

## Notification

### Use of Ethanol Blended Fuel

#### Symbols:

Please pay attention to the following symbols throughout this document emphasizing particular information.

- ▲ **WARNING:** Identifies an instruction, which if not followed, may cause serious injury or even death.
- **CAUTION:** Denotes an instruction which if not followed, may severely damage the aircraft or could lead to suspension of warranty.
- ◆ **NOTE:** Information useful for better handling.

### 1. General

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Date of effect: April 1<sup>st</sup> 2010

Compliance: immediately

Release Number: NOT-001-ethanol fuel

Superseded notice: none

Models affected: G-3, G-3/600, GX

Affected S/N: all

Reason: increasing content of ethanol in auto fuel

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### 2. Information

In the past the terms auto fuel or automotive fuel and MOGAS have been identical: premium gas with at least AKI 91, no lead and not blended with ethanol. While the definition of MOGAS is still valid, the definition of auto fuel has changed in the past.

For several reasons, auto fuel may contain a certain amount of ethanol. In addition to ethanol-free auto fuel there are actually two blends provided at auto fuel stations: E5, which contains 5% of ethanol and E10, which contains 10% ethanol. Higher amounts of ethanol (E15 or higher) are currently under discussion. The amount of ethanol in the fuel is not marked on the gas pumps in car gas stations. Therefore the customer does not know if and which blend of fuel he actually purchases.

While car system and engines are not affected by ethanol blended fuel, aircraft systems and engines may be affected. It must be explicitly pointed out, that it is not sufficient that the engine tolerates ethanol fuel. The materials used in the fuel system must be compatible with ethanol blended fuel as well. This affects: sealing, fuel lines, fuel sensors, material of the fuel tank itself, etc.

**There is no long-term experience available with compatibility of the fuel system of the REMOS aircraft with ethanol-blended fuels.**

Another challenge is the undetermined amount of water that may be present for various reasons (e.g. condensation) in any given quantity of fuel. Water does not mix with fuel. In types of fuel without ethanol, water will settle underneath the fuel, at the bottom of any container; therefore frequent draining is required to eliminate water from fuel cells.

The behaviour of fuel containing ethanol is different. Ethanol mixes with fuel as well as with water. Fuel, again, does not mix with water. Ethanol mixes better with water than with fuel. A so called emulsion occurs in which water is present throughout the fuel volume. This mixture has other properties than pure MOGAS:

- Ethanol-blended fuel has a significantly lower vapour pressure. This increases the danger of vapour lock.
- Water can freeze when flying in cold weather. Ice crystals can block the filter in the fuel tank, the fuel filter, etc. This problem seems to be quite unlikely in REMOS aircraft, as the fuel tank is a separate cell inside the fuselage, therefore the fuel is not directly exposed to a cold environment.

With increasing amount of water, the ethanol cannot sustain the emulsion. Ultimately, phase separation will occur. At the bottom of the fuel tank, the water-ethanol mixture will settle down whereas the fuel without water or ethanol is found above. If this liquid is shaken, an emulsion reoccurs, but the phases

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separate again within seconds. Once phase separation has occurred, the following undesired effects may occur:

- Fuel is sucked from the bottom of the fuel tank. Therefore the entire fuel system and the engine are flushed with pure ethanol-water blend.
- Components that may resist E10 fuel may not necessarily accept pure ethanol and can therefore be damaged. This damage will manifest itself in a leaking fuel system (resulting, among other things, in toxic fumes, fire hazard etc.).
- The engine may suffer from combustion problems as it was designed to burn gas, not ethanol. The resistance of the engine systems against pure ethanol is unknown; the engine is not approved by ROTAX to burn pure ethanol. (Refer to ROTAX SI-912-016\_R2)
- Ethanol is an excellent cleaning solvent. Therefore any dirt particles that are enclosed in the fuel system can be washed out and can block filters, pumps or carburetors.

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### 3. Recommendations

- REMOS recommends using MOGAS.
- If MOGAS is not available, use AVGAS 100LL.
- Using Avgas leads to shorter service intervals and possibly lead deposits inside the engine. Refer to the Maintenance Handbook of the ROTAX 912 engine and to ROTAX Service Instruction SI-912-016\_R2 for further information.
- There are additives available on the market that prevents lead deposits, e.g. DECALIN and ALCOR TCP. Although REMOS and ROTAX have not tested such additives, field experience shows no detrimental effect on the engine, when used in the recommended manner. Refer to ROTAX SI-912-016\_R2 (this statement included for completeness of information and the process' suitability to the operators intended use of the aircraft needs to be determined by the operator; it is not explicitly endorsed by REMOS).
- For the use of auto fuel, it is recommended to use such without ethanol. Ethanol blends can be identified by means of ethanol tests. The test procedure issued by EAA is hereby approved by REMOS: [http://www.eaa.org/autofuel/faqs/alcohol\\_testing.asp](http://www.eaa.org/autofuel/faqs/alcohol_testing.asp) Fuels that are free of ethanol are listed in section 4 of this notification.
- There are additives available on the market that prevent phase separation, if fuel is used that contains ethanol, e.g. K-100MG. Although REMOS and ROTAX have not tested such additives, field experience shows no detrimental effect on the engine, when used in the recommended manner (this statement included for completeness of information and the process' suitability to the operators intended use of the aircraft needs to be determined by the operator; it is not explicitly endorsed by REMOS).
- If fuel is used that contains ethanol, then switch on the electric fuel pump during entire flight. A different start-up procedure is required; see section 5 of this notification.
- There is no long-term experience for resistance of the fuel cell against fuel containing ethanol. Up to this point in time, users that operate their aircraft with fuel that contains ethanol do not report any negative experiences in this regard. From SN 378, aircraft are factory equipped with a fuel system that is resistant against the effects of ethanol. Aircraft with earlier SN's can be retrofitted.

