



## Summary Report

A summary investigation, in accordance with article 46 of the Ordinance on the Safety Investigation of Transport Incidents (OSITI), was carried out with regards to the following accident or serious incident. This report was prepared to ensure that lessons can be learned from the incident in question.

<b>Aircraft</b>	Piper PA46-310P (Malibu)	N46U		
<b>Operator</b>	Private			
<b>Owner</b>	Aircraft Guaranty Corp Trustee, PO Box 2549, Onalaska 77360-2549, Texas, USA			
<b>Pilot</b>	Swiss citizen, born 1944			
<b>Licence</b>	Private pilot certificate from the American Federal Aviation Administration (FAA) based on the European Aviation Safety Agency (EASA) private pilot licence aeroplane (PPL(A)), issued by the Swiss Federal Office of Civil Aviation (FOCA)			
<b>Flying hours</b>	<b>Total</b>	3700 h	<b>During the last 90 days</b>	16:11 h
	<b>On the incident type</b>	2500 h	<b>During the last 90 days</b>	16:11 h
<b>Safety pilot</b>	Swiss citizen, born 1945			
<b>Licence</b>	Private pilot certificate (A) from the FAA based on the EASA PPL(A), issued by the FOCA			
<b>Flying hours</b>	<b>Total</b>	3905 h	<b>During the last 90 days</b>	34:23 h
	<b>On the incident type</b>	1600 h	<b>During the last 90 days</b>	13:37 h
<b>Location</b>	Birrfield Airport (LSZF)			
<b>Coordinates</b>	---	<b>Altitude</b>	---	
<b>Date and time</b>	9 January 2017, 11:07 (LT = UTC + 1 h) All information in this report is given in local time			
<b>Type of operation</b>	Private flight			
<b>Flight rules</b>	Z flight plan (VFR/IFR)			
<b>Flight phase</b>	Take-off and climb			
<b>Type of serious incident</b>	Runway excursion after aborted take-off			
<b>Point of departure</b>	Birrfield (LSZF)			
<b>Destination</b>	Straubing Wallmühle (EDMS)			
<b>Injuries to persons</b>	<b>Crew</b>	<b>Passengers</b>	<b>Third parties</b>	
	Minor	0	0	0
	None	2	0	-
<b>Damage to aircraft</b>	Minor	Bent nose landing gear fork		
<b>Third-party damage</b>	None			

## Course of events

The Piper PA46-310P, registered with the Aircraft Registry of the United States of America as N46U, was to be flown from Birrfeld (LSZF) to Straubing (EDMS) for its annual inspection. In order to clarify any possible further questions directly with the maintenance company on site, a second pilot (safety pilot) who was familiar with N46U joined the pilot responsible for the flight. It was envisaged that the plane would take off under visual flight rules (VFR) and subsequently switch to instrument flight rules (IFR).

In the days preceding the serious incident and also on the morning of 9 January 2017, the temperature was well below freezing and was -1°C at the time of the serious incident. The tarmac runway was partially covered in snow.

As the pilot later stated, the aircraft was refuelled before the flight and 1 part per thousand<sup>1</sup> of methyl glycol<sup>2</sup> was added to the fuel to inhibit icing.

Following the pre-flight outside checks, which included checking the fuel tanks for water (draining), the engine could be started without any problems. Likewise, no abnormalities were detected during the engine run-up in front of the hangar. According to the pilot, the engine drew the fuel for this from the right wing tank. The position of the fuel selector switch remained unchanged for the take-off that followed.

The pilot subsequently taxied N46U to the holding point for runway 26, checking the magnetos as he did so. He then taxied along taxiway F to runway 26 and began the take-off run. Up until this time, the engine was running smoothly and showed no abnormalities whatsoever. The pilot only noticed a marked loss of power when lifting the nose landing gear off the ground at an indicated airspeed of approx. 80 kt and he aborted the take-off immediately.

He then steered the aircraft slightly to the right in a north-westerly direction, as the remaining distance to the main road beyond was greater there. The aircraft overshot the end of runway 26 by some 40 m and came to a standstill in the adjacent snow-covered meadowland.

The pilot managed to taxi the aircraft back onto the apron unaided. Apart from the slight bend in the nose landing gear fork, no further damage to the aircraft was evident. Both occupants were unhurt.

## Findings and further investigation

The engine of the Malibu N46U is a Continental TSIO 550CI4B six-cylinder, horizontally opposed piston engine with two exhaust gas turbochargers and charge air coolers. N46U had been fitted with a brand-new engine on 18 February 2016.

Approximately two hours after the serious incident, a static engine test was carried out. Nothing unusual was found. The engine started straight away, functioned normally throughout the entire operating range up to and including take-off power, and also ran perfectly after a little over a minute at maximum power.

