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NOTES

TOA) Table of amendments

Approval*

The technical content of this document is approved under the authority of DOA ref. EASA.21J.048.

current no.	chapter	page	date of change	remark for approval	date of approval from authorities	date of issue	signature
0	1 to 9	all	09 01 2012	DOA*			
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1	7	7-5	04 01 2013	DOA*			
1	8	8-1	04 01 2013	DOA*			

NOTES

TOA) Summary of changes

Content Summary of the relevant amendments in this context, but makes no claim to completeness.

current no.	chapter	page	date of change	comment
0		cover, rear	09 01 2012	New layout
		page	09 01 2012	
0	1	1-4	09 01 2012	Environment note
		1-6	09 01 2012	iRMT
0	2	2-4, 2-7	09 01 2012	Operating limits fuel pressure
0	3	3-4, 3-7	09 01 2012	Engine start
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0	9	9-1, 9-3, 9-5,	09 01 2012	Form
		9-6, 9-7, 9-8	09 01 2012	Overview of authorized distributor
1	1	1-5	04 01 2013	Warning: change of text
		1-10	04 01 2013	change of text
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1	3	3-6	04 01 2013	change of text
		3-10, 3-11	04 01 2013	change of text
1	4	4-2, 4-3	04 01 2013	Additional text: unscheduled Maintenance
		4-5	04 01 2013	oil pressure
		4-6	04 01 2013	oil level, oil pressure at cold start
1	7	7-5	04 01 2013	positioning of text
1	8	8-1	04 01 2013	Note added

NOTES

1.4) Safety notice

Normal use

⚠ WARNING

Non-compliance can result in serious injuries or death!
Never fly the aircraft equipped with this engine at locations, airspeeds, altitudes, or other circumstances from which a successful no-power landing cannot be made, after sudden engine stoppage.

- This engine is not suitable for acrobatics (inverted flight etc.).
- This engine shall not be used on rotorcrafts with an in-flight driven rotor (e.g. helicopters).
- It should be clearly understood that the choice, selection and use of this particular engine on any aircraft is at the sole discretion and responsibility of the aircraft manufacturer, assembler and owner/user.
- Due to the varying designs, equipment and types of aircraft, BRP-Powertrain grants no warranty or representation on the suitability of its engine's use on any particular aircraft. Further, BRP-Powertrain grants no warranty or representation of this engine's suitability with any other part, components or system which may be selected by the aircraft manufacturer, assembler or user for aircraft application.

⚠ WARNING

Non-compliance can result in serious injuries or death!
Unless correctly equipped to provide enough electrical power for night VFR (according latest requirement as e.g. ASTM), the ROTAX 912 UL/ULS/ULSFR is restricted to DAY VFR only.

- Certain areas, altitudes and conditions present greater risk than others. The engine may require humidity or dust/sand preventative equipment, or additional maintenance may be required.
- You should be aware that any engine may seize or stall at any time. This could lead to a crash landing and possible severe injury or death. For this reason, we recommend strict compliance with the maintenance and operation and any additional information which may be given to you by your dealer.

Training

- Whether you are a qualified pilot or a novice, complete knowledge of the aircraft, its controls and operation is mandatory before venturing solo. Flying any type of aircraft involves a certain amount of risk. Be informed and prepared for any situation or hazard associated with flying.
- A recognized training program and continued education for piloting an aircraft is absolutely necessary for all aircraft pilots. Make sure you also obtain as much information as possible about your aircraft, its maintenance and operation from your dealer.
- Engine-specific training courses are authorized by the distributors according to manufacturer specifications (iRMT).

Regulation

- Respect all government or local rules pertaining to flight operation in your flying area. Fly only when and where conditions, topography, and airspeeds are safest.
- Consult your aircraft dealer or manufacturer and obtain the necessary information, especially before flying in new areas.

Instrumentation

- Select and use proper aircraft instrumentation. This instrumentation is not included with the ROTAX engine package. Only approved instrumentation may be installed.

Engine log book

- Keep an engine log book and respect engine and aircraft maintenance schedules. Keep the engine in top operating condition at all times. Do not operate any aircraft which is not properly maintained or has engine operating irregularities which have not been corrected.

Maintenance (iRMT)

- Before flight, ensure that all engine controls are operative. Make sure all controls can be easily reached in case of an emergency.
- Since special tools and equipment may be required, engine servicing should only be performed by an authorized ROTAX engine dealer. BRP-Powertrain requires that any service be carried out and verified by a technician that has a current iRMT rating.

