

# SERVICE INSTRUCTION

## SELECTION OF MOTOR OIL AND GENERAL OPERATING TIPS FOR ROTAX<sup>®</sup> ENGINES TYPE 912 AND 914 (SERIES)

SI-18-1997

### MANDATORY

#### 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.

#### 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

none

##### 1.3) Reason

- Field experience has shown that additional information about the choice of suitable motor oils and oil change and maintenance intervals for the ROTAX engines Type 912 and 914 is necessary.

Regardless of which brand of fuel is used, foreign particles are suspended in this motor oil. Heavy accumulation of particles on high temperature zones such as on piston rings, exhaust valve guides, may result in stuck piston rings and valves due to burning and coking of the oil.

On turbocharged engine, failing to ensure an adequate cool-down period prior to shut-off may lead to particle deposits on the turbocharger wheels. This could result in an unbalance of the turbo wheel and consequently to a complete destruction of the turbocharger. Particle deposits or coking may become loose in the engine and may block the lubrication system causing damage to the engine due to lack of oil.

- In some cases, high wear and excessive residues formation have been noted on above engine types. This is primarily due to the use of motor oils and oil change intervals that are unsuitable for operating conditions, mission profiles and type of fuel used.

- Excessive use of carburetor air pre-heating and prolonged periods of engine idling can cause rich mixture condition which accelerates the breakdown and contamination of engine oil.

- The lead content of currently available leaded AVGAS fuels is very high. The 100 LL AVGAS commonly available in North America contains up to 0.58 ml / litre of tetraethyl lead, more than 4 times the lead found in the leaded 80/87 AVGAS previously available. Due to this extremely high lead content, residue formation leading to operating difficulties with valve and piston ring sticking and cylinder wall glazing occurs more frequently when engines are primarily operated with leaded AVGAS fuels.

Lead deposits could cause glazing of the cylinder walls.

#### 1.4) Subject

Selection of motor oil and general operating tips for ROTAX<sup>®</sup> engines type 912 und 914 (Series)

- This information is intended to assist the aircraft designer, manufacturer, builder and operator to achieve correct operating conditions and installation of the engine and consequently optimum performance and reliability.

#### 1.5) Compliance

When mainly using leaded AVGAS fuels, and/or when operating conditions are severe, shorter maintenance intervals must be met.

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

#### 1.6) References

In addition to this technical information refer to

- current issue of the Operator's Manual (OM)
- Maintenance Manual (MM)

#### 1.7) Other publications affected

The following documentations must be replaced as a consequence of this Service Instructions and will become invalid therefore.

Description	Part no.	Issue	Date	Rev.	Chapter	Page
SI-18-1997	-	0	January 1999	2		

### 2) Material Information

none

### 3) Accomplishment / Instructions

#### 3.1) Remedy

- If possible, operate the listed engine types using **unleaded fuel or MOGAS**.
  - Use of the recommended motor oils according to sections 3.2 and 3.3 of this Service Instruction.
  - Use only oil with API classification "**SF**" or "**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 as this could result in clutch slipping during standard operation.
  - High quality, heavy duty semi or full synthetic (depending on fuel type used) motorcycle oils offer many advantages and are generally the best choice for 912/914 engines.
  - Avoid oils designed strictly for use in Diesel engines. Oils designed for use primarily in Diesel engines 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, glider towing 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).
  - On turbocharged engines always conduct a cool-down run in accordance with the relevant Operators Manual. After heavy load operation (e.g. glider tug operation) the cool-down period should be prolonged to 3 to 5 minutes.
  - Carefully observe of the engine operation tips found in section 3.4 of this Service Instruction.
- ◆ **NOTE:** Severe operating conditions may include but not be limited to flight training, glider tow operations, extended low RPM, prolonged use of carb heat etc.

