

SERVICE INSTRUCTION

SELECTION OF SUITABLE OPERATING FLUIDS

FOR ROTAX® ENGINE TYPE 912 AND 914 (SERIES)

SI-912-016 R2

SI-914-019 R2

Repeating 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 engine or could lead to suspension of warranty.

◆ **NOTE:** Information useful for better handling.

|| | A revision bar outside of the page margin indicates a change to text or graphic.

1) Planning information

1.1) Engines affected

All versions of the engine type:

- 912 (Series)

- 914 (Series)

1.2) Concurrent ASB/SB/SI and SL

In addition to this Service Instruction the following additional Service Bulletin must be observed and complied with:

- SB-912-043 / SB-914-029, "Change of coolant specification", current issue.

1.3) Reason

Field experience has shown that additional information about the choice of suitable operating fluids, such as motor oil, coolant and fuel, and about oil change and maintenance intervals for ROTAX® engine types 912 and 914 is necessary.

1.4) Subject

Selection of suitable operating fluids for ROTAX® engine type 912 and 914 (Series)

- This information should help the aircraft builder and operator ensure that the operating conditions and installation are correct and thereby achieve optimum performance and reliability.

1.5) Compliance

According Maintenance Manual of engine type ROTAX® 912 and 914 (Series), current issue.

▲ **WARNING:** Non-compliance with these instructions could result in engine damages, personal injuries or death.

1.6) Approval

The technical content is approved under the authority of DOA Nr. EASA.21J.048.

1.7) References

In addition to this technical information refer to current issue of

- Operators Manual (OM)

- Maintenance Manual (MM)

- Installation Manual (IM)

◆ **NOTE:** The status of Manuals can be determined by checking the table of amendments of the Manual. The 1st column of this table is the revision status. Compare this number to that listed on the ROTAX WebSite: www.rotax-aircraft-engines.com. Updates and current revisions can be downloaded for free.

2) Material Information

2.1) Material - cost and availability

None.

3) Lubricant

3.1) General

Foreign particles formed during combustion are suspended in the motor oil. Together with oil components that are not sufficiently resistant to heat, these foreign particles can cause parts such as pistons, piston rings, exhaust valves, etc., to seize and lead to problems.

On turbocharged engines, failing to ensure an adequate cool-down period prior to shut-off may lead to particle deposits and cause damage to bearings and seals. Hard oil residues can obstruct parts of the oil system and lead to damage.

- In addition to insufficient cool-down periods, the use of unsuitable oils and not obeying oil change intervals can especially cause such damage.
- Long-term operation with an engine that is too cold and/or operating too long with an overly rich fuel mixture can cause water and fuel contamination in the oil, reducing its lubrication capacity.
- Furthermore, long down times with oil that contains water and contaminants can cause corrosion damage, especially on the bearings, with serious consequential damage.

The criteria for correct motor oil selection are:

- Correct oil viscosity for cold starts and sufficient oil pressure at high temperatures.
- Good gear wear protection.
- Avoidance of clutch slipping due to use of additives.
- Insufficient oil flow capability so that too much volume remains in the engine, leading to low oil level in the external oil tank. This can only be detected during testing with an oil level indicator installed on the oil tank.
- Ability to withstand combustion products containing lead, which enter the oil during AVGAS operation.
- High oil temperature durability. This is especially important for the turbo engine due to the risk of oil carbon build-up on the bearing and sealing seats of the turbocharger. The oil carbon build-up (coking) can also flake off and block/restrict the oil return passage.

Conclusions

- If possible, operate the listed engine types using **unleaded** or low-lead fuel. (AVAGS 100 LL is not considered low leaded in this context.)
- Use the recommended motor oils according to sections 3.2 and 3.3 of this Service Instruction.
- Use only oil with API classification „SG“ or higher!
- Due to high stresses in the reduction gears, oils with gear additives such as good quality 4 stroke motorcycle oils are highly recommended.
- Because of the incorporated friction clutch, oils with friction modifier additives are unsuitable because this could result in clutch slipping during standard operation.
- Heavy duty, semi- or fully synthetic (depending on fuel type used) brand name oils offer many advantages and are generally the best choice.
- Avoid oils designed strictly for use in Diesel engines. These may not be suitable due to insufficient high temperature properties and additives that may affect the operation of the slipper clutch in the gear box.
- In case of severe operating conditions (i.e., flight school, towing, near-idle operation over a long period, over-use of carburetor preheating, etc.) the time between maintenance intervals must be generally shorter and in particular, the frequency of oil changes must be increased regardless of the type of fuel mainly used (MOGAS or AVGAS). Refer to current Maintenance Manual for more information and instructions.
- On turbocharged engines, always conduct a cool-down run before shutting down in accordance with the relevant Operators Manual.
- Careful attention to engine operation tips (see section 6).