Illustrations

The illustrations in this Manual are mere sketches and show a typical arrangement. They may not represent the actual part in all its details but depict parts of the same or similar function. Therefore deduction of dimensions or other details from illustrations is not permitted.

NOTE: The Illustrations in this Manual are stored in a graphic data base system and are provided with a consecutive irrelevant number.

This number (e.g. 00277) is of no significance for the content.

1.6) Standard version

Serial production

- 4-stroke, 4 cylinder horizontally opposed, spark ignition engine, single central cam-shaft - push-rods - OHV
- Liquid cooled cylinder heads
- Ram air cooled cylinders
- Dry sump forced lubrication
- Dual breakerless capacitor discharge ignition
- 2 constant depression carburetors
- mechanical fuel pump
- Electric starter (12 V 0.7 kW)
- Integrated AC generator with external rectifier-regulator (12 V 20 A DC)
- Propeller drive via gearbox with integrated mechanical shock absorber and overload clutch

NOTE: The overload clutch is standard equipment on all certified and non-certified aircraft engines with configuration 3.

Optional

- Electric starter (12 V 0.9 kW)
- External alternator (12 V 40 A DC)
- Vacuum pump (only for A1, A2 and A4 possible)
- Hydraulic constant speed propeller governor (for configuration 3 only)

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2.4) Operating media-Fuel

General note

NOTICE Obey the local codes and the latest edition of Service Instruction SI-912-016 for the selection of the correct fuel.

NOTICE Use only fuel suitable for the respective climatic zone.

NOTE: Risk of vapour formation if using winter fuel for summer operation.

Knock resistance

The fuels with following specifications can be used:

Fuel specifikationen		
	Usage/Description	
Knock resistance	**912 A/F/UL**	**912 S/ULS**
	Min. RON 90 (min. AKI* 87)	Min. RON 95 (min. AKI* 91)

* Anti Knock Index (RON+MON)/2

MOGAS

	Usage/Description	
Mogas	**912 A/F/UL**	**912 S/ULS**
European standard	EN 228 Normal	
	EN 228 Super	EN 228 Super
	EN 228 Super plus	EN 228 Super plus

AVGAS

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.

	Usage/Description	
AVGAS	**912 A/F/UL**	**912 S/ULS**
Aviation Standard	AVGAS 100 LL (ASTM D910)	AVGAS 100 LL (ASTM D910)

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2.5) Operating media-Lubricants

General note

NOTICE

Obey the manufacturers instructions about the lubricants.
If the engine is mainly run on AVGAS more frequent oil changes will be required. See Service Information SI-912-016, latest edition.

Oil type

For the selection of suitable lubricants refer to the Service Information SI-912-016, latest edition.

Oil consumption

Max. 0.06 l/h (0.13 liq pt/h).

Oil specification

- Use only oil with API classification **"SG"** or higher!
- Due to the high stresses in the reduction gears, oils with gear additives such as high performance motor cycle oils are required.
- Because of the incorporated overload clutch, oils with friction modifier additives are unsuitable as this could result in a slipping clutch during normal operation.
- Heavy duty 4-stroke motor cycle oils meet all the requirements. These oils are normally not mineral oils but semi- or full synthetic oils.
- Oils primarity for Diesel engines have **insufficient high temperature properties and additives which favour clutch slipping, and are generally unsuitable.**

Oil viscosity

Use of multi-grade oils is recommended.

NOTE: Multi-viscosity grade oils are less sensitive to temperature variations than single grade oils.

They are suitable for use throughout the seasons, ensure rapid lubrication of all engine components at cold start and get less fluid at higher temperatures.

3.2) Before engine start

Carry out pre-flight checks.

3.3) Pre-flight checks

Safety

⚠ WARNING

Non-compliance can result in serious injuries or death!
Ignition "OFF". Before moving the propeller. Switch off both ignition circuits and anchor the aircraft. Have the cockpit occupied by a competent person.

⚠ WARNING

Risk of burnings and scalds!
Hot engine parts!
Carry out pre-flight checks on the cold or luke warm engine only!

Operating media

Step	Procedure
1	Check for any oil-, coolant- and fuel leaks. If leaks are evident, rectify and repair them before next flight.

Coolant

NOTICE

The coolant specifications of the section Chapter 2.3) Operating media are to be observed!

Step	Procedure
1	Verify coolant level in the **overflow bottle**, replenish as required up to top. The coolant level must be between min. and max. mark.

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NOTICE The oil specifications of the section Chapter 2.5) Operating media are to be observed!

