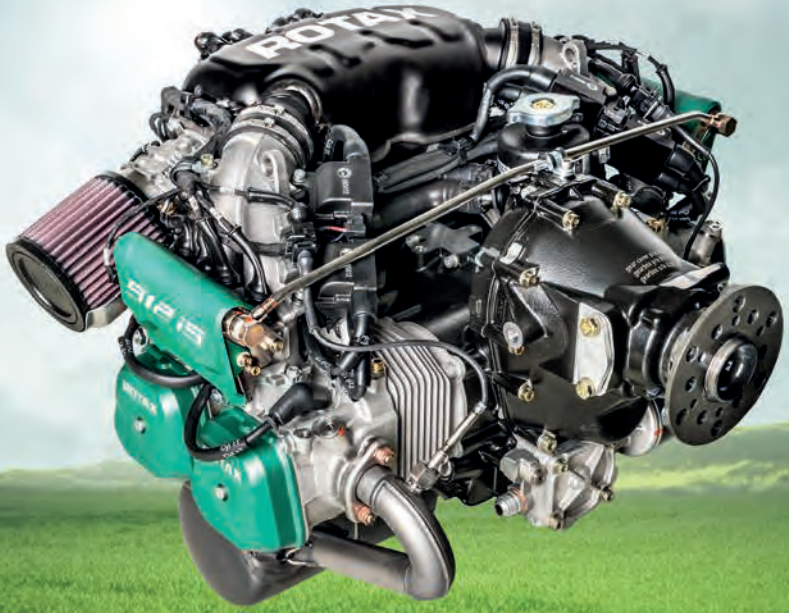
ROTAX®
AIRCRAFT ENGINES

OPERATORS MANUAL

FOR ROTAX® ENGINE TYPE 912 i SERIES



ref. no.: OM-912 i | part no.: 898741

picture: ROTAX® 912 iS with options

⚠ WARNING

Before starting the engine, read the Operators Manual, as it contains important safety relevant information. Failure to do so may result in personal injuries including death. Consult the original eq uipment manufactur-ers handbook for additional instructions!

Translation into other languages might be performed in the course of language localization but does not lie within ROTAX® scope of responsibility.

In any case the original text in English language and the metric units are authoritative.

Table of Content

Chapter **INTRO** – Introduction

Chapter **LEP** – List of effective pages

Chapter **TOA** – Table of amendments

Chapter **1** – General note

Chapter **2** – Operating instructions

Chapter **3** – Standard operation

Chapter **4** – Abnormal operation

Chapter **5** – Performance and Fuel consumption

Chapter **6** – Weights

Chapter **7** – System Description

Chapter **8** – Preservation and storage

Chapter **9** – Supplement

Chapter **10** – Proper disposal

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INTRO) Introduction

Topics in this chapter

Foreword

BRP-Rotax GmbH & Co KG (hereinafter “BRP-Rotax”) provides “Instructions of Continued Airworthiness”, which are based on the design, the tests and certification of the engine and its components. These instructions apply only to engines and components supplied by BRP-Rotax.

Before operating the engine, read this Operators Manual carefully. If any passages of the Manual are not clearly understood or in case of any questions, please contact our ROTAX® Authorized Distributors or their independent Service Centers.

This Operators Manual contains important information about safe operation of the engine together with descriptions of the systems, technical data, operating media and the operational limits of the engine.

The specified information and procedures apply only to the engine and not to specific applications in particular aircraft. The aircraft manufacturers Operators Manual is therefore definitive in terms of the operation of the engine, as it contains all of the aircraft-specific instructions

BRP-Rotax wishes you much pleasure and satisfaction flying your aircraft powered by this ROTAX® aircraft engine.

Document structure

The structure of the Manual follows whenever it is possible the structure of the “GAMA Specification #1 for Pilot’s Operating Handbook“.

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LEP) List of effective pages

Each new revision to the Operators Manual will have a new List of Effective Pages.

Chapter	Page	Date
	cover page	
INTRO	1	June 01 2019
	2	June 01 2019
LEP	1	June 01 2019
	2	June 01 2019
TOA	1	June 01 2019
	2	June 01 2019
1	1	June 01 2019
	2	June 01 2019
	3	June 01 2019
	4	June 01 2019
	5	June 01 2019
	6	June 01 2019
	7	June 01 2019
	8	June 01 2019
	9	June 01 2019
	10	June 01 2019
	11	June 01 2019
	12	June 01 2019
	13	June 01 2019
	14	June 01 2019
2	1	June 01 2019
	2	June 01 2019
	3	June 01 2019
	4	June 01 2019
	5	June 01 2019
	6	June 01 2019
	7	June 01 2019
	8	June 01 2019
3	1	June 01 2019
	2	June 01 2019
	3	June 01 2019
	4	June 01 2019
	5	June 01 2019
	6	June 01 2019
	7	June 01 2019
	8	June 01 2019
	9	June 01 2019
	10	June 01 2019
	11	June 01 2019
	12	June 01 2019
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	14	June 01 2019
4	1	June 01 2019
	2	June 01 2019
	3	June 01 2019
	4	June 01 2019
	5	June 01 2019
	6	June 01 2019
	7	June 01 2019
	8	June 01 2019
	9	June 01 2019
	10	June 01 2019
	11	June 01 2019
	12	June 01 2019
5	1	June 01 2019
	2	June 01 2019

Chapter	Page	Date
	3	June 01 2019
	4	June 01 2019
	5	June 01 2019
	6	June 01 2019
6	1	June 01 2019
	2	June 01 2019
7	1	June 01 2019
	2	June 01 2019
	3	June 01 2019
	4	June 01 2019
	5	June 01 2019
	6	June 01 2019
	7	June 01 2019
	8	June 01 2019
	9	June 01 2019

Chapter	Page	Date
	10	June 01 2019
	11	June 01 2019
	12	June 01 2019
	13	June 01 2019
	14	June 01 2019
8	1	June 01 2019
	2	June 01 2019
	3	June 01 2019
	4	June 01 2019
9	1	June 01 2019
	2	June 01 2019
10	1	June 01 2019
	2	June 01 2019
	Index	
	rear page	

TOA) Table of amendments

Approval*
The technical content of this document is approved under the authority of DOA ref. EASA.21J.048. This document is part of the ICA for product [2014]

Edition 2/Rev. 0	January 01 2019	Obsolete with Revision 1, which is a complete re-revision.
Revision 1	June 01 2019	

Rev. no.	Chapter	Page	Date of change	Remark for approval	Date of approval from authorities	Date of inclusion	Signature
0	INTRO	all	January 01 2019	DOA*			
0	LEP	all	January 01 2019	DOA*			
0	TOA	all	January 01 2019	DOA*			
0	1 up to 10	all	January 01 2019	DOA*			

Rev. no.	Chapter	Page	Date of change	Remark for approval	Date of approval from authorities	Date of inclusion	Signature
1	LEP	all	June 01 2019	DOA*			
1	TOA	all	June 01 2019	DOA*			
1	1	14	June 01 2019	DOA*			
1	2	2,3,4,5	June 01 2019	DOA*			
1	4	4	June 01 2019	DOA*			
1	5	2, 3, 4	June 01 2019	DOA*			

Summary of amendments

Summary of the relevant amendments in this context, but without any claim to completeness.

Rev. no.	Chapter	Page	Date of change	Comments
0	1 up to 10	all	Jan. 01 2019	new layout and change of company name, also changes in chapter structure; technical updates
1 1 1 1	1 2 4 5	14 2, 3, 4, 5 4, 2,3,4	June 01 2019 June 01 2019 June 01 2019 June 01 2019 June 01 2019	correction of text correction and change of text change of text new graphic, new table, change of text

1) General note

Topics in this chapter

1.1 General 2
1.2 Abbreviations and terms 3
1.3 Safety 7
1.4 Safety information 9
1.5 Technical documentation 12
1.6 Type description 14

1.1) General

Purpose

The purpose of this Operators Manual is to familiarize the aircraft manufacturers installing this aircraft engine with operating instructions and safety information.

This document is not intended for use by end customers (private aircraft owners, flight schools...) for operating the engine. Due to various executions of engine installations, only the aircraft manufacturer is able to provide end customers with operation and safety information tailored for a specific aircraft.

Nevertheless, all provided information in this Operators Manual (such as operating limits, safety information, operation instructions...) must be adhered to. The aircraft manufacturer is obliged to forward this information to the end customer in an appropriate way (e.g. within the aircraft specific Operators Manual).

For detailed information related to aircraft and aircraft/engine installation, maintenance, safety or flight operation, consult the documentation provided by the aircraft manufacturer and/or its dealer.
For additional information on engines, their maintenance or parts, you can also contact your nearest ROTAX® authorized aircraft engines distributor or their independent Service Center.

Engine serial number

When making inquiries or ordering parts, always indicate the engine serial number. Due to continuous product improvement, engines of the same engine type might require different support and spare parts.
The engine serial number is located on top of the crankcase, behind the propeller gearbox.