3.2) Operation with unleaded and low-lead fuel (less than 0.1 g/liter lead content)

■ **CAUTION:** When operating primarily on unleaded fuels or MOGAS, the maintenance intervals remain unchanged from the published maintenance schedule found in the currently valid Maintenance Manual for the engine type.

In case of severe operating conditions, the time between maintenance intervals must be generally shorter, and in particular, the frequency of oil changes must be increased regardless of the type of fuel mainly used (MOGAS or AVGAS).

Use the following oils and observe the oil specification indicated:

Motor oils recommended (for use with unleaded fuel or MOGAS)

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Marke / brand	Bezeichnung / description	Spezifikation / specification	Viskosität * / viscosity	Code ¹⁾ / code ¹⁾
SHELL®	AeroShell Sport Plus 4	API SL	SAE 10 W-40	2
SHELL®	Advance VSX 4	API SG	SAE 10 W-40	3
SHELL®	Advance VSX 4	API SG	SAE 15 W-50	3
SHELL®	Advance Ultra 4	API SJ	SAE 10 W-40	1
SHELL®	Formula Shell Synthetic Blend	API SL	SAE 10 W-30	4
MOBIL®	Mobil 1	API SJ/CF	SAE 5 W-30	5
MOBIL®	Mobil 1	API SJ/CF	SAE 15 W-50	5
MOBIL®	Mobil 1 MX4T	API SG/CF	SAE 10 W-40	1
MOBIL®	Mobil 1 V-Twin	API SG/CF	SAE 20W-50	1
MOBIL®	Mobil 1 Clean 7500	API SM/SL	SAE 10W-30	4
Yacco®	MVX 500 Synthetic	API SJ	SAE 10 W-40	3
EVVA®	EVVA Mehrbereichsöl C52 / multigrade oil C52	API SJ/CF	SAE 15 W-50	3

¹⁾ recommendation code

- 1 Full-synthetic motorcycle oil with gear additives. Highly recommended for high oil temperature operation (higher than 120 °C / 250 °F) using only unleaded fuels.
- 2 Semi-synthetic aviation oils with gear additives. Highly recommended for normal (lower than 120 °C / 250 °F) and high oil temperature (higher than 120 °C / 248 °F) operation using leaded or unleaded fuels.
- 3 Semi-synthetic motorcycle oils with gear additives. Highly recommended for normal (lower than 120 °C / 250 °F) and high oil temperature (higher than 120 °C / 248 °F) operation using leaded or unleaded fuels.
- 4 Semi-synthetic oil. Recommended for normal (lower than 120 °C / 248 °F) and high oil temperature (higher than 120 °C / 250 °F) operation using leaded or unleaded fuels.
- 5 Full-synthetic oil: Recommended for high oil temperature operation (higher than 120 °C / 248 °F) using only unleaded fuels.

* The viscosity column is only a guideline. Substituting other than that shown is acceptable.

Example: Formula Shell Synthetic Blend SAE 5W-30 is a substitute for 10W-30. The guidelines given here must, however, be obeyed in all cases, using only those oils with which there have already been good operating experiences on ROTAX® engine types 912 and 914 (series).

◆ **NOTE:** The coefficient of viscosity indicates the tendency of oil to flow but it is not necessarily a quality code. Country specific deviations of the viscosity are possible.

3.3) Operation with leaded AVGAS fuels

If the engine is mainly operated with leaded AVGAS fuels, the following maintenance operations are necessary in addition by latest after **every 50 operating hours**:

- change of oil filter
- change of engine oil
- oil level checks, etc., according to the most recent Maintenance Manual.