Step	Procedure
1	Check oil level and replenish as required.
2	NOTE: Propeller shouldn't be turned excessively reverse the normal direction of engine rotation. Remove oil tank cover, turn the propeller slowly by hand in direction of engine rotation several times to pump oil from the engine into the oil tank.
3	It is essential to build up compression in the combustion chamber. Maintain the pressure for a few seconds to let the gas flow via the piston rings into the crankcase. The speed of rotation is not important but the pressure and the amount of gas which is transfered into the crankcase
4	This process is finished when air is returning back to the oil tank and can be noticed by a gurgle from the open oil tank.
5	Install oil tank cap.

Oil level (oil dipstick)

NOTE: The oil level should be in the upper half (between the “50%“ and the “max“ mark) and should never falls below the “min“ mark. Prior to long flights oil should be added so that the oil level reaches the “max“ mark.

Avoid oil levels exceeding the “max“ mark, since excess oil could be poured out through the venting system.

Difference between max.- and min.- mark = 0.45 litre (0.95 liq pt).

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3.5) Prior to take-off

Safety

⚠ WARNING Non-compliance can result in serious injuries or death!
Do not take the engine into operation if any person is near the aircraft.

Warming up period

Step	Procedure
1	Start warming up period at approx. 2000 rpm for approx. 2 minutes.
2	Continue at 2500 rpm, duration depending on ambient temperature, until oil temperature reaches 50 °C (120 °F).
3	Check temperatures and pressures.

Throttle response

NOTICE After a full-load ground test allow a short cooling run to prevent vapour formation in the cylinder head.

Step	Procedure
1	**Short** full throttle ground test (consult Aircraft Operators Manual since engine speed depends on the propeller used).

Ignition check

Check the two ignition circuits at **4000 rpm** (approx. 1700 rpm propeller).

Step	Procedure
1	Speed drop with only one ignition circuit must not exceed **300 rpm** (approx. 130 rpm propeller).
2	**115 rpm** (approx. 50 rpm propeller) max. difference of speed by use of either circuit, A or B.
	NOTE: The propeller speed depends on the actual reduction ratio.

Propeller governor

Check of hydraulic propeller governor:
Check control of the hydraulic propeller governor to specifications of the manufacturer.

NOTE: Cycling the propeller governor puts a relatively high load on the engine. Unnecessary cycling should be avoided.

3.6) Take-off

Safety

⚠ WARNING Non-compliance can result in serious injuries or death!

- Oil temperature, cylinder head temperature and oil pressure has to be observed. Limits must not be exceeded!
  See Chapter 2.1) Operating limits.
- Respect “cold weather operation” recommendations, see Chapter 3.9).

Climb

Climbing with engine running at take-off performance is permissible (max. 5 minutes) (see Chapter 2.1).

3.7) Cruising

Performance

Step	Procedure
1	Set performance as per performance specifications Chapter 5) and respect operating limits as per Chapter 2.1).

Oil temperature

Step	Procedure
1	Avoid operation below normal operation oil temperature (90 to 110 °C / 194 to 230 °F), as possible formation of condensation water in the lubrication system badly influences the oil quality. To evaporate possibly accumulated condensation water, at least once a day 100 °C (212 °F) oil temperature must be reached.

3.8) Engine shut-off

General note

Normally the cooling down of the engine during descending and taxiing will be sufficient to allow the engine to be shut off as soon as the aircraft is stopped.

At increased operating temperatures make an engine cooling run of at least minimum 2 minutes.

3.9) Cold weather operation

General note

Generally, an engine service should be carried out before the start of the cold season.

Coolant

For selection of coolant and mixing ratio, see "Coolant", Chapter 2.3)

Lubricant

For selection of oil, see table of Lubricants Chapter 2.5).

Cold start

- With throttle closed and choke activated (open throttle renders starting carb ineffective).
- Be aware, no spark below crankshaft speed of 220 rpm (propeller speed of 90 rpm).
- As performance of electric starter is greatly reduced when hot, limit starting to periods not much longer than 10 sec. With a well charged battery, adding a second battery will not improve cold starts.

Remedy - Cold start

Step	Procedure
1	Use of multigrade oil with the low end viscosity code of 5 or 10.
2	Check electrode gap of spark plugs and set it to the minimum or fit new spark plugs.
3	Preheat engine.

Icing in the air intake system

Icing due to humidity

Carburetor icing due to humidity may occur on the venturi and on the throttle valve due to fuel evaporation and leads to performance loss and change in mixture.

Remedy

- Intake air pre-heating is the only effective remedy. See Flight Manual supplied by the aircraft manufacturer.

Icing due to water in fuel

Icing due to water in fuel

NOTICE

Fuels containing alcohol always carry a small amount of water in solution. In case of temperature changes or increase of alcohol content, water or a mixture of alcohol and water may settle and could cause troubles.