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### 4. Fuel without Ethanol

Per date (March 2010) the following types of fuel available in Germany are free of ethanol:

- ARAL ULTIMATE 100
- SHELL V-POWER RACING
- TOTAL Superplus

The fuel distributors are free to change their specifications at any time, without advance warning and without notification to the customer.

It is paramount that the operator acquires all the fuel data required to determine whether operation is safe. Ask your local fuel distributor for further information.

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### 5. Alternate Start-Up Procedure for use of MOGAS and Autofuel

Having the electrical fuel pump switched on during flight eliminates the problem of vapour lock. The fuel pump used on REMOS aircraft is a boost pump that sets the fuel system under pressure, therefore vapour bubbles cannot occur. In general, MOGAS has a lower vapour pressure than AVGAS, even without any ethanol. This is a second reason why it is recommended to have the fuel pump always switched on. The start-up procedure is to be changed to ensure that a failure of the mechanical fuel pump is detected:

<b>Starting a cold engine:</b>	1. Master Switch	ON
	2. Anti collision lights	ON
	3. Position lights	ON
	4. Oil radiator inlet flap	PUSH
	5. Electric fuel pump	ON
	6. Throttle lever	IDLE
	7. Choke lever	PULL
	8. Starter	Engage max 10s

Do not hold the key in position "START" for more than 10 seconds, in order to avoid overheating the starter. If the engine does not start, release the key to position "0", wait 2 minutes and repeat the procedure.

<b>Starting a hot engine:</b>	1. Main Switch	ON
	2. Anti collision lights	ON
	3. Oil radiator inlet flap	PULL
	4. Electric fuel pump	ON
	5. Throttle lever	IDLE
	6. Starter	Engage max 10s

Do not hold the key in position "START" for more than 10 seconds, in order to avoid overheating the starter. If the engine does not start, release the key to position "0", wait 2 minutes and repeat the procedure.

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<b>After starting the engine:</b>	1. If engine has started, release ignition key	RELEASE
	2. Choke lever	RELEASE
	3. Oil pressure	CHECK
	4. Avionics switch	ON
	5. Avionic devices	ON
	6. Electric fuel pump	OFF
	7. Engine speed for warm up	2.500 rpm
<b>Engine check:</b>	1. Oil Temperature	MIN 120°F
	2. Engine speed	4.000 rpm
	3. Magnetos – maximum rpm decrease 300 rpm	CHECK
	4. Engine speed	IDLE
	5. Electric fuel pump	ON

By having the electric fuel pump switched off after having started the engine, only the mechanical pump is providing the engine with fuel. Make sure that the engine is running without the electrical pump for at least two minutes. In that time, the engine burns all fuel in the fuel system behind the mechanical fuel pump. If the engine continues to function, is assured that the mechanical fuel pump is operational.

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### References

- ROTAX Service Instruction SI-912-016\_R2  
<http://www.rotax-aircraft-engines.com>
- FAA Advisory Circular Letter AC23.1521-2  
[http://www.faa.gov/regulations\\_policies/advisory\\_circulars/index.cfm/go/document.information/documentID/22281](http://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/22281)
- FAA Special Airworthiness Information Bulletin CE-07-08  
[http://rgl.faa.gov/Regulatory\\_and\\_Guidance\\_Library/rgSAIB.nsf/0/6f3250f958b6a22286257259006d6dab/\\$FILE/CE-07-06.pdf](http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgSAIB.nsf/0/6f3250f958b6a22286257259006d6dab/$FILE/CE-07-06.pdf)
- EASA Safety Information Bulletin SIB 2009-02  
<http://www.caa.lv/UserFiles/File/Jaunumi/Drosibas%20zinojums/SIB%202009-02%20Piston-engined%20aircraft%20using%20Automotive%20or%20Jet%20Fuel.pdf>
- Product Information K-100MG  
[http://www.k100online.com/mm5/merchant.mvc?Screen=K100MG&Store\\_Code=KFTO](http://www.k100online.com/mm5/merchant.mvc?Screen=K100MG&Store_Code=KFTO)
- Product Information DECALIN  
<http://www.decalinchemicals.com/fueladditive.html>
- Product Information ALCOR TCP  
<http://www.alcorinc.com/fuel-treatment/alcor-tcp.php>