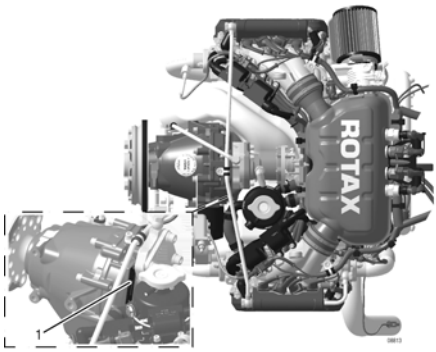


Figure 1: Pos. 1: Engine serial number

1.2) Abbreviations and terms

Abbreviations	Description
*	Reference to another section
	center of gravity
	The drop symbol indicates use of sealing agents, adhesives or lubricants (only in the Illustrated Parts Catalog).
°C	Degrees Celsius (Centigrade)
°F	Degrees Fahrenheit
rpm	Revolutions per minute
A	Ampere
AAPTS	Ambient Air Pressure Temperature Sensor
AC	alternating current
AD	Airworthiness Directives
Ah	Ampere hour
A/C	Aircraft
AR	as required
assy.	assembly
ASB	Alert Service Bulletin
ACG	Austro Control GmbH
ACL	Anti Collision Light
API	American Petrol Institute
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
AWG	American Wire Gauge
CAN	Controller Area Network
Coil 1–4	Ignition coils 1–4
CPS 1+2	Crankshaft Position Sensor 1+2
CSA	Constant Speed Actuator
CTS	Cooling Temperature Sensor
CW	clockwise

CCW	counter-clockwise
CGSB	Canadian General Standards Board
DCDI	Dual Capacitor Discharge Ignition
DC	direct current
DOA	Design Organisation Approval
DOT	Department of Transport
EASA	European Aviation Safety Agency
IM	Installation Manual
ECU	Engine Control Unit
EGT	Exhaust Gas Temperature
INTRO	Introduction
EMS	Engine Management System
EMS GND	Engine system internal ground reference which is intended to be disconnected from aircraft common ground during flight
EMC	Electromagnetic compatibility
EN	European Standard
ETFE	Ethylene Tetrafluoroethylene
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
FOD	Foreign object damage
Fuse box	Power conditioning and distribution for the Engine Management System
hr.	hours
HIC A	Harness Interface Connector A
HIC B	Harness Interface Connector B
IAT	Indicated Air Temperature
ICA	Instructions for Continued Airworthiness
IFR	Instrument Flight Rules
IFSD	In-flight-shutdown
INJ 1–8	Injector 1–8
IPC	Illustrated Parts Catalog

ips	inch per second
iRMT	independent ROTAX Maintenance Training
ISA	International Standard Atmosphere
kg	Kilograms
KNOCK	Knock sensor
Lane A	System A of Engine Management System
Lane B	System B of Engine Management System
LOPC	Loss of power control
MAPS 1 & 2	Manifold Air Pressure Sensor 1 & 2
MATS 1 & 2	Manifold Air Temperature Sensor 1 & 2
MON	Motor Octane Number
MAG	Magneto Side
N	Newton
n.a.	not available
NDT	Non Destructive Testing
Nm	Newtonmeter
NVFR	Night Visual Flight Rules
OAT	Organic Acid (Additive) Technology
OHM	Overhaul Manual
OHV	Over Head Valve
OM	Operators Manual
OPS	Oil Pressure Sensor
OTS	Oil Temperature Sensor
PCD	Pitch Circle Diameters
PCV	Pressure Control Valve
PMA	Permanent magnet alternator
POA	Production Organisation Approval
PS	Power supply
PTFE	Polytetrafluoroethylene (Teflon)
PTO	Power Take Off
Rev.	Revision

ROTAX®	is a trademark of BRP-Rotax GmbH & Co KG
RON	Research Octane Number
RON 424	ROTAX® Standard 424
s.v.	still valid (only Illustrated Parts Catalog)
S/N	Serial Number
SAE	Society of Automotive Engineers
SEP	Single Engine Piston
SB	Service Bulletin
SI	Service Instruction
SI-PAC	Service Instruction Parts and Accessories
SPST	Single pole single throw
STP	Shield twisted pair
SL	Service Letter
SMD	Surface Mounted Devices
TBO	Time Between Overhaul
TC	Type certificate
part no.	part number
TOA	Table Of Amendments
TOC	Table of content
TPS	Throttle Position Sensor
TSN	Time Since New
TSNP	Time Since New Part
TSO	Time Since Overhaul
V	Volt
VFR	Visual Flight Rules
LEP	List of Effective Pages
MM	Maintenance Manual
MEP	Multi Engine Piston
X3	Connector on Engine Management System wiring harness which serves as an interface for power supply
XXXX	shows the serial component number

1.3) Safety

Although reading such information does not eliminate any hazards, it promotes understanding, and applying the information will promote correct use of the engine. Always apply common workshop safety rules.

The information and descriptions of components and systems contained in this Manual are correct at the time of publication. BRP-Rotax maintains a policy of continuous improvement of its products without imposing upon itself any obligation to retrofit products previously manufactured.

Revisions

BRP-Rotax reserves the right to remove, replace or discontinue any design, specification, feature or other at any time, and without incurring obligation.

Measurement

Specifications are given in the SI metric system with the imperial and US customary measurement system equivalents in parenthesis.

Symbols used

This Manual uses the following symbols to emphasize particular information. This information is important and must be observed.

⚠ WARNING
Identifies an instruction which, if not followed, may cause serious injury or even fatal injury.

⚠ CAUTION
Identifies an instruction which, if not followed, may cause minor or moderate injury.

ATTENTION
Identifies an instruction which, if not followed, may severely damage the engine or could void any warranty.

NOTE

Indicates supplementary information which may be needed to fully complete or understand an instruction.

ENVIRONMENTAL NOTE

Environmental notes give you tips on environmental protection.

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

1.4) Safety information

Use for intended purpose

⚠ WARNING

Non-compliance can result in serious injuries or death!
Never fly the aircraft equipped with this engine at locations, air speeds, altitudes or in other situations which do not allow a successful no-power landing after sudden engine stoppage.

- This engine is not suitable for acrobatics (inverted flight, etc.). Flight attitudes outside the permissible limits are not allowed.
- This engine has exclusively been developed and tested for gyrocopter, pusher and tractor applications. In case of any other usage, the OEM is responsible for testing and the correct function of the engine.
- 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-Rotax grants no warranty on the suitability of its engine's use on any particular aircraft. Further, BRP-Rotax grants no warranty on 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!
For each use of DAY VFR, NIGHT VFR or IFR in an aircraft the applicable legal requirements and other existing must be adhered to.

- 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 a solo flight. 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 provided by the authorized distributors according to manufacturer specifications (iRMT).

Regulations

- Respect all legal requirements or local rules pertaining to flight operation in your flying area. Only fly 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 in the ROTAX® engine package. Verification to the latest regulations such as FAR or EASA has to be conducted by the aircraft manufacturer.

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)

- Since special training, tools and equipment are required, engine servicing shall only be performed by an authorized ROTAX® aircraft engine distributor or their independent service center. BRP-Rotax requires that any service or maintenance work be carried out and verified by a technician that has a current iRMT rating.
- When the engine will not be operated for a longer period protect the engine and fuel system from contamination and environmental exposure.

Engine operation

- Never operate the engine without sufficient quantities of operating fluids (oil, coolant, fuel).
- Never exceed the maximum permitted operational limits.
- In the interest of safety, the aircraft must not be left unattended while the engine is running.

- To eliminate the risk of injury or damage, ensure any loose equipment or tools are properly secured before starting the engine.
- Allow the engine to cool at idle for several minutes before turning off the engine.

Vacuum pump

- This engine may be equipped with a vacuum pump. The safety warning accompanying the vacuum pump must be given to the owner/operator of the aircraft into which the vacuum pump is installed.

Governor

- This engine may be equipped with a governor. The safety warning accompanying the governor must be given to the owner/operator of the aircraft into which the governor is installed.

1.5) Technical documentation

These documents form the instructions ensuring continued airworthiness of ROTAX® aircraft engines.
The information contained herein is based on data and experience that are considered applicable for authorized mechanics (iRMT, see Maintenance Manual Line) under normal conditions. Due to the fast technical progress and fulfillment of particular specifications of the customers it may occur that existing laws, safety prescriptions, constructional and operational regulations may not be sufficient or cannot be transferred completely to the object bought, in particular for special constructions.

Documentation

- Installation Manual
- Operators Manual
- Maintenance Manual (Line and Heavy Maintenance)
- Overhaul Manual
- Illustrated Parts Catalog
- Alert Service Bulletins
- Service Bulletins
- Service Instructions
- Service Instruction–Parts and Accessories
- Service Letters

Status

The status of Manuals can be determined by checking the table of amendments. The first column of this table indicates the revision status which should be compared with the revision provided on the ROTAX®-Website: www.FLYROTAX.com
Amendments and current versions can be downloaded free of change.

Replacement pages

Furthermore the Manual is constructed in such a way that single pages can be replaced instead of the complete document. The list of effective pages is given in the chapter LEP. The particular edition and revision number is given on the footer of each page.

Reference

Any reference to a document refers to the latest edition issued by BRP-Rotax if not stated otherwise.

This symbol informs you of additional references (data sheets, Manuals, etc.) associated with the given subject.

Illustrations

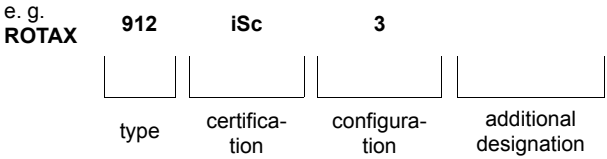
The illustrations in this Manual are merely sketches and show typical arrangements. They may not represent full detail or the exact shape of the parts but should outline the same or similar function. Therefore deriving dimensions or other details from illustrations is not permitted.
TYPICAL indicates a general view which may not represent exact details..

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. AE 5iS001) is of no significance for the content.

1.6) Type description

The type description is made up the following.



Designation

Designation		Description
Type	**912**	4-cyl. horizontally opposed, normally aspirated engine.
Certification	**iSc**	Certified to EASA CS-E (TC No. EASA. E.121).
	iS	Approved according to ASTM F2339
Configuration	**2**	Prop shaft with flange for fixed prop.
	3	Prop shaft with flange for constant speed propeller and drive for hydraulic governor for constant speed propeller.
Additional designation		standard version
	Sport	version with improved torque curve

2) Operating instructions

Topics in this chapter

2.1 Operating limits....2
2.2 Operating media-Coolant....5
2.3 Operating media-Fuel....6
2.4 Operating media-Lubricants....7

NOTE

ROTAX 912 i Series includes 912 iS, 912 iS Sport and 912 iSc Sport.

Introduction

The operating limits for certified engines are also given in the type certificate for the relevant engine type.
This chapter of the Operators Manual contains the operating limits that must be observed and adhered to while operating this type of engine.

2.1) Operating limits

General

ATTENTION
Monitor Operating limits. Limits must not be exceeded. If one or more operating limits are exceeded, the engine must be operated so that the values fall back into the allowed range. Carry out instructions for abnormal operation

performance is measured under following boundary conditions:

- Standard engine (without governor). Without auxiliary equipment (e.g. external alternator)
- Installation in accordance with installation guidelines (e.g. intake and exhaust system).

