co. Galway. The licenced engineer who was responsible for the aircraft maintenance accompanied the Pilot on the flight; they were the co-owners of the aircraft. Following take-off the aircraft radio was found to be unserviceable. The aircraft returned to the airfield. The Pilot alighted to contact Galway Air Traffic Control (ATC). During his absence the engine was left idling. The passenger remained in the aircraft and attempted to diagnose and rectify the radio problem. The Pilot contacted ATC at Galway Airport (by telephone) to advise them that his radio was unserviceable and that he would be operating visual low-level circuits at Craughwell airfield. The Pilot returned to the aircraft after approximately ten minutes. He strapped in and lined up on runway (RWY) 16 for take-off. The ground roll and initial take-off proceeded without incident but between 100 ft and 150 ft above the ground the engine, "*coughed and died*". The Pilot pumped the throttle but to no avail. A forced landing was carried out to a field directly ahead, and south of the airfield. The aircraft impacted heavily, suffered substantial damage and came to rest quickly **(Photo No. 1)**. There were no injuries or fire, and both occupants exited the aircraft without assistance. Following notification of this accident to the Air Accident Investigation Unit (AAIU), the Investigator-in-Charge gave permission for a detailed photographic survey of the accident site to be carried out and the wreckage to be recovered to the airfield hangar. The Investigation visited the site and inspected the aircraft on the day after the accident.

Photo No. 1: Aircraft as it came to rest

1.2 Site Visit Observations

The Investigation determined that the aircraft had adequate fuel on board. Control continuity was verified except for impact related damage. The Investigation found that the aircraft was well maintained and there were no significant problems previously noted with the aircraft. All aircraft damage was consistent with impact damage and no evidence of pre-existing failure or damage was observed. An examination of the engine revealed no evidence of mechanical failure. The Pilot informed the Investigation that he was not aware of the exact temperature and dew point for the time of the accident flight. He also informed the Investigation that the aircraft was operated on a 50/50 mix of Avgas and Mogas[1]. The aircraft is not fitted with a carburettor heating system. The Pilot advised the Investigation that he believed the cause of the accident was carburettor icing.

1.3 Meteorological Information

Met Éireann provided the following aftercast for the Craughwell area at the time of the accident.

Meteorological Situation:	*The incident region lay in a southwesterly flow. A warm front was approaching the west coast of Ireland.*
Wind:	*Surface: 200 º at 10Kts*
	2,000 feet: 230 º at 15 kts gusting to 20Kts
Visibility:	*Generally 20 to 30km. Low probability of 7 to 10km*
Weather:	*Generally no significant weather but weak RADAR echoes in the vicinity of Craughwell suggest intermittent light rain was possible.*
Cloud:	*FEW/SCT 1,500-2,000ft. BKN 3,000-5,000ft*
Surface Temp/Dew Pt:	*17 ° C/12 ° C*
MSL Pressure:	*1015hPa*
Freezing Level:	*9,000 ft*

1.4 Mogas Guidance

The Irish Aviation Authority (IAA) published Aeronautical Notice (AN) A16, "*Use of motor gasoline (MOGAS) in certain light aircraft*", which provides operators with information on the use of Mogas. AN A16 states that, "*Unless the proportion of*

[1] Mogas is a generic term describing gasoline, which is supplied for use in motor vehicles.

Motor Gasoline in the aircraft fuel is less than 25% the aircraft shall be assumed to be using Motor Gasoline".

AN A16 contains advice that particular attention should be paid to carburettor heat, including, "*making sure during pre-take-off checks that a good RPM drop is obtained when hot air is selected*", and, "*intermittent selection of hot air in flight whether or not the obvious symptoms of loss of power are experienced*".