Water in fuel will accumulate at the lower parts of the fuel system and leads to freezing of fuel lines, filters or jets.

Remedy

- Use non-contaminated fuel (filtered through suede)
- Generously sized water separators
- Fuel lines routing inclined
- Prevent condensation of humidity, i.e avoid temperature differences between aircraft and fuel.

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4) Abnormal operation

Introduction

⚠ WARNING Non-compliance can result in serious injuries or death!
At unusual engine behaviour conduct checks as per Maintenance Manual, Chapter 05-50-00 before the next flight.

NOTE: Further checks - see Maintenance Manual.

Table of contents

This chapter of the Operators Manual contains expanded operating and maintenance instruction at abnormal operation.

4.1) Start during flight

Engine stop

- If the propeller turns in flight cause of windmilling, but its speed is not sufficient to start the engine, then the electric starter is easily usable.
  It is never ever necessary to wait for the standstill of the propeller.

4.2) Exceeding of max. admissible engine speed

Exceeding of max. engine speed

- Reduce engine speed. Any exceeding of the max. admissible engine speed has to be entered by the pilot into the logbook, stating the duration and extend of overspeed.
- Carry out an unschedulded maintenance check according to Maintenance Manual Line chapt. 05-50-00.

4.3) Exceeding of max. admissible cyl. head temperature

Exceeding of cylinder head temperature

NOTICE

Reduce engine power setting to the minimum necessary to maintain flight and carry out precautionary landing.

- Any exceeding of the max. admissible cylinder head temperature has to be entered by the pilot into the logbook, stating duration and extent of over-temperature condition.
- Carry out an unschedulded maintenance check according to Maintenance Manual Line chapt. 05-50-00.

4.4) Exceeding of max. admissible oil temperature

Exceeding of oil temperature

NOTICE

Reduce engine power setting to the minimum necessary to maintain flight and carry out precautionary landing.

- Any exceeding of the max. oil temperature must be entered by the pilot in the logbook, stating duration and extent of over-temperature condition.
- Carry out an unschedulded maintenance check according to Maintenance Manual Line chapt. 05-50-00.

4.5) Oil pressure below minimum - during flight

Oil pressure below minimum

NOTICE

Reduce engine power setting to the minimum necessary and carry out precautionary landing.

- Check oil system.
- Carry out an unschedulded maintenance check according to Maintenance Manual Line chapt. 05-50-00.

4.6) Oil pressure below minimum - on ground

Immediately stop the engine and check for reason. Check oil system.

- Check oil quantity in oil tank.
- Check oil quality. See Chapter 2.5).
- Carry out an unschedulded maintenance check according to Maintenance Manual Line chapt. 05-50-00.

4.7) Trouble shooting

Introduction

All checks in accordance with the Maintenance Manual (current issue/revision).

⚠ WARNING

Non-compliance can result in serious injuries or death!
Only qualified staff (authorized by the Aviation Authorities) trained on this particular engine, is allowed to carry out maintenance and repair work.

NOTICE

If the following hints regarding remedy do not solve the problem, contact an authorized workshop. The engine must not be operated until the problem is rectified.

Table of content

This chapter of the Operators Manual contains possible cause and remedy in case of trouble shooting.

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Starting problems

Engine does not start

Possible cause	Remedy
Ignition off.	Switch on.
Closed fuel valve or clogged filter.	Open valve, clean or renew filter, check fuel system for leaks.
No fuel in tank.	Refuel.
Starting speed too low, faulty or discharged battery.	Fit fully charged battery.
Starting speed too low, start problems on cold engine.	Use top quality, low friction oil; allow for sufficient cooling period to counter for performance drop on hot starter; pre-heat engine.
Wrong fuel (Jetfuel or Diesel).	Change of fuel.

Engine run

Engine idles rough after warm-up period, smoky exhaust emission

Possible cause	Remedy
Starting carb (Choke) activated.	Close starting carb (Choke).

Engine keeps running with ignition off

Possible cause	Remedy
Overheating of engine.	Let engine cool down at idling at approx. 2000 rpm.

Knocking under load

Possible cause	Remedy
Octane rating of fuel too low.	Use fuel with higher octane rating.

Oil pressure

Low oil pressure

Possible cause	Remedy
Not enough oil in oil tank.	Refill oil.