### 3.2) Operation with unleaded fuel or MOGAS

■ **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)

01462

Marke / brand	Bezeichnung / description	Spezifikation / specification	Viskosität / viscosity	Code <sup>1)</sup> / code <sup>1)</sup>
Castrol®	Formula SLX	API SH/CF	SAE 0 W-30	3
Castrol®	GTX Magnatec	API SJ	SAE 10 W-40	4
Castrol®	GPS	API SG/CD	SAE 10 W-40	2
Castrol®	RS	API SG/CD	SAE 10 W-60	3
Castrol®	Superbike	API SG	SAE 5 W-40	1
Castrol®	Syntech Full Synthetic	API SJ	SAE 10 W-30	3
Castrol®	Syntech Full Synthetic	API SJ	SAE 20 W-50	3
Castrol®	Syntech Blend	API SJ	SAE 10 W-30	4
Castrol®	Syntech Blend	API SJ	SAE 5 W-50	4
ELF®	MOTO XT 4	API SG	SAE 10 W-50	1
MOTUL®	5100 Synthetic Blend	API SJ	SAE 10 W-40	2
Mobil®	Mobil1	API SJ/CF	SAE 15 W-50	3
SHELL®	Advance VSX 4	API SG	SAE 20 W-40	2
SHELL®	Advance Ultra 4	API SG	SAE 10 W-40	1
SHELL®	Formula Shell Synthetic Blend	API SJ	SAE 10 W-30	4
SHELL®	ROTELLA SB High Performance Synthetic Blend	API SH	SAE 10 W-40	4
Pennzoil®	Performax 100	API SJ	SAE 5 W-50	3
Valvoline®	High Performance Synthetic	API SJ	SAE 5 W-30	3
Valvoline®	High Performance Synthetic	API SJ	SAE 20 W-50	3
Valvoline®	DuraBlend Synthetic	API SJ	SAE 10 W-40	4

<sup>1)</sup> recommendation code

**1** Full-synthetic motorcycle oil with gear additives. Highly recommended for high temperature operation (higher than 120 °C / 250 °F) using only unleaded fuels.

**2** Semi-synthetic motorcycle oils with gear additives. Highly recommended for normal (less than 120 °C / 250 °F) and high temperature (higher than 120 °C / 250 °F) operation using leaded or unleaded fuels.

**3** Full-synthetic oil. Recommended for high temperature operation (higher than 120 °C / 250 °F) using only unleaded fuels.

**4** Semi-synthetic oil. Recommended for normal (less than 120 °C / 250 °F) and high temperature (higher than 120 °C / 250 °F) operation using leaded or unleaded fuels.

◆ **NOTE:** The coefficient of viscosity indicates the tendency of oil to flow but it is not a quality code. Country specific deviations of the viscosity are possible but will hardly influence the oil characteristic. In cases of doubt compare the product specifications, notes and requirements, as for instance for highly fluid (low viscosity) oils as friction modifiers could have been added.

### 3.3) Operation with leaded AVGAS fuels

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

- change of oil filter
- change of engine oil
- check of oil level

In addition, compliance with following operating conditions is required:

- avoid extended or unnecessary use of carburetor air pre heating
- avoid prolonged periods of low speed idling

◆ **NOTE:** 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.

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)

01463

Marke / brand	Bezeichnung / description	Spezifikation / specification	Viskosität / viscosity	Code <sup>1)</sup> / code <sup>1)</sup>
Castrol®	GTX Magnatec	API SJ	SAE 10 W-40	4
Castrol®	GPS	API SG/CD	SAE 10 W-40	2
Castrol®	GP	API SG	SAE 10 W-40	5
Castrol®	Syntech Blend	API SJ	SAE 10 W-30	4
Castrol®	Syntech Blend	API SJ	SAE 5 W-50	4
MOTUL®	5100 Synthetic Blend	API SJ	SAE 10 W-40	2
SHELL®	Advance VSX 4	API SG	SAE 20 W-40	2
SHELL®	Formula Shell Synthetic Blend	API SJ	SAE 10 W-30	4
SHELL®	ROTELLA SB High Performance Synthetic Blend	API SH	SAE 10 W-40	4
SHELL®	Formula Shell	API SJ	SAE 10 W-30	6
SHELL®	Formula Shell	API SJ	SAE 20 W-50	6
Pennzoil®	PZL Turbo Motor Oil	API SJ	SAE 10 W-30	6
Pennzoil®	GT Performance	API SJ	SAE 20 W-50	6
Valvoline®	DuraBlend Synthetic	API SJ	SAE 10 W-40	4
Valvoline®	All-Climate	API SJ	SAE 10 W-40	6
Valvoline®	All-Climate	API SJ	SAE 20 W-50	6

<sup>1)</sup> recommendation code

**2** Semi-synthetic motorcycle oils with gear additives. Highly recommended for normal (lower than 120 °C / 250 °F) and high temperature (higher than 120 °C / 250 °F) operation using leaded or unleaded fuels.