See latest Installation Manual for the engine type 912 i Series.

- ISA Condition(**I**nternational **S**tandard **A**tmosphere)

Engine speed

Parameter	
Take-off speed	5800 rpm (max. 5 min.)
Max. continuous speed	5500 rpm
Idle speed	min. 1400 rpm

Performance

Engine type	**912 iS**	**912 iS Sport**	**912 iSc Sport**
Take-off performance	73.5 kW (100 HP) at 5800 rpm	73.5 kW (100 HP) at 5800 rpm	73.5 kW (100 HP) at 5800 rpm
Max. continuous. performance	69 kW (93 HP) at 5500 rpm	72 kW (97 HP) at 5500 rpm	72 kW (97 HP) at 5500 rpm

Acceleration

Limit of engine operation at zero gravity and in **negative "g"** condition.

Parameter	Min.	Max.
Acceleration	–	–0.5 g (max. 5 seconds)

Static roll angle

Up to this value the dry sump lubrication system warrants lubrication in every flight situation.

Parameter	Min.	Max.
Static roll angle ß		40°

Oil pressure

Max.	7 bar (102 psi)

ATTENTION
For a short period admissible at cold start.

Min.	0.8 bar (12 psi) (below 3500 rpm)
Normal	2.0 to 5.0 bar (29-73 psi) (above 3500 rpm)

Oil temperature

Max.	130 °C (266 °F)
Min.	50 °C (120 °F)
Normal operating temperature	approx. 90 to 110 °C (190 – 230 °F)

Coolant temperature

Max.	120 °C (248 °F)

Exhaust gas temperature

Parameter	Min.	Max.
Exhaust gas temperature		950 °C (1742 °F)

Ambient temperature

Max. in flight	60 °C (140 °F) (manifold temperature)
Max. at start	50 °C (120 °F) (ambient temperature)
Min. at start	-20 °C (–13 °F) (oil temperature)

Fuel pressure

Parameter	Min.	Max.
Fuel pressure at fuel rail	2.8 bar (40.61 psi)	3.2 bar (46.41 psi)
Acceptable Fuel pressure exceedance (max. 3 sec.)	2.5 bar (36 psi)	3.5 bar (51 psi)

NOTE

Fuel pressure exceedance only allowed after power setting change.

Propeller governor

Power consumption of the hydraulic propeller governor	
Max.	600 W

External alternator

Power consumption of the external alternator	
Max.	600 W

2.2) Operating media-Coolant

ATTENTION

Obey the latest edition of Service Instruction SI-912 i-001, for the selection of the correct operating media.

Conventional coolant

Conventional coolant mixed with water has the advantage of a higher specific thermal capacity than water-less coolant.

Application

When correctly applied, there is sufficient protection against vapor bubble formation, freezing or thickening of the coolant within the operating limits.
Use the coolant specified in the manufacturer's documentation.

Mixture

ATTENTION

Obey the operating media manufacturer's instructions!

	Mixture ratio %	
Designation	**Concentrate**	**Water**
Conventional e.g. BASF Glysantine Protect Plus G48 anticorrosion	50	50

2.3) Operating media-Fuel

ATTENTION
Obey the latest edition of Service Instruction SI-912 i-001, for the selection of the correct operating media.

ATTENTION
Use only fuel suitable for the respective climatic zone.

NOTE

Risk of vapour formation when using winter fuel for summer operation.

Antiknock properties

Fuels with following specification can be used:

	Usage/Description
Anti knock properties	**912 i Series**
	Min. RON 95 (min. AKI[1] 91)

NOTE

For fuels according to ASTM D4814 specifications following AKI (Anti Knock Index) value has to be observed: min. AKI 91.

MOGAS

	Usage/Description
MOGAS	**912 i Series**
European standard	EN 228 super 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 i Series**
Aviation Standard	AVGAS 100 LL (ASTM D910)

1. Anti Knock Index (RON+MON)/2

2.4) Operating media-Lubricants

ATTENTION

Obey the manufacturer's instructions about the lubricants.
If the engine is mainly run on AVGAS more frequent oil changes will be required. See Service Information SI-912 i–001, latest edition.

Oil type

At the selection of suitable lubricants refer to the additional information in the Service Information SI-912 i-001, latest edition.

Oil consumption

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

Oil specification

- Use only oil with RON 424 classification

NOTE

The ROTAX® Norm 424 (RON 424) is a BRP-Rotax internal standard, which is only available on special request via the ROTAX® authorized distributor and will not be disclosed to third parties without prior consent.

- 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 clutch slippage during normal operation.
- Heavy duty 4-stroke motor cycle oils meet most of the requirements. These oils are normally not mineral oils but semi- or full synthetic oils.
- Conventional aircraft oils (a.d.=ashless dispersant) are not suitable. Oils with ashless dispersant do not have suitable cleaning agents for modern designs such as the ROTAX® 912 i Series.
- Oils primarily 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.

Table of lubrication

Since the temperature range of neighboring SAE grades overlap, there is no need for change of oil viscosity at short duration of ambient temperature fluctuations.

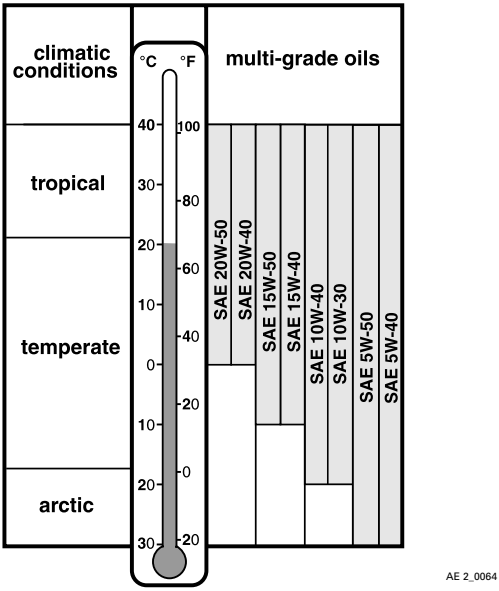


Figure 1: Temperature range

3) Standard operation

Topics in this chapter

3.1 Daily checks 2
3.2 Before engine start 5
3.3 Pre-flight checks 5
3.4 Engine start 6
3.5 After engine start 10
3.6 Engine run-up 10
3.7 Take-off 13
3.8 Cruising 13
3.9 Engine shut-off 13
3.10 Cold weather operation 14

Introduction

To warrant reliability and efficiency of the engine, meet and carefully observe all the operating and maintenance instructions.
The following description of procedures depends on the respective type of installation in the aircraft and shall therefore only be seen functionally.

NOTE

The control elements mentioned in this chapter are only symbolic and should support the understanding of the procedures. The execution of control elements is in the responsibility of the aircraft manufacturer.

3.1) Daily checks

Safety

To warrant reliability and efficiency of the engine, meet and carefully observe all the operating and maintenance instructions.

⚠ WARNING

Risk of burnings and scalds! Hot engine parts!
Conduct checks on the cold engine only!

⚠ WARNING

Non-compliance can result in serious injuries or death!
When performing checks which do not require ignition make sure that the ECU is turned off and the aircraft is secured to prevent unwanted engine starts.

ATTENTION

If established abnormalities (e.g. excessive resistance of the engine, noise etc.) inspection in accordance with the relevant Maintenance Manual is necessary. Do not release the engine into service before rectification.

Coolant level

ATTENTION

Operating media must be observed.
Inappropriate coolant quantity can lead to serious engine damage.

The specifications given in Chapter 2.2 must be adhered to when refilling coolant.

Step	Procedure
1	Verify coolant level in the **expansion tank**, replenish as required up to top. The max. coolant level must be flush with the bottom of the filler neck.
2	Verify coolant level in the **overflow bottle**, replenish as required. The coolant level must be between max. and min. mark.

ENVIRONMENTAL NOTE

Protect the environment!
Do not harm the environment by spilling coolant. Dispose coolant in an environmentally friendly manner.

Expansion tank

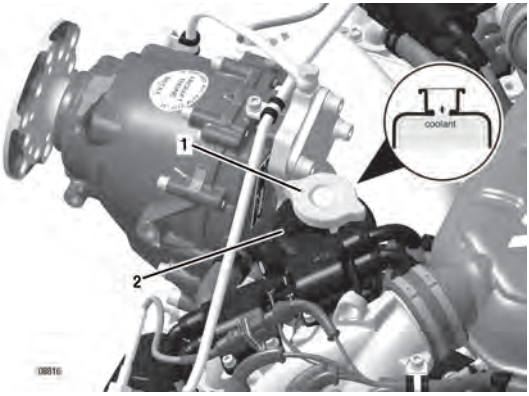


Figure 1: Expansion tank

1 Radiator cap *2 Expansion tank*

Overflow bottle

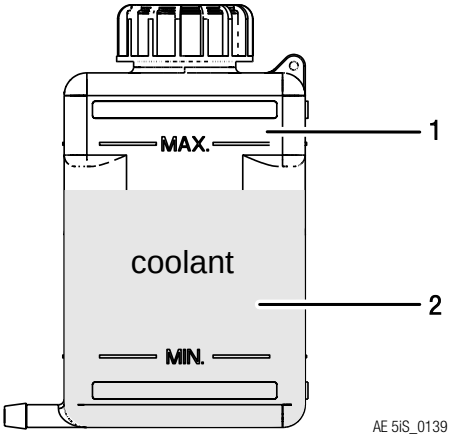


Figure 2: Overflow bottle

1 Overflow bottle *2 Coolant*

Mech./electronic components

Check of mechanical/electronic components.

Step	Procedure
1	Turn propeller slowly by hand in direction of engine rotation several times and observe engine for odd noises or excessive resistance and normal compression.
2	Verify free movement of throttle valve and the complete range.
3	Inspect for damages, leakage and general condition of exhaust system.
4	Visual inspection for mechanical and thermal damages of sensor, actuators and the wiring harness.

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!
MASTER SWITCH, LANE A and LANE B switch “OFF”. Before moving the propeller anchor the aircraft.

⚠ WARNING

Risk of burnings and scalds! Hot engine parts!
Conduct checks on the cold 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.

Oil level

ATTENTION

Operating media must be observed.
Inappropriate oil quantity can lead to serious engine damage.