In addition, compliance with the following operating conditions is required:

■ **CAUTION:** The engine is considered to be operated mainly on leaded AVGAS, when run for more than 30% of engine operating time on leaded AVGAS fuel.

◆ **NOTE:** When operating primarily on leaded AVGAS fuel, we **recommend** to make a change of engine oil **every 25 operating hours**.

More frequent oil changes will assure timely removal of residues and oil sludge thus avoiding increased wear or operating troubles.

Use the following oils and observe the oil specification indicated:

Motor oils recommended (for use with leaded AVGAS)

Marke / brand	Bezeichnung / description	Spezifikation / specification	Viskosität * / viscosity	Code ¹⁾ / code ¹⁾
SHELL®	AeroShell Sport Plus 4	API SL	SAE 10 W -40	2
SHELL®	Advance VSX 4	API SG	SAE 10 W -40	3
SHELL®	Formula Shell Synthetic Blend	API SL	SAE 10 W -30	4
SHELL®	Formula Shell	API SJ	SAE 10 W -30	5
SHELL®	Formula Shell	API SJ	SAE 20 W -50	5
Valvoline®	DuraBlend Synthetic	API SJ	SAE 10 W -40	4
MOBIL®	Mobil 1 Clean 7500	API SM/SL	SAE 10 W -30	4
EVVA®	EVVA Mehrbereichsöl C52 / multigrade oil C52	API SJ/CF	SAE 15 W -50	3
YACCO®	MVX 500 Synthetic	API SJ	SAE 10 W -40	3

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¹⁾ recommendation code

2 Semi-synthetic aviation oils with gear additives. Highly recommended for normal (lower than 120 °C / 248 °F) and high oil temperature (higher than 120 °C / 248 °F) operation using leaded or unleaded fuels.

3 Semi-synthetic motorcycle oils with gear additives. Highly recommended for normal (lower than 120 °C / 248 °F) and high oil temperature (higher than 120 °C / 248 °F) operation using leaded or unleaded fuels.

4 Semi-synthetic oil. Recommended for normal (lower than 120 °C / 248 °F) and high oil temperature (higher than 120 °C / 248 °F) operation using leaded or unleaded fuels.

5 Petroleum based oil. Recommended for use only when oil temperatures remain below 120 °C (248 °F) and when using leaded fuels.

* The viscosity column is only a guideline. Substituting other than that shown is acceptable providing all temperature limitations are respected.

Example: Formula Shell Synthetic Blend SAE 5W-30 is a substitute for 10W-30. The guidelines given here must, however, be obeyed in all cases, using only those oils with which there have already been good operating experiences on ROTAX® engine types 912 and 914 (series).

◆ **NOTE:** The coefficient of viscosity indicates the tendency of oil to flow but it is not necessarily a quality code. Country specific deviations of the viscosity are possible.

3.4) Motor oils not suitable for engine types 912 / 914 Series

Experience has shown that only some oils are suitable for use in ROTAX[®] engine types 912 / 914 and careful selection is advised following the recommendations in this Service Instruction.

◆ NOTE: In principle ROTAX[®] has not approved any specific oils, but oils must meet certain quality requirements. ROTAX[®] only recommends the oils described in Sections 3.2 and 3.3 of this Service Instruction.

ROTAX[®] is aware of formulation changes to some oils previously recommended for use in this Service Instruction. As a result, ROTAX[®] no longer recommends following oils and these should not be used anymore.

Marke / brand	Bezeichnung / description	Spezifikation / specification
Castrol [®]	Castrol Power 1	API SJ
Castrol [®]	GPS	API SG / CD
MOTUL [®]	5100 Synthetic Blend	API SJ

4) Coolant

4.1) General

All engine types 912/914 have liquid cooled cylinder heads and ram air cooled cylinders. The function of the coolant is to protect the cylinder heads from over-temperature by means of heat dissipation. Protection against corrosion of the engine components and freezing of the coolant is achieved with appropriate additives.

In principle, 2 different types of coolant are permitted:

- Conventional coolant based on ethylene glycol with 50% water content
- Waterless coolant based on propylene glycol

4.2) Conventional coolant

Conventional coolant (with about 50% water content) has a specific thermal capacity that is higher than waterless coolant. It gives excellent corrosion protection, especially for aluminum, and protection against freezing.