Transport Canada produced TP 10737: "*The use of automobile gasoline (Mogas) in aviation*", (1993). The UK CAA produced, "*Safetysense Leaflet 4 Use of Mogas*", (January 2009), and the UK Light Aircraft Association (LAA, formerly the PFA), produced, "*Operating Information – Unleaded Mogas*", (May 2009). AN A16 contains some of the same information. However, the other documents provide detailed information on the scientific basis of the increased susceptibility of Mogas to vapour locking and carburettor icing compared to Avgas. The documents highlight that Mogas has a greater volatility than Avgas. This greater volatility means that Mogas has a higher latent heat of vaporisation than Avgas and consequently, when it is vaporised in a carburettor, Mogas will absorb more heat from the mixing air thereby inducing a greater temperature drop. The LAA document cites tests that showed that under the same ambient conditions, "*carburettor throat temperatures of a Lycoming O-360 were typically 7º C lower with winter grade Mogas than Avgas. The result is that when using Mogas, carburettor icing will occur under higher temperature conditions and lower humidity than for Avgas*".

Transport Canada produced an indicative chart ("*TP 2700 – Carburettor Icing Conditions*") that provides guidance to pilots. The chart plots carburettor icing risk and power setting against air temperature and dew point. The chart is widely known and referred to in General Aviation. Transport Canada describes the chart as a, "*rough guide to conditions conducive to carburettor icing*". The chart is based on Avgas, and TC says that for Mogas, "*the risk areas would be larger*". It is impossible to be more specific due to the variability of Mogas volatility. However, TC notes, "*In severe cases, ice may form at OATs*[2] *up to 20º C higher than with Avgas*". **Figure No. 1** shows a version of this (Avgas) chart, with the temperature and dew point for the accident flight plotted.

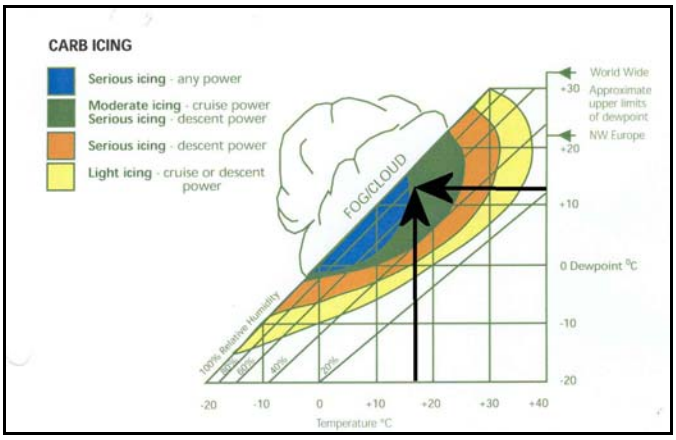

Figure No. 1: AVGAS carburettor icing chart for accident flight

[2] OAT is an acronym for Outside Air Temperature

Besides AN A16, there are four other MOGAS related documents on the IAA website. These are General Aviation Safety Notice – Motor Gasoline Fuels (MOGAS), Piston Engine Icing (UK CAA), Airworthiness Advisory Memorandum 01/2001and AIC 11/93. These documents contain salient information on the properties and behaviour of MOGAS. However, the Investigation notes that AN A16, which is the IAA's direction on MOGAS usage, does not explicitly mention or explain vapour lock, higher Mogas volatility, the higher latent heat of vaporisation of Mogas, or that the, "*standard*", carburettor icing chart refers only to Avgas, and is not valid for Mogas. AN A16 does not have sufficient information to explain the alcohol testing procedure.

The Investigation, as part of this Investigation and another contemporaneous investigation, spoke with a number of individuals involved in the general aviation community. It appears that the information contained in AN A16 has not achieved widespread acceptance and understanding. In particular when the scientific basis for AN A16 was discussed and explained it appeared that the ramifications of AN A16 were better appreciated. In many cases the alcohol testing requirement appears to either be unknown or not complied with.