The subsequent visual check of the air filter and all of the connecting pipes in the engine bay revealed nothing out of the ordinary.

A fuel sample was taken from the outlet valve of both collector tanks in the wings as well as from the fuel filter sump and was later analysed in the laboratory.

Two weeks after the serious incident, the nose landing gear – fitted with a new fork – was reinstalled in N46U. After that, an inspection of the engine and fuel system was carried out. This revealed nothing which could have explained the malfunction. Subsequently, a further static engine test was carried out. The engine ran perfectly.

That same day, N46U was flown from Birrfeld to Straubing. The flight was uneventful.

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<sup>1</sup> This equates to a quantity of 1 decilitre per 100 litres of fuel.

<sup>2</sup> Also referred to as ethylene glycol monomethyl ether (see section on “Fuel additive for icing inhibition”)

### Fuel additive for icing inhibition

Water can be found in a dissolved form or floating as an emulsion both in aviation gasoline (AVGAS) for piston engines and in jet fuel (kerosene). The dissolving power for water varies with temperature: less water can be dissolved in the fuel in low temperatures. Therefore, water that has been dissolved previously can be separated from the fuel through cooling and change into small, floating droplets. As long as the temperature does not fall below freezing, the fine water droplets gradually sink, coagulate to become larger drops and collect as free water in the deepest part of the tank. Such contamination can be removed from the system by draining fuel from the sump during the pre-flight check.

However, if the temperature is below freezing, the fine droplets that have separated freeze and become fine ice crystals. The density of ice is lower than that of water and approximately the same as the density of the fuel, which means that the fine ice crystals in the fuel continue to float and do not sink. Under unfavourable conditions, this can lead to blockages in the fuel system (e.g. in fuel filters) and subsequently cause engine failure.

Jet fuel has a far greater tendency to suffer from the problems described above because more water can be dissolved in this type of fuel, but the phenomenon is also known to occur in AVGAS.

The problem described above can be prevented by mixing in additives to inhibit icing. Hygroscopic substances are used as additives, which simultaneously lower the freezing point of the additive/water solution when they are combined with water.

In the past, ethylene glycol monomethyl ether (EGMME), commonly known by the brand name Prist, was used for this purpose in jet fuel. EGMME was specified in accordance with MIL-I-27686. Since 1994, EGMME has been replaced with diethylene glycol monomethyl ether (DEGMME) and the previous standard replaced with MIL-DTL-85470. Since that time, the generally recognised name Prist has continued to be used for DEGMME.

Prist is also suitable as a fuel system icing inhibitor for AVGAS.

The required concentration is 0.1 - 0.15 % both for AVGAS and jet fuel and the additive must be mixed in with the fuel as evenly as possible during the refuelling process.

Another commonly used additive for preventing the formation of ice crystals in AVGAS is isopropyl alcohol, also called isopropanol, in accordance with the specification TT-I-735A. Isopropyl alcohol must be added to the AVGAS to produce a concentration of 1 %, and mixed for even distribution. This means that around ten times as much additive is required compared to Prist.

According to the pilot's operating handbook (POH), the use of anti-icing additive in accordance with MIL-I-27686, i.e. Prist, is permitted for the PA46-310P (Malibu). It can be added with a percentage by volume of between 0.1 % and 0.15 % during refuelling.

### Testing of the fuel

The three fuel samples from the aircraft were tested in the laboratory. This revealed that all samples complied with the specifications for AVGAS 100LL. However, there were abnormalities in terms of the water content:

Source of sample	Water content	Appearance
Fuel filter sump	30 mg/kg	Clear, free from undissolved water and solid substances
Right collector tank	110 mg/kg	Clear, free from undissolved water and solid substances
Left collector tank	430 mg/kg	Clear, free from solid substances, contained approx. 0.5 ml of free water

**Table 1:** Findings from the analysis of the fuel samples

**Analysis and conclusions**

The investigations following the serious incident showed no abnormalities with the engine which could explain the loss of power during take-off.

Due to the high water content found in the fuel samples, it is a fair assumption that the fuel supply to the engine was temporarily restricted by the formation of ice crystals, which led to a loss of power during the take-off run.

The pilot acted in a logical and justified manner and aborted the take-off. He prudently steered the aircraft slightly to the right in a north-westerly direction, as the remaining distance to the main road beyond was greater there.

Based on article 29, paragraph 1 of the Ordinance on the Safety Investigation of Transport Incidents (OSITI), the STSB will not investigate further and concludes the investigation with this summary report in accordance with article 46 of the OSITI.

Bern, 13 June 2017

Swiss Transportation Safety Investigation Board