◆ NOTE: For exact monitoring of the coolant temperature, a limit has been set. This is necessary because standard coolant based on ethylene glycol such as BASF Glysantin in a 50/50 proportion mixture can boil at a temperature as low as 120 °C (248 °F). Refer to the current Installation Manual for more information and instructions.

■ CAUTION: The certification and determination of the correct coolant type must be conducted by the aircraft manufacturer. As each aircraft type has different characteristics, testing must be done to determine the most suitable coolant and instrumentation for each aircraft type.

◆ NOTE: Coolant should be a low silicate or silicate free formular. Follow coolant manufacturer directions regarding mixture percentages etc.

Recommended coolant with a mixture of 50% antifreeze and 50% water

Marke / brand	Bezeichnung / description
BASF®	Glysantin Protect Plus/G48
CASTROL®	Antifreeze All-Climate
CASTROL®	Antifreeze Anti-Boil
YACCO®	LR-35
SHELL®	DEX-COOL
SHELL®	Antifreeze Concentrate
VELVANA®	FRIDEX G49
TEXACO®	Havoline Extended Life Antifreeze / Coolant DEX-COOL
PETROL®	Antifreeze Concentrate / Antifreeze G 11

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4.3) Waterless coolant

Waterless coolant has advantages to prevent boiling of the cooling system because of its high boiling point. However, the specific thermal capacity is lower than with conventional coolant resulting in slightly higher running temperatures.

The cooling system of ROTAX[®] engine types 912 / 914 is designed for operation with waterless coolant and thus must not be modified, i.e., drainage or ventilation holes must not be closed.

◆ NOTE: With waterless coolant based on propylene glycol such as EVANS NPG+, it is sufficient to monitor the cylinder head temperature since the boiling point is very high.

■ CAUTION: The certification and determination of the correct coolant type must be conducted by the aircraft manufacturer. As each aircraft type has different characteristics, testing must be done to determine the most suitable coolant and instrumentation for each aircraft type.

Recommended coolant (100% concentrate)

Marke / brand	Bezeichnung / description
EVANS [®]	NPG+
EVANS [®]	NPGR

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■ CAUTION: EVANS NPGR contraction point is approx. -23 °C (-10 °F) . It will not freeze and expand like conventional coolant. Do not use if conditions expose the engine to non-operational temperatures below -23 °C (-10 °F).

4.3.1) Warnings for operating with waterless coolant

- Water or coolant containing water must **never** be added to the cooling system!
 - The max. water content must not exceed 3.6 %; it can be tested using a Brix refractometer.
 - Any water present in the cooling system is separated out as vapor. This can cause the cooling system to fail due to insufficient coolant quantity.
 - If EVANS NPG+/NPGR is not available locally for servicing the cooling system, a conventional coolant based on ethylene glycol can be used temporarily. However, the coolant must be replaced again with EVANS NPG+/NPGR within the next 15 days.
- CAUTION: As some conventional coolants are available in a pre-mixed formula (water added) be sure you only add 100% pure ethylene glycol if EVANS NPG+/NPGR is not available.
- CAUTION: The above warnings are taken from the manufacturer's user manual, however the original text and description in the user manual is binding.

5) Fuel

For ROTAX[®] aircraft engines different fuel types are available. See Operators Manual of the relevant engine type and/or the table in chapter 5.3.

5.1) Automotive fuels

In addition to AVGAS various automotive fuel types with different quality are available. Due to various environmental, economic and political reasons a number of fuel types with different amount of ethanol blend is available. Therefore the maximum amount of ethanol blend is defined as follows:

5.1.1) E10 (Unleaded gasoline blended with 10 % ethanol)

In addition to AVGAS and unleaded automotive fuel (Mogas) the ROTAX[®] 912/914 series of engines are now approved for use with E10. Fuels that contain more than 10% ethanol blend have not been tested nor are they permitted for use.

5.1.2) Suitability of fuel system components of airframe

ROTAX[®] urges owners to confirm with their airframe manufacturer that ethanol blended fuels of up to 10% (E10) are compatible with all fuel system components. It is the responsibility of the aircraft manufacturer to test their fuel system components and supply any further information on techniques, procedures and limitations of using ethanol blended fuel.