The specifications given in Chapter 2.4 must be adhered to when refilling oil.

Step	Procedure
1	**NOTE** *Propeller shouldn't be turned in reverse of the normal direction of engine rotation.* Remove bayonet cap from the oil tank, turn the propeller slowly by hand in direction of engine rotation several times to pump oil from the engine into the oil tank.
2	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 rather the

Step	Procedure
	continuous pressure and the amount of gas which is transferred into the crankcase.
3	This process is finished when air is returning back to the oil tank and can be noticed by an audible gurgle from the open oil tank.
4	Check oil level and add oil if necessary. The oil level should be in the upper half (between the “50%“ and the “max“ mark) and should not fall below the “min.“ mark of the oil dipstick. 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). Oil consumption max 0.06 l/h (0.13 liq pt/h).
5	Re-install bayonet cap.

ENVIRONMENTAL NOTE

Protect the environment.
Do not harm the environment by spilling oil. Dispose of oil in an environmentally friendly manner.

3.4) Engine start

⚠ WARNING

Non-compliance can result in serious injuries or death!
Do not start the engine if any person is near the engine.

Engine start

Step	Designation	Procedure
1	Fuel valve.	open
2	Accomplish aircraft specific startup.	**activate Flight Display**
3	Master Switch.	**ON**
4	Fuel pump	**ON**

ATTENTION

Only switch on one fuel pump when starting the engine. Switching on both fuel pumps can lead to a bad start behavior.

Step	Designation	Procedure
5	Lane select Switch A. Lane select Switch B.	**ON**
6	Start Power Switch.	**Activate Start Power Switch** during steps 7, 8, 9 and 10.
7	Check of Warning Lamps.	Check if **Warning Lamps** illuminate and **extinguish** after around 3 seconds.

ATTENTION

When the voltage supply is switched on, both lamps are automatically subject to a function test. Both lamps illuminate for around 3 seconds and then extinguish.If one of the two warning lamps start to flash, fail to illuminate, or still illuminates after a few seconds, then this indicates an anomaly operation.

Step	Designation	Procedure
8	Engine instruments.	**Check** if **fuel pressure** has reached its fuel pressure **of 3 bar (43.5 psi)**.
9	Throttle valve.	Put throttle **between 1 to 2 cm throttle opening** (correlates with 55%-65% throttle valve opening).

ATTENTION

For more and detailed information on the throttle opening during engine start up see the diagram.

Step	Designation	Procedure
10	Starter button.	**Press** until the engine runs and release after engine has reached 1500 rpm or more (stable engine run).

ATTENTION

Activate starter for maximum of 10 seconds only (without interruption), followed by a cooling period of 2 minutes.

Step	Designation	Procedure
11	Throttle valve.	**Reduce throttle valve position as required.**
12	Engine instruments.	**Check status of warning lamps** and ensure compliance with the operating limits using the engine instruments. Check if **oil pressure** has risen within 10 seconds after engine start and **monitor oil** pressure..

ATTENTION

Increasing engine speed is only permitted at steady oil pressure readings above 3 bar (43.5 psi).

Step	Designation	Procedure
13	Throttle valve.	**Increase engine speed above 2500 rpm** and **hold for 5 seconds** (Generator B shifts to Generator A).

ATTENTION

If after the engine start a warning lamp flashes or lights up, perform a Lane and IGNITION check. After the Lane and IGNITION check both warning lamps must be deactivated, otherwise there is an error. If one of the lamps illuminates or flashes: abnormal operation.

Step	Designation	Procedure
14	Engine instruments.	**Check status of warning lamps** and ensure compliance with the operating limits using the engine instruments.

⚠ WARNING

Non-compliance can result in serious injuries or death!
Monitor operating limits. Limits must not be exceeded.

Engine start performance

Good engine start behavior will be achieved when setting the throttle at 50% (± 5%) during engine start. In the aircraft this number approximately corresponds to a throttle lever travel of 1-2 cm.

NOTE

These numbers depend strongly on the design and the actuation mechanism of the throttle leverage and will vary from aircraft to aircraft.

ATTENTION

Throttle must be reduced as required right after the engine start to avoid unnecessary high engine rpm, while the engine is still cold.

Diagram

For detailed information see following diagram.

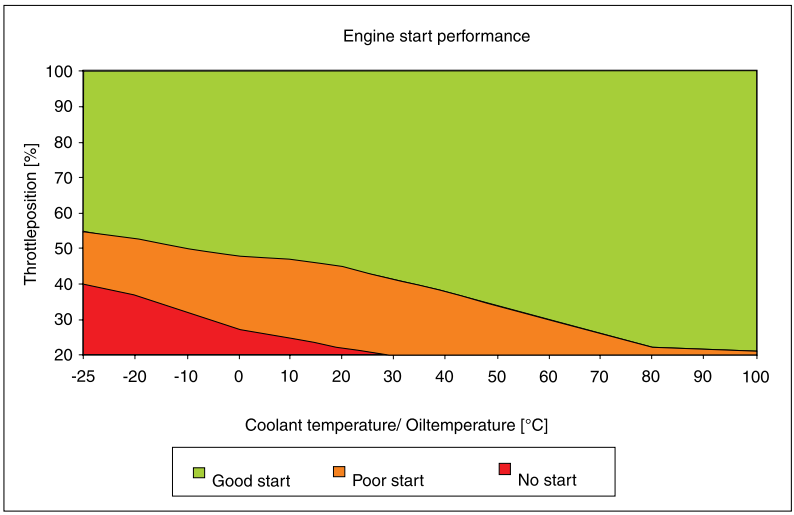


Figure 3: Diagram

3.5) After engine start

⚠ WARNING

Non-compliance can result in serious injuries or death!
Do not start the engine if any person is near the engine.

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 pressure.

3.6) Engine run-up

Ground test

ATTENTION

After a full-load ground test allow a short cooling run at idle speed 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 double ignition
Check the two ignition circuits at **4000 rpm** (approx. 1700 rpm propeller).
Lane and Ignition check:

ATTENTION

If the engine speed drops or any error messages are present from the EMS then find out what the cause is and take corresponding action to rectify the problem.

Step	Procedure
1	Rise engine speed up to 4000 rpm.
2	**Turn “OFF“ Lane selector Switch A**. Observe the rev counter.

ATTENTION
Engine speed should not drop/increase more than 250 rpm. If the fuel pressure is not within the limits, the cause must be determined. The engine must not be put into service until the problem is rectified.

Step	Procedure
3	**Turn “ON“ Lane selector Switch A.**
4	**Turn “OFF“ Lane selector Switch B**. Perform checks in same way as Lane A.
5	**Turn “ON” Lane select Switch B**.
6	Reduce to idle speed.

NOTE

Lane A and Lane B have different sensor inputs. During Lane and Ignition check, some sensor values are not displayed, depending on the activation of the Lanes.

Not available sensor values if Lane A = OFF and Lane B = ON:

- Coolant temperature
- Exhaust gas temperatures from cyl. 1-4
- Ambient temperature
- Throttle lever position

Not available sensor values if Lane B = OFF and Lane A = ON:

- Oil temperature
- Oil pressure

Check of fuel pumps

Verify that both fuel pumps are working and no loss of power or irregular running by deactivation of one fuel pump occurs. The limits for fuel pressure must not be exceeded.
Activate both fuel pumps (MAIN and AUX) for the take-off and landing.

Step	Procedure
1	Set engine speed to **2000 rpm**.
2	Deactivate auxiliary fuel pump for 5 seconds.
3	Check fuel pressure, then activate auxiliary fuel pump.
4	Deactivate main fuel pump for 5 seconds.
5	Check fuel pressure, then activate main fuel pump.

ATTENTION

If the fuel pressure is not within the limits, the cause must be determined. The engine must not be put into service until the problem is rectified.

Check the power output

To check the acceleration and available power, run the engine at full load with the aircraft stationary for a maximum of 10 seconds (refer to the Operators Manual of the aircraft for speed information, as it depends on the type of propeller being used).

Performance

Step	Procedure
1	Set performance as per performance specifications Chapter: Performance data and respect operating limits as per Chapter: Operating limits.
2	Carry out performance checks in accordance with the aircraft manufacturer regulations.

Propeller governor

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

Step	Procedure
1	Check governor control range (engine speed at 4300 rpm, approx. 1700 rpm propeller)

NOTE

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

3.7) Take-off

⚠ WARNING

Non-compliance can result in serious injuries or death!
Monitor Operating limits. Limits must not be exceeded.

Monitor oil temperature, oil pressure (**LANE select switch B** has to be activated) and coolant temperature (**LANE select switch A** has to be **activated**). See Chapter 2.1 Operating limits

Climb

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

3.8) Cruising

Oil temperature

Step	Procedure
1	Avoid operation below normal 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.

3.9) Engine shut-off

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.

Step	Procedure
1	Check the engine instruments.
2	Reduce engine speed down to idling.
3	**Deactivate** Lane select Switch B.
4	**Deactivate** Lane select Switch A.
5	Switch the fuel pumps “**OFF**“.
6	Shut-off according to the aircraft manufacturer regulations.
7	Set **main Switch** to “**OFF**“.

3.10) Cold weather operation

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

Coolant

For selection of coolant and mixing ratio, see Chapter 2.3.

Lubricant

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

Cold start

- As performance of electric starter is greatly reduced when hot, limit starting to periods not much longer than 10 sec.

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 if worn fit new spark plugs. See Maintenance Manual Line of the respective engine type.
3	Preheat engine.

Icing

Icing due to water in fuel.