**4** Semi-synthetic oil. Recommended for normal (lower than 120 °C / 250 °F) and high temperature (higher than 120 °C / 250 °F) operation using leaded or unleaded fuels.

**5** Petroleum based motorcycle oils with gear additives. Highly recommended for use only when oil temperatures remain below 120 °C (250 °F) and when using leaded fuels.

**6** Petroleum based oil. Recommended for use only when oil temperatures remain below 120 °C (250 °F) and when using leaded fuels.

◆ **NOTE:** The coefficient of viscosity indicates the tendency of oil to flow but it is no quality code. Country specific deviations of the viscosity are possible but will hardly influence the oil characteristic. In cases of doubt compare the product specifications, notes and requirements.

### 3.4) General engine operation requirements and operating tips

- Keep the motor oil temperature below 120° C (250° F) over most of the operating period.
- 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.
- For turbocharged engines ensure an adequate running cool-down period to prevent deposits by coking of oil.
- 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. See Remedy in section 3 on page 2 of this Service Instruction.
- 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).
- When safe and sensible, avoid extended use of carburetor air pre-heating.
- 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 Operator's 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. Observance of the following maintenance and operating tips can reduce engine vibration and maintain accurate carburetor fuel metering:

- Regular pneumatic synchronization of the carburetors and synchronization of bowden cable for throttle and choke adjustment can greatly improve the smoothness of engine operation.
- Proper adjustment of the engine idle speed and maintenance of the air induction system can also aid smooth engine operation and helps to maintain the correct air / fuel mixture. Proper air / fuel mixture will reduce the separation of the non - volatile components in leaded AVGAS, and helps to minimize the rate of lead deposition in the engine.
- Whenever safe and sensible, the engine should be operated at speeds between 2500 and 2750 crankshaft RPM (1100 to 1200 propeller RPM with 2,27:1 reduction ratio, 1050 to 1150 propeller RPM with 2,43:1 reduction ratio) after starting and during the initial warm up period.
- Avoid rapid changes in engine RPM immediately after start up.
- Rapid engine cooling down resulting from altitude changes performed at a low power setting, landing approaches flown at low power settings, or rapid engine shut down after landing or ground operations should be avoided.
- Maintain engine speed between 2500 and 2750 crankshaft RPM (1100 to 1200 propeller RPM with 2,27:1 reduction ratio, 1050 to 1150 propeller RPM with 2,43:1 reduction ratio) until engine temperatures have stabilized before stopping the engine.
- Maintaining high friction torque values on the gear reduction unit can reduce vibrations from the torsion load absorber, further reducing overall engine vibrations, particularly at low RPM.
- Correct balancing of the propeller to a tolerated value can greatly reduce engine vibration, decrease wear of engine and gear reduction unit components, improve engine performance, and add to engine life. Recent developments in electronic propeller balancing equipment now allow quick dynamic balancing of propellers without removing the propeller from the aircraft. Other benefits of correct propeller balance include the reduction of cockpit noise and vibration levels, and a reduction in fatigue of exhaust components, air boxes, sheet metal components, cowlings, engine linkages and aircraft sections.
- Regular compliance with SI-912-005 / SI-914-007 „Lubrication System for all ROTAX Engine Type 912 (series) and 914 (series) engines“, (current version) will assure proper function of the engine lubrication system and optimum engine life.

### 3.5) Summary

- ▲ **WARNING:** The oil change has to be carried out as per the relevant Maintenance Manual and Operators Manual.
- ▲ **WARNING:** Non-compliance with this recommendations could result in engine damage, personal injury or death!

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