ROTAX[®] recommends that aircraft manufacturer and owner/operators read the following:

- FAA Advisory Circular Letter AC 23.1521-2
- FAA Special Airworthiness Information Bulletin CE-07-06
- EASA Safety Information Bulletin – SIB 2009-02

These contain details regarding the use of ethanol (alcohol) blended fuels and the type certificate requirements.

It is strongly recommended that also non-certified aircraft also conform to the information given in the above documents.

5.2) AVGAS fuel additives

Additives, which aid the scavenging of lead deposits under the names of Decalin[®] and Alcor TCP[®], have not been tested by ROTAX[®]. Field experience gained shows that these products have no detrimental effect on the engine, when used in the recommended manner.

Always follow the additive manufacturers instructions especially with regard to health and safety precautions. ROTAX[®] only has field experience with Decalin Runup[™] and Alcor TCP[®] brands. Other similar additives are not advised as ROTAX[®] cannot comment on their suitability for the 912/914 engine types.

5.3) Fuel according to local standards

The following fuels can be used.

Usage / Description		
	912 UL / A / F	912 ULS / S - 914 UL / F
MOGAS		
European standard	EN 228 Normal ¹⁾	
	EN 228 Super ¹⁾	EN 228 Super ²⁾
	EN 228 Super plus ¹⁾	EN 228 Super plus ²⁾
Canadian standard	CAN/CGSB-3.5 Quality 1 ³⁾	CAN/CGSB-3.5 Quality 3 ⁴⁾
US standard	ASTM D4814 ³⁾	ASTM D4814 ⁴⁾

AVGAS		
Aviation standard	AVGAS 100 LL (ASTM D910)	AVGAS 100 LL (ASTM D910)

released brand-name		
	HJELMCO AVGAS 91/96 UL ⁵⁾	HJELMCO AVGAS 91/96 UL ⁵⁾
	HJELMCO AVGAS 91/98 UL ⁵⁾	HJELMCO AVGAS 91/98 UL ⁵⁾

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- 1) min. RON 90
- 2) min. RON 95
- 3) min. AKI* 87
- 4) min. AKI 91
- 5) unleaded, available most important in Scandinavian area

* Anti-Knock Index, (RON+MON)/2

AVGAS 100LL places greater stress on the valve seats due to its high lead content and forms increased deposits in the combustion chamber and lead sediments in the oil system. Thus it should only be used in case of problems with vapor lock or when other types of gasoline are unavailable.

■ **CAUTION:** Use only the correct fuel for the specific climate zones.

◆ **NOTE:** There is a risk of vapor lock formation if winter fuel is used for summer operation.

6) General engine operation requirements and operating tips

- || 1. Keep the motor oil temperature below 120 °C (250° F) over most of the operating period.
- || 2. Always insure that the oil type used is adequate for climatic conditions and peak engine operating temperatures. If operational oil temperatures exceed 120 °C (250 °F), use of a mineral or petroleum based oil is not recommended.
- || 3. For turbocharged engines ensure an adequate running cool-down period to prevent deposits by coking of oil.
- || 4. When operating with unleaded fuels or MOGAS and when engine oil temperatures often exceed 120 °C (250 °F) use of a high quality full synthetic oil is recommended.
- || 5. To avoid formation of condensation water in the motor oil, the oil temperature must rise at least once every operational day to at least 100 °C (212 °F).
- || 6. When safe and sensible, avoid extended use of carburetor air pre-heating.
- || 7. The type of fuel used, operating conditions, and the demands of the engine mission profile may need to increase the frequency of oil changes to avoid the excessive build up of lead and other residues in the engine oil. Always adjust the engine oil change intervals to avoid excessive build up of sludge in the engine oil.

■ **CAUTION:** Do not use oil additives and observe the operating limits as per the relevant Operators Manual. Excessive engine vibration, particularly at low idle speeds, can impair the carburetor fuel metering system leading to a too rich mixture condition. This rich mixture condition can further lead to rough engine operation and excessive carbon and lead deposits.

7) Summary

▲ **WARNING:** Non-compliance with these recommendations could result in engine damage, personal injury or death!

Approval of translation to best knowledge and judgment - in any case the original text in the German language and the metric units (SI-system) are authoritative.