ATTENTION

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 and without undrained low points
- Prevent condensation of humidity, i. e avoid temperature differences between aircraft and fuel

4) Abnormal operation

Topics in this chapter

4.1 EMS 3

4.2 Engine not responding to power inputs 5

4.3 Occurrence of uncharacteristic and severe engine vibrations 5

4.4 Re-Start during flight 5

4.5 Failure of the EMS power supply 5

4.6 Exceeding max. admissible engine speed 6

4.7 Exceeding of max. admissible coolant temperature 6

4.8 Exceeding of max. admissible oil temperature 6

4.9 Oil pressure below minimum – during flight 7

4.10 Oil pressure below minimum - on ground 7

4.11 Oil pressure above permitted range at low ambient temperatures 7

4.12 Engine on fire or fire in the engine compartment 8

4.13 Fuel pressure outside range 8

4.14 Exceeding of maximum permissible exhaust temperature 8

4.15 EMS voltage supply below the minimum required level 9

4.16 The sprag clutch fails to decouple from the starter 9

4.17 Troubleshooting 9

⚠ WARNING

Non-compliance can result in serious injuries or death!
Unless otherwise in this chapter stated, operating an engine with limited airworthiness is not permitted. Unscheduled maintenance action is required. At unusual engine behavior conduct checks as per maintenance Manual Line Chapter 05-50-00 before the next flight. Only qualified staff (authorized by the Aviation Authorities) trained on this particular engine, is allowed to carry out maintenance and repair work.

The following description of procedures depends on the respective type of installation in the aircraft and shall therefore only be seen functionally.

4.1) EMS

Warning lamps

HIC A**)	HIC B**)	Effect on engine	Proposed action on ground if warning lamp is persistent *)	Proposed action in flight *)
0 V	Oscillating 0-12 V	No effect on engine power, 2 systems available	Maintenance action required	Flight is possible to your destination at your own discretion.
Oscillating 0-12 V	0 V	No effect on engine power, 2 systems available	Maintenance action required	Flight is possible to your destination at your own discretion.
0 V	12 V	No effect on engine power, rely on alternate system	Maintenance action required	Flight is possible to your destination at your own discretion.
Oscillating 0-12 V	Oscillating 0-12 V	No effect on engine power, rely on alternate power supply system	Maintenance action required	Flight is possible to your destination at your own discretion.
Oscillating 0-12 V	12 V	No effect on engine power, rely on alternate system (oscillating system)	Maintenance action required	Flight is possible to your destination at your own discretion.
12 V	0 V	No effect on engine power, rely on alternate system	Maintenance action required	Flight is possible to your destination at your own discretion.

HIC A**)	HIC B**)	Effect on engine	Proposed action on ground if warning lamp is persistent *)	Proposed action in flight *)
12 V	Oscillating 0-12 V	No effect on engine power, rely on alternate system (oscillating system)	Maintenance action required	Flight is possible to your destination at your own discretion.
12 V	12 V	Loss of engine power possible (LOPC up to IFSD), system relies on default values and tries to maintain operation	Maintenance action required Flight not permissible	Flight is possible to your destination at your own discretion.

*) Pilot Action depends on installation relevant situation (SEP vs. MEP, operational conditions, additional installation provisions, etc.) and can not be determined at the engine manufacturing level and therefore must be established at the aircraft manufacture's level.
**) HIC A: Voltage between Terminal 2 and Terminal 8 (Warning Indicator A)
**) HIC B: Voltage between Terminal 2 and Terminal 10 (Warning Indicator B)

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

NOTE

An oscillating system indicates limited capability from the system (e.g. set value determination, diagnostics, etc.) however it still continues to be able to provide full engine power.

NOTE

If a warning indicator remains on permanently, it indicates that a error with higher severity (Failure) has been detected by the internal testing procedures of the ECU.
In this case, the ECU will continue to operate in an alternative control mode, which will transfer the control of ignition and injection to the error- free Lane. Regular operation as well as alternative control modes of the ECU are able to represent the full engine power. Differences arise only in the efficiency of the engine.
If limitations were exceeded, warning lamps may be reset by restart or lane check.

4.2) Engine not responding to power inputs

Engine not responding

Engine not responding to throttle inputs

- Possible breakage/blockage of throttle valve actuation/ linkage.
- Possible problem/influence of alternate air system.
- Limited flight operation with available power possible.
- A maintenance inspection should be carried out.

4.3) Occurrence of uncharacteristic and severe engine vibrations

Engine vibrations

- If the vibrations occur in conjunction with a loss of power then the engine may only be firing on 3 cylinders
- Limited flight operation
- A maintenance inspection should be carried out

4.4) Re-Start during flight

If the propeller continues to rotate during flight by windmilling, but the speed is not sufficient to start the engine, the electric starter can be used. It is not required to wait until the propeller stops rotating.

4.5) Failure of the EMS power supply

Failure of the EMS power supply

- If the EMS power supplies (alternator A) fails then the ECU automatically switches one-time over to the second EMS power supply (alternator B)

ATTENTION
No charging of battery!

- While alternator B runs, no power drop is recognizable
- Failure of both EMS power supplies (alternator A/B) result in engine stoppage. Remedy: Switch “ON“ the **Battery Backup Switch** (In this case the power supply is provided by the aircraft battery). Restart engine.
- Land the aircraft at the next available opportunity
- A maintenance inspection should be carried out

4.6) Exceeding max. admissible engine speed

Exceeding engine speed

Reduce the engine speed. Any exceeding of the max. admissible engine speed has to be entered by the pilot into logbook, stating duration and extent of over engine speed.

- A maintenance inspection should be carried out

4.7) Exceeding of max. admissible coolant temperature

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

Coolant temperature max.

Applicable for engine S/N with Suffix -01.

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

4.8) Exceeding of max. admissible oil temperature

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

Exceeding oil temperature

- Any exceeding of the max. oil temperature must be entered by the pilot in the logbook, stating duration and extent of over-temperature condition.
- A maintenance inspection should be carried out.

- Check the ECU error log file.

4.9) Oil pressure below minimum – during flight

ATTENTION

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

Oil pressure

Oil pressure below minimum - during flight

- Check oil system.
- A maintenance inspection should be carried out.
- Check the ECU error log file.

4.10) Oil pressure below minimum - on ground

ATTENTION

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

Oil pressure too low

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

- Check oil quantity in oil tank.
- Check oil quality. See Chapter: Operating media-Lubricants.
- A maintenance inspection should be carried out.

4.11) Oil pressure above permitted range at low ambient temperatures

ATTENTION

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

Oil pressure too high

- Reduce engine speed and check the oil pressure again once it has reached a higher oil temperature
- A maintenance inspection should be carried out
- Check the ECU error log file

4.12) Engine on fire or fire in the engine compartment

ATTENTION
Carry out emergency procedures as prescribed in the flight manual of the engine manufacturer.

- After landing locate the cause of fire and resolve the error before next flight by qualified staff (authorized by the Aviation Authorities)
- An entry in the logbook must be made
- A maintenance inspection should be carried out

4.13) Fuel pressure outside range

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

Exceeding fuel pressure

- If the pressure is too high, switch the AUX- pump OFF. If this has no effect then limited flight operation with reduced power is possible.
- If the pressure is too low, switch the AUX-pump ON. If this has no effect then limited flight operation with reduced power is possible.
- A maintenance inspection should be carried out.

4.14) Exceeding of maximum permissible exhaust temperature

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

Exceeding exhaust temperature

- Check the exhaust temperature sensors
- Oil and coolant limits must not be exceeded
- A maintenance inspection should be carried out

4.15) EMS voltage supply below the minimum required level

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

- Limited flight operation is possible if the voltage (alternator A or B) is OK here
- Proceed according to section: “Failure of the EMS power supply“ if this shows no effect
- A maintenance inspection should be carried out

4.16) The sprag clutch fails to decouple from the starter

ATTENTION
Shut down engine! Risk of fire and danger of the electric starter overheating.

- Move the throttle lever to the idle position.
- Set the EMS main switches to “OFF“.
- Switch both LANE select switches to “OFF“.
- A maintenance inspection should be carried out.

4.17) Troubleshooting

⚠ 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.

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

All checks in accordance with the Maintenance Manual 912 i Series, current issue.

Starting problems

Engine does not start

Possible cause	Remedy
Turn **OFF** the Lane select Switch A/B.	Turn **ON** the Lane select Switch A/B.
Turn **OFF** the **Master switch**.	Turn **ON** the **Master switch**.
Closed fuel selector/valve.	Open valve, clean or renew fuel filters, check fuel system for leaks.
No fuel in tank.	Refuel.
Fuel pumps	Set both to “**ON**”.
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; preheat engine.
Wrong fuel (Jetfuel or Diesel).	Change of fuel.

Knocking under load

Possible cause	Remedy
Octane rating of fuel too low.	Use fuel with higher octane rating.
Intake air temperature to high.	Reduce the power. Check air filter according to Maintenance Manual Line Chapter: 12–20–00.

Oil pressure

Low oil pressure

Possible cause	Remedy
Not enough oil in oil tank.	Refill oil.
Too hot oil.	Cool down oil.

Possible cause	Remedy
Too cold oil	Cover oil cooler or install thermostat.
Wrong viscosity of oil	Change oil to lower viscosity.

Oil level

Oil level is increasing

Possible cause	Remedy
Oil too cold during engine operation.	Cover oil cooler surface, maintain the oil temperature prescribed.
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 an oil 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 tank must be observed and the oil pressure 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 reading lower than 1 bar (15 psi) oils with lower viscosity are to be used. See SI-912 i-001, current issue.

NOTE

Oil pressure must be measured at idle at an oil temperature of minimum 50 °C (122 °F). Be sure the oil pressure does not go below minimum at idle.

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5) Performance and Fuel consumption

Topics in this chapter

5.1 Performance data 2

5.1) Performance data

The performance tables and performance graphs on the next few pages are intended to show you what kind of performance to expect from your engine in terms of power output. The indicated power can be achieved by following the procedures laid out in the Operators Manual and ensuring that the engine is well-maintained.

Performance data Engine 912 iSc/iS Sport

Performance data for standard conditions (ISA)

Providing engine speed over 5500 rpm is restricted to 5 minutes.