2. ANALYSIS

2.1 Mogas Guidance

Although the aircraft was operating on 50/50 Avgas/Mogas mixture, in accordance with AN A16 the aircraft is considered to have been operating on Mogas. For an Avgas-operated aircraft the prevailing conditions (temperature and dew point) were conducive to the formation of moderate carburettor icing at cruise power and serious carburettor icing at descent power. Allowing for the use of Mogas the chart suggests that, on the day of the accident, there was a serious risk of carburettor icing at any power setting. Evidence of carburettor icing is perishable and carburettor icing is usually diagnosed by exclusion i.e. by ruling out other potential causes such as mechanical failure. In this case the prevailing temperature and dew point **(Figure No. 1)**, suggests a strong possibility of carburettor icing, particularly when cognisance is taken of Transport Canada's warning in relation to the (Avgas) chart, that, "*the risk areas would be larger*", for Mogas.

The advice in AN A16 that particular attention should be paid to carburettor heat, including, "*making sure during pre-take-off checks that a good RPM drop is obtained when hot air is selected*", and, "*intermittent selection of hot air in flight whether or not the obvious symptoms of loss of power are experienced*", could be taken to mean that an aircraft without carburettor heat should not operate on Mogas. If this was the intention then the notice should be revised to ensure that this is explicitly stated. Even if this was not the intention, consideration should be given to whether it is appropriate to operate aircraft without carburettor heat, on Mogas, in the Irish climate.

The complications of operating on Mogas, and the precautions and tests required to do so safely, are not widely appreciated/understood in the General Aviation community. In this regard the widely used carburettor icing chart is invalid for Mogas, and may be giving false comfort/readings to General Aviation operators. In extreme cases it may be incorrect by as much as 20º C.

AN A16 does not provide the scientific basis and explanation for the difference between Mogas and Avgas. The absence of this information may be partly responsible for a less than optimal compliance with AN A16's requirements. It could also indicate that additional methods (other than the Aeronautical Notice and the website) may be required to ensure that the safety issues associated with Mogas usage are fully appreciated by the General Aviation community. In response to the Draft Report, the IAA stated that, "*The General Aviation Department of the Authority will, however, review the availability of information on the IAA website and, where appropriate, include cross references in an effort to make the information more user friendly*".

2.2 Operating Factors

It is noted that the aircraft had been idling for a prolonged time before take-off. At low power settings adiabatic cooling related to the pressure drop across the carburettor throat is increased and can result in cold soaking of the carburettor throat, which increases the likelihood of ice formation in the throat.

3. CONCLUSIONS

(a) Findings

1. The aircraft was well maintained and there is no evidence of pre-existing damage or failure that could have contributed to the accident.

2. The engine stoppage was probably due to carburettor icing.

3. The prolonged period of ground idling before take-off increased the likelihood of carburettor ice formation.

4. The use of Mogas as a fuel rendered the aircraft more likely to experience carburettor icing.

5. AN A16 does not include basic scientific information that might make it appear more relevant to the General Aviation community.

6. Amongst the General Aviation community the operational issues associated with Mogas appear not to be fully appreciated.

7. The standard carburettor icing indicative chart is not valid for Mogas; the indicated risk areas are indeterminably larger for Mogas.

8. AN A16 does not address Mogas operation of aircraft that are not equipped with a carburettor heat system.

(b) Probable Cause

The aircraft experienced carburettor icing leading to stoppage of the engine that resulted in a forced landing during which the aircraft was substantially damaged.

(c) Contributory Cause(s)

1. The use of Mogas rendered the aircraft more susceptible to carburettor icing.

2. The lack of a carburettor heat system.

3. The prolonged period of ground idling before take-off.

4. SAFETY RECOMMENDATIONS

It is recommended that:

The IAA should consider revising AN A16 to include relevant scientific and operational information such as that made available by Transport Canada and the UK's CAA and LAA. **(IRLD2010004)**

The IAA should review and clarify the position regarding the use of Mogas in aircraft operating in Ireland without carburettor heating systems. **(IRLD2010005)**

The IAA should consider the use of additional means to educate the General Aviation community regarding Mogas related safety issues. **(IRLD2010006)**

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