Oil level

Oil level is increasing

Possible cause	Remedy
Oil too cold during engine operation.	Cover oil cooler surface, observe the operating limits.
Contamination with diesel fuel.	Check fuel

Cold engine start

Engine hard to start at low temperature

Possible cause	Remedy
Starting speed too low.	Preheat engine.
Low charge battery.	Fit fully charged battery.
High oil pressure.	At cold start a pressure reading of up to around 7 bar (102 psi) does not indicate a malfunction.
Oil pressure too low after cold start.	Too much resistance in the oil suction system at low temperatures due to cold oil. Stop engine and preheat oil. After a cold start the oil pressure must be observed and should be above 1.5 bar (22 psi). Otherwise, the speed must be lowered again, because not enough cold oil can be sucked. If oil pressure is lower than 1 bar (15 psi) oils with lower viscosity have to be used. See SI-912-016, current issue.
NOTE:	Oil pressure must be measured at idle at an oil temperature of minimum 50 °C (120 °F). Be sure the oil pressure does not go below minimum at idle.

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7.3) Lubrication system

General note

See Fig. 3

The engines are provided with a dry sump forced lubrication system with a main oil pump with integrated pressure regulator (1) and oil pressure sensor (2).

Lubrication

The oil pump (3) sucks the motor oil from the oil tank (4) via the oil cooler (5) and forces it through the oil filter (6) to the points of lubrication in the engine

Crankcase

The surplus oil emerging from the points of lubrication accumulates on the bottom of crankcase and is forced back to the oil tank by the piston blow-by gases.

Oil pump

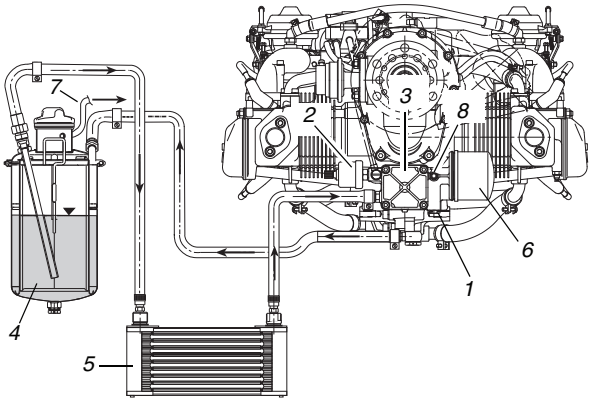
The oil pumps are driven by the camshaft.

Oil venting system

The oil circuit is vented via bore (7) on the oil tank.

Oil temperature sensor

The oil temperature sensor (8) for reading of the oil inlet temperature is located on the oil pump housing.



Part	Function
1	Pressure regulator
2	Oil pressure sensor
3	Oil pump
4	Oil tank
5	Oil cooler
6	Oil filter
7	Venting tube
8	Oil temperature sensor

Fig. 3 *08650*

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8) Checks

Introduction

All checks to be carried out as specified in the current Maintenance Manual (last revision).

⚠ WARNING

Non-compliance can result in serious injuries or death!
Only qualified staff (authorized by the Aviation Authorities) trained on this particular engine, is allowed to carry out maintenance and repair work.

NOTE: Further useful information about service and airworthiness of your engine is also available on **www.rotax-owner.com**.

NOTICE

Carry out all directives of Service Bulletins (SB), according to their **priority**.
Observe according Service Instructions (SI) and Service Letter (SL).

Table of content

This chapter of the Operators Manual contains checks of the aircraft engines.

8.1) Engine preservation

General note

⚠ WARNING

Risk of burnings and scalds!
Hot engine parts!
Always allow engine to cool down to ambient temperature before start of any work.

Due to the special material of the cylinder wall, there is no need for extra protection against corrosion for the ROTAX aircraft engines. At extreme climatic conditions and for long out of service periods we recommends the following to protect the valve guides against corrosion:

Step	Procedure
1	Operate the engine until the temperatures have stabilized for a period of 5 min (engine oil temperature between 50 to 70 °C (122 to 160 °F).
2	Switch the engine OFF.
3	Allow the engine to cool down.
4	Change oil.
5	Remove the air intake filters and insert approx. 30 cm³ (1 fl oz) of corrosion inhibiting oil into the carburetor throat with the engine running at increased idle speed. Shut off engine.
6	Drain carburetor float chamber.
7	Apply oil to all joints on carburetors.
8	Close **all** openings on the cold engine, such as exhaust end pipe, venting tube, air filter etc. against entry of dirt and humidity.
9	Spray all steel external engine parts with corrosion inhibiting oil.

8.2) Engine back to operation

If preservation (including oil change) took place within a year of storage, oil renewal will not be necessary. For longer storage periods repeat preservation annually.

Step	Procedure
1	Remove all plugs and caps.
2	Clean spark plugs with plastic brush and solvent.
3	Reinstall.