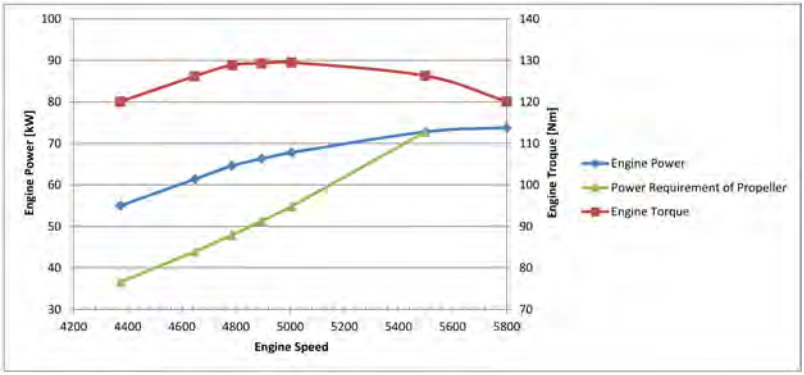


Figure 1: Performance data

Performance data Engine 912 iSc/iS

Performance data for standard conditions (ISA

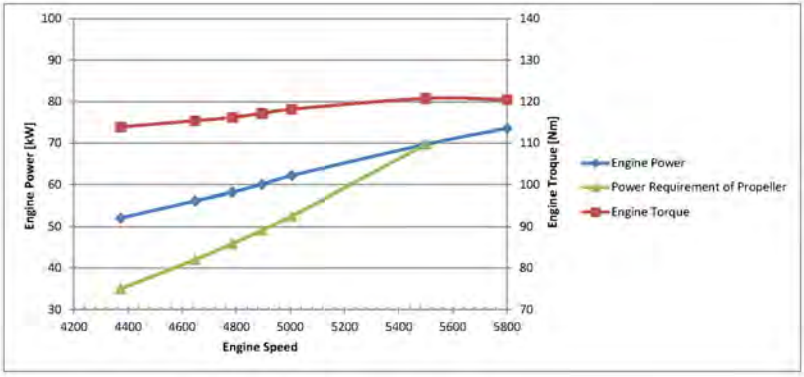
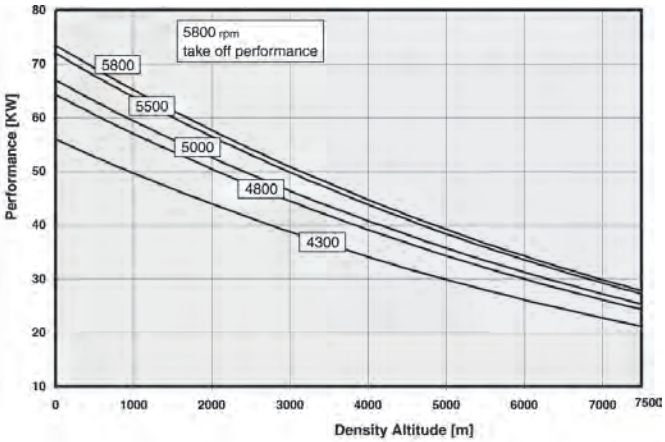


Figure 2: Performance data

Performance graph for non-standard conditions Engine 912 iSc/iS and 912 iS/iSc Sport

The following graph shows the performance drop with increasing flight altitude. The curves show the performance at 5800, 5500, 5000, 4800 and 4300 rpm, at full throttle.

At deviation of temperature conditions from standard atmosphere conditions the engine performance to be expected can be calculated from the performance indicated, multiplied by standard temperature, divided by actual temperature in °K.



$$P_{akt.} = P_{stand.} \frac{T_{standard}}{T_{aktuell}}$$

$$T\,[K] = t\,[°C] + 273$$

Figure 3: Performance graph

Further essential information regarding engine behavior see Service Letter SL-912 i-003, latest edition.

Performance data 912 iSc/iS Sport

Engine speed over 5500 rpm is restricted to 5 minutes. Run the engine in accordance with the following table.

Power setting	Engine speed (rpm)	Perform-ance (kW)/ (HP)	Torque	
			(Nm)	(ft. lb)
Take-off power	5800	73.5/100	121.4	89.54
max. continuous power	5500	72.02/ 97.9	126.4	93.23
75%	5000	54.0/73.4	103.1	76.04
65%	4800	46.7/63.5	93.3	68.81
50%	4300	35.9/48.8	78.5	57.90

Performance data 912 iSc/iS

Power setting	Engine speed (rpm)	Perform-ance (kW)/ (HP)	Torque	
			(Nm)	(ft. lb)
Take-off power	5800	73.5/100	121.0	89.24
max. continuous power	5500	69.0/92	119.8	88.36
75%	5000	51.8/69	98.7	72.79
65%	4800	44.9/60	89.5	66.01
50%	4300	34.5/46	75.3	55.53

Fuel consumption

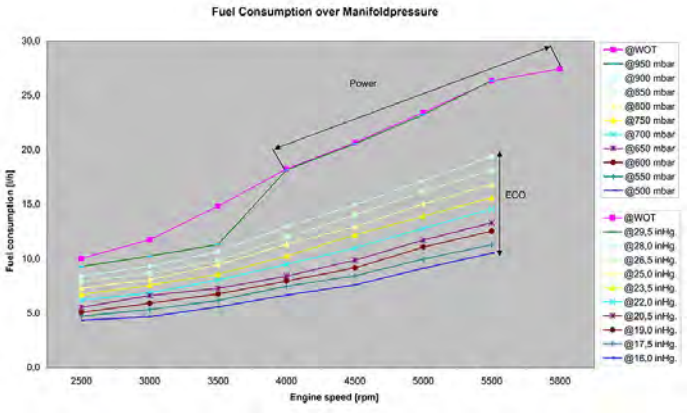


Figure 4: Fuel consumption

The indicated fuel consumption was determined at 974 hPa and is only valid for an error-free operation of the engine. Error may lead to a higher fuel consumption.

Power vs. ECO Modus

The 912 iSc/iS engine has two different modes, the POWER and ECO mode which differ significantly in fuel consumption.

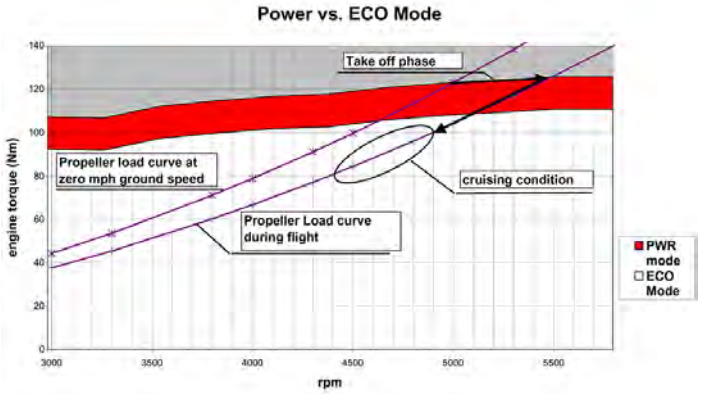


Figure 5: Power

NOTE

The switchover between ECO and RICH mode is about 97 % of throttle position. Appropriate display instruments indicate this threshold.

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6) Weights

Topics in this chapter

6.1 Weights-engine 2

The stated weights are dry weights (without operating fluids) and are guide values only.

Further weight information relating to the equipment can be found in the current Installation Manual for the engine type 912 i Series .

6.1) Weights-engine

Engine

- inclusive oil tank
- inclusive electric system: wiring harness, ECU, FUSE BOX and start relay
- exclusive of: engine suspension frame, exhaust system, fuel pumps assy., cooling baffle, radiator, oil cooler

912 iSc/iS
63,6 kg (140.2 lb)

7) System Description

Topics in this chapter

7.1 General specification 2
7.1.1 Basic specification 2
7.1.2 Technical data 2
7.1.3 Engine components 3
7.1.4 Cylinder arrangement 4
7.1.5 Direction of rotation 4
7.2 Cooling system 5
7.3 Fuel system 6
7.4 Lubrication system 9
7.5 Electric system 11
7.5.1 Engine Management System 12
7.5.2 Ignition control 13
7.5.3 Fuel injection control 14
7.5.4 Communication interfaces 14
7.6 Propeller gearbox 14

Introduction

This chapter of the Operators Manual contains information about the general engine specification as well as a description of cooling system, fuel system, lubrication system, electric system and the propeller gearbox.
The system description refers only to the engine and not to a specific application in a particular aircraft. The aircraft manufacturer's Operators Manual is therefore definitive in terms of the operation of the engine, as it contains all the aircraft specific instructions.

The design shown in this chapter does not represent a specified execution but should support the understanding of the system.

7.1) General specification

7.1.1) Basic specification

Basic

- 4- stroke-, 4 cylinder horizontally opposed-, spark ignition engine, single central camshaft push rods – OHV (Over Head Valve)
- Liquid cooled cylinder heads
- Ram air cooled cylinders
- Dry sump forced lubrication
- Fully redundant electronic engine management system (EMS) for controlling fuel injection, ignition, etc.
- Propeller drive via gearbox with integrated mechanical vibration absorber and overload clutch
- Oil tank
- Electric starter (12 V 0.8 kW)
- Fuel pump assy.

Optional

- Preparation for hydraulic governor for constant speed propeller (configuration 3 only)
- Exhaust system
- Cooling air baffle
- Engine suspension frame

7.1.2) Technical data

Description	912 i Series
Bore	84 mm (3.31 in)
Stroke	61 mm (2.40 in)
Displacement	1352 cm³ (82.5 in³)
Compression ratio.	10.8:1

7.1.3) Engine components

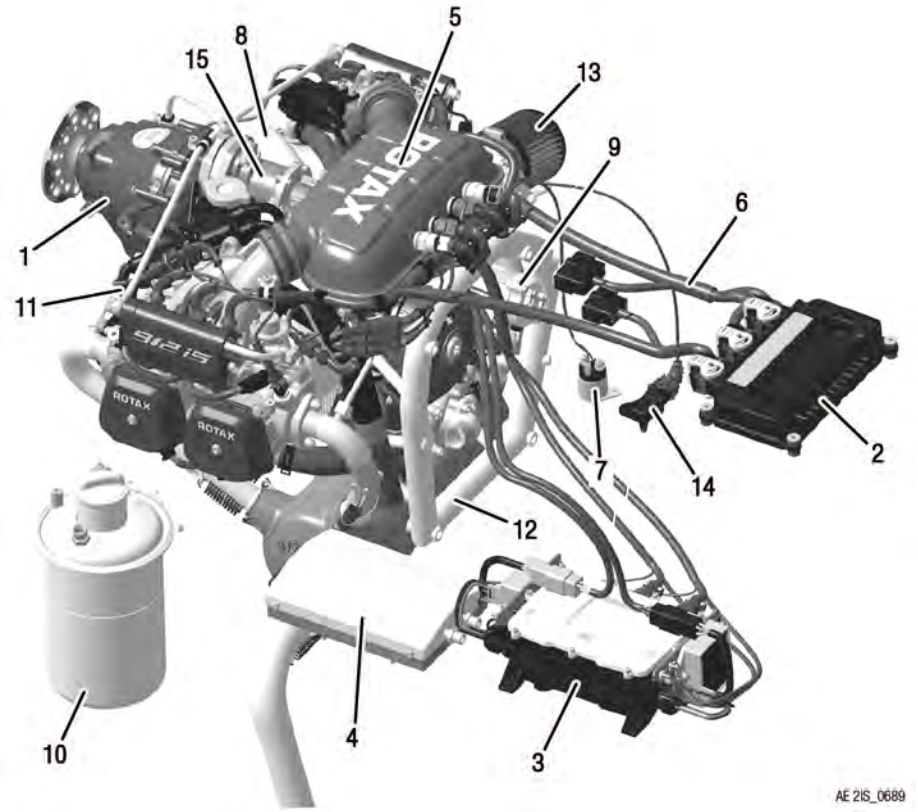

Figure 1: Engine components

1	*Propeller gearbox*	*2*	*ECU*	*3*	*Fusebox*
4	*Fuel pumps*	*5*	*Airbox*	*6*	*Wiring harness*
7	*Starter relay*	*8*	*Air baffle*	*9*	*Electric starter*
10	*Oil tank*	*11*	*Oil filter*	*12*	*Suspension frame*
13	*Air filter*	*14*	*Ambient Air Pressure Temperature Sensor*	*15*	*Hydraulic governor or vacuum pump*

7.1.4) Cylinder arrangement

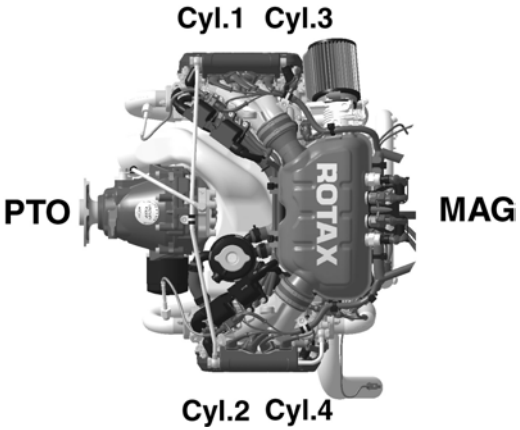

Figure 2: Cylinder arrangement

7.1.5) Direction of rotation

Direction of rotation on propeller shaft

Direction of rotation on propeller shaft: counter clockwise, viewed from the front.

Figure 3: Normal direction of propeller rotation (engine)

7.2) Cooling system

System Overview

The cooling system of the engine is designed for liquid cooling of the cylinder heads and ram-air cooling of the cylinders. The cooling system of the cylinder heads is a closed circuit with an expansion tank.

Coolant flow

The coolant flow is forced by a water pump, driven from the camshaft, from the radiator to the cylinder heads. From the top of the cylinder heads the coolant passes on to the expansion tank. Since the standard location of the radiator is below engine level, the expansion tank located on the top of the engine allows for coolant expansion.

Expansion tank

From the expansion tank the coolant is sucked back to the water pump. In common installations the coolant passes a radiator in between. Additionally the expansion tank is closed by a pressure cap (with excess pressure valve and return valve). At temperature rise of the coolant the excess pressure valve opens and the coolant will escape via hose at atmospheric pressure. In common installation this hose is connected to an overflow bottle. This overflow bottle allows that, when the engine is cooling down, the coolant will be sucked back into the cooling circuit.

Coolant temperature measuring

The coolant temperature sensor is located on cylinder head 4.

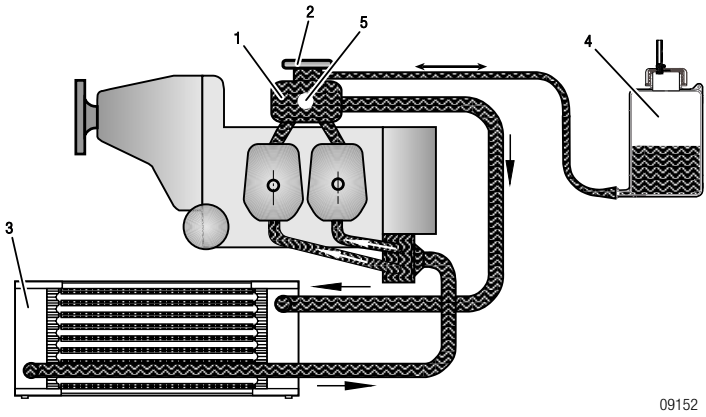

Figure 4: Cooling system (symbolic)

1 Expansion tank
2 Pressure cap
3 Radiator
4 Overflow bottle
5 Level glass

7.3) Fuel system

Fuel flow

The fuel flows from the tanks via a water separator/coarse filter to the electric fuel pumps (1) (connected in series) from where it is pumped thru the fine filter to the fuel rails (2, 4), the fuel injectors (3) and to the fuel pressure regulator (5)

Fuel pump switches

The fuel pumps are activated directly through the switch OFF/ON. During take off and landing both switches (main and aux.) must be ON.

Fuel pressure regulator

A fuel pressure regulator ensures that the pressure differential between the fuel injectors and the intake manifold remains constant. This enables the fuel injection system to inject the same quantity of fuel at any point given the same injection period.

Return line

Through the return line surplus fuel flows back to the fuel tank.

NOTE

The return line must be always returned into the tank, from which fuel is sucked into the fuel pump.

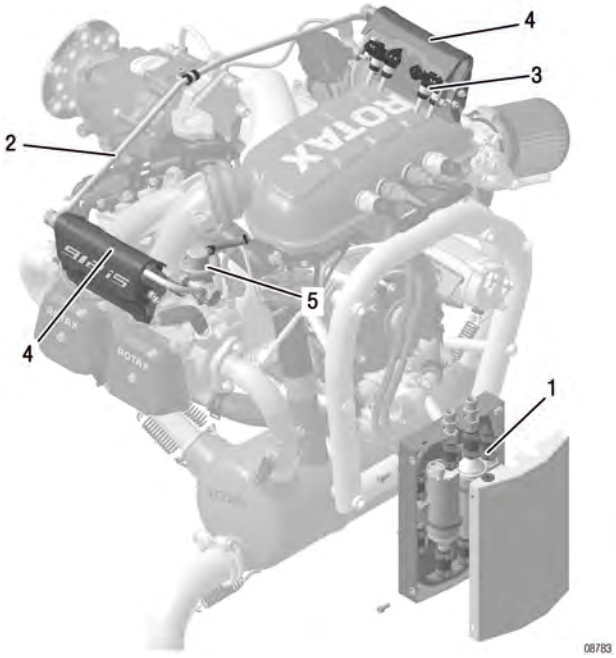

Figure 5: Fuel system

1	*Fuel pumps*	*2*	*Fuel hose*
3	*Fuel injector*	*4*	*Fuel rail*
5	*Fuel pressure regulator*		

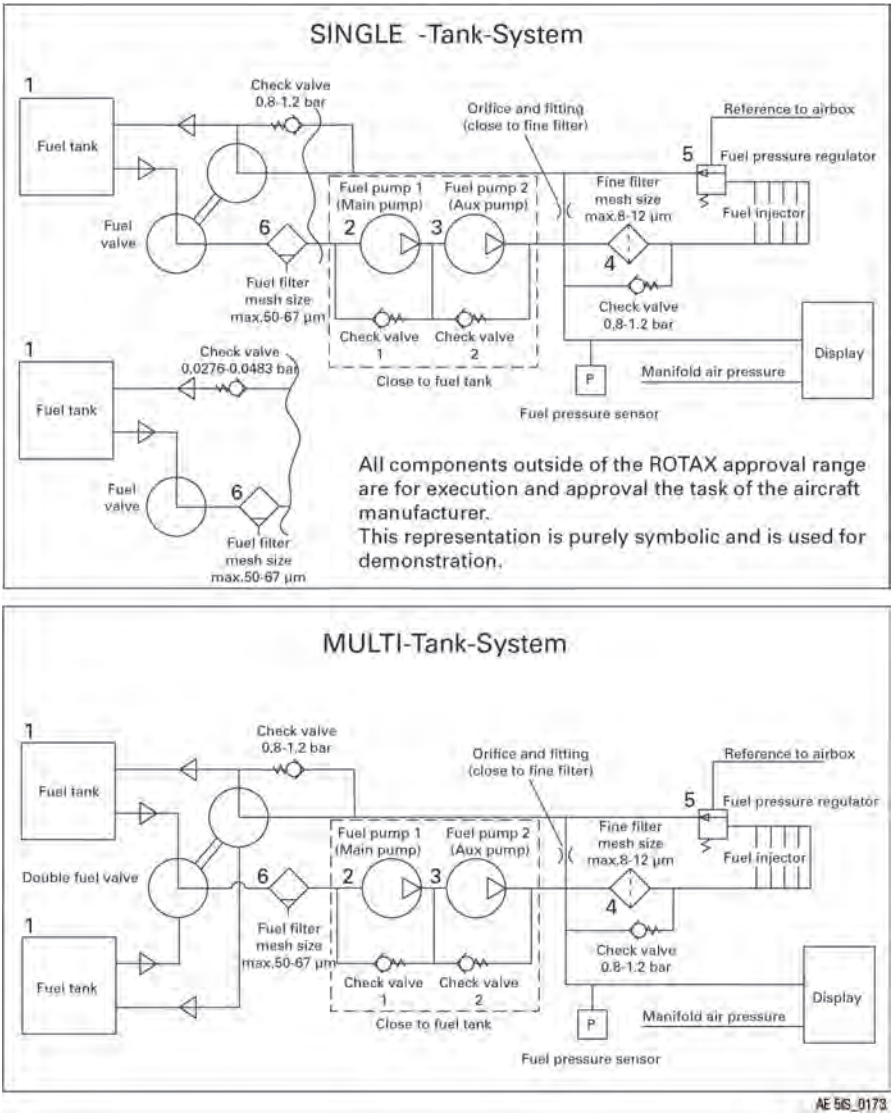

Figure 6: Fuel system

1	*Fuel tank*	*2*	*Fuel pump 1 (Main pump)*
3	*Fuel pump 2 (Aux pump)*	*4*	*Fine filter*
5	*Fuel pressure regulator*	*6*	*Coarse filter/water trap*

7.4) Lubrication system

The engine is provided with a dry sump forced lubrication system with a main oil pump with integrated pressure regulator.

Lubrication

The oil pump sucks the motor oil from the oil tank via the oil cooler and forces it through the oil filter 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 pump is driven by the camshaft.

Oil venting system

The oil circuit is vented via bore on the oil tank.

Oil temperature sensor

The oil temperature sensor for reading of the oil temperature is located on the crankcase, on the mag side of the engine.

Oil pressure sensor

The oil pressure sensor for reading of the oil pressure is located on the ignition housing.

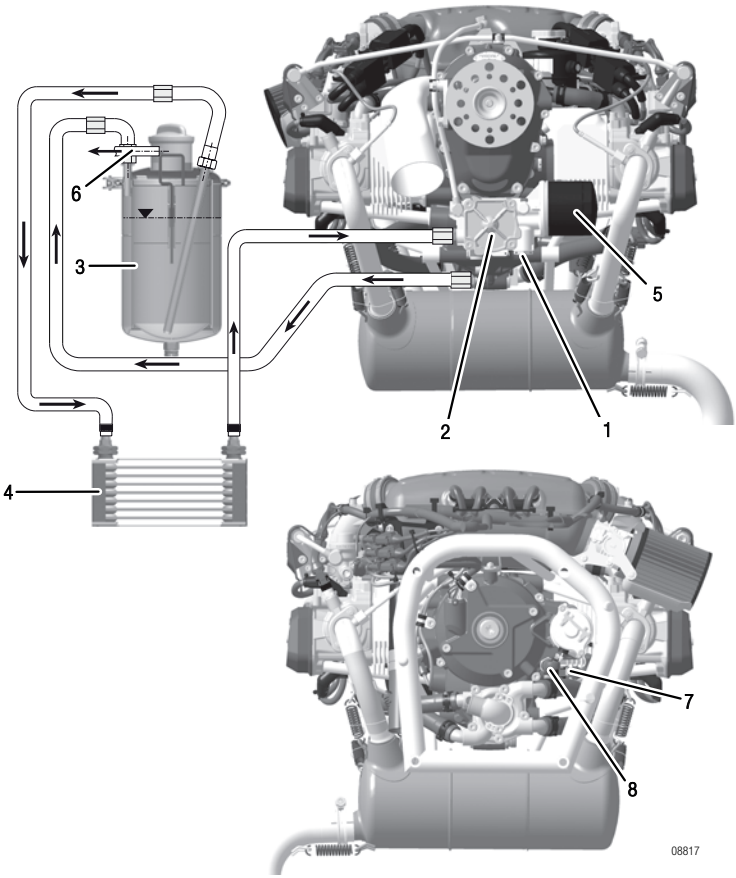

Figure 7: Lubrication system

1	*Pressure regulator*	*2*	*Oil pump*
3	*Oil tank*	*4*	*Oil cooler (optional)*
5	*Oil filter*	*6*	*Venting tube*
7	*Temperature sensor (oil)*	*8*	*Pressure sensor (oil)*

7.5) Electric system

This System is responsible for supplying the Engine Management System (EMS) and the Airframe with electrical power. It consists of the Fusebox with Regulators and the Internal Generators.

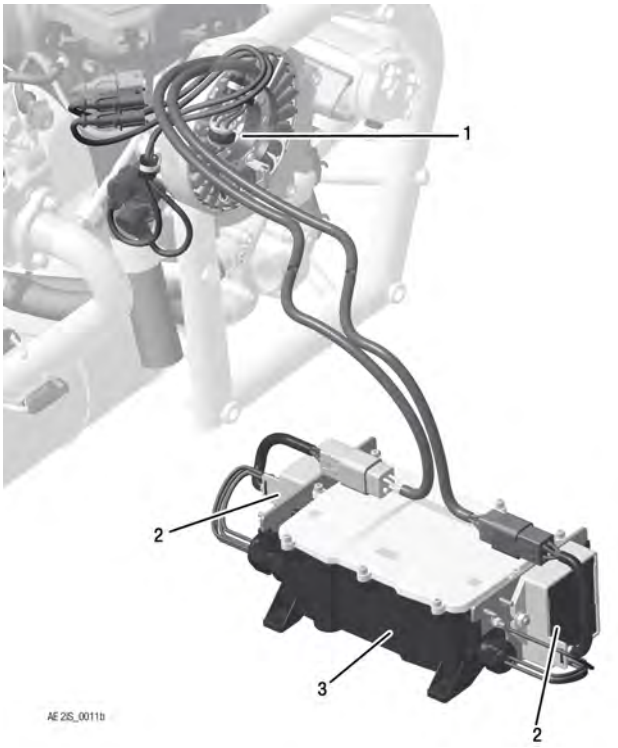

Figure 8: Internal power supply

1 Stator

2 Rectifier regulator A, B

3 Fusebox

Generators 1 and 2

The two generators (Generator 1 and Generator 2) are electrically isolated and mounted on one stator. Each generator is connected with a regulator mounted on the Fusebox. The Fusebox takes care of the energy management and allows selecting whether the EMS is supplied by an external power source (e.g. Battery) or one of the generators. The selection which of the generators is powering the EMS depends on the engine status and can only be done by the Engine Control Unit (ECU).
During the engine start an external power source is needed to power the EMS. After the engine speed is high enough to power the EMS with the Generator 2, for running the engine the external power source is only required in emergency situations. If a defined engine speed threshold has been reached for a certain time Generator 1 takes over to supply the EMS. After this, Generator 2 can be used to supply the Airframe (e.g. instrumentation). In no operation state Generator 1 can be used to supply the airframe

Malfunction

In case of an malfunction of Generator 1 the internal electric supply system changes to fail-safe mode where Generator 2 again is in charge to supply the EMS. In fail-safe mode Generator 2 is not able to charge external power sources or supply the airframe.

The EMS is not capable of supervising the power provided to the airframe. If the EMS is powered by Generator 1 and Generator B fails no indication is provided from engine side.

7.5.1) Engine Management System

The Engine Management System has following main functionality

- Ignition control
- Fuel injection control
- Fault detection
- (Internal-) Generator management

Parts

Parts of the Engine Management System are Sensors, Actuators, the ECU and the wiring harness. The core of the EMS is the engine control unit (ECU), which consists of two modules. These modules will be denoted by Lane A and Lane B, each one capable of taking over control, regulation and monitoring of the engine. In error-free engine operation, both Lanes are turned ON.
During engine control by Lane A, Lane B ensures that the engine operation can be maintained even after a failure or reduced functionality of Lane A. Depending on the activity and the failure status of the two Lanes, the ECU automatically selects a

Lane to take over control of the engine. A huge quantity of sensors (e. g. sensors for measuring the pressure in the airbox) and actuators (e. g. ignition coils) of the engine are designed with redundancy. In this case, each of the sensors or actuators is connected to a Lane, so that the two Lanes have the same measurement values and send the same output signals. Non-redundant sensors (e. g. oil pressure sensors) are connected to one Lane only and serve for the expanded monitoring of the engine functionality. Due to an ECU internal communication, these sensor values will be exchanged between the two Lanes (assuming that both Lanes are active and free of errors).

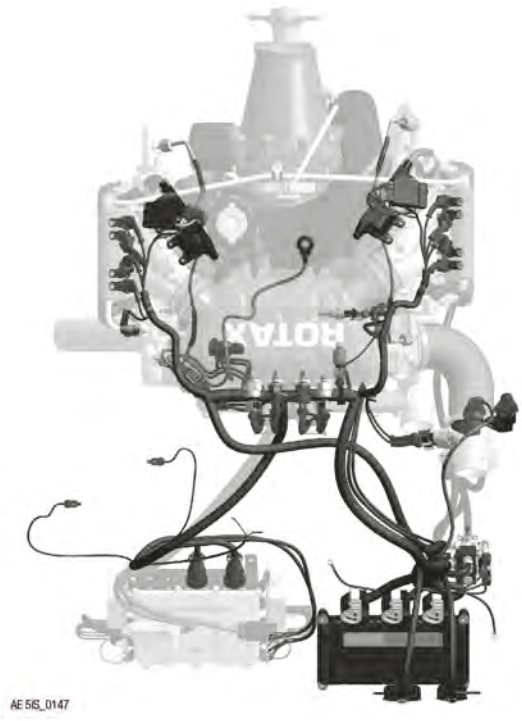

Figure 9: Management System

7.5.2) Ignition control

The 912 iSc/iS Sport is equipped with 4 double ignition coils. The ignition system is almost entirely wear-free, as the ECU generates and processes the ignition signal electronically.

Firing sequence 1-4-2-3.

7.5.3) Fuel injection control

The engine is equipped with an electronic fuel injection system. This system is controlled by the ECU and enables highly accurate metering of the fuel according to operating and load conditions, whilst at the same time also taking ambient conditions into account.
The key input variables are throttle valve position, engine speed signal, intake air temperature, ambient pressure, manifold pressure and exhaust temperature. Ultimately, the required fuel quantity or injection period is determined on the basis of the calculated air density in the airbox. It is monitored continuously.

7.5.4) Communication interfaces

Each Lane has a maintenance and a display interface (CAN-bus). While the maintenance interface is required to work with the BUDS Aircraft Diagnostic Software to perform various diagnostic and maintenance activities, the display CAN interface enables the connection of a display for visualization of engine parameters.

B.U.D.S Software

For engines of the ROTAX® 912 i Series, the maintenance and BUDS Aircraft Diagnostic Software is available. This provides not only the reading of ECU logs, it also provide a variety of functionality to support troubleshooting of the engine. To start this software and connect the engine with a computer a BUDS Aircraft Diagnostic Software kit is required. This is a hardware interface that provides different software functionality depending on its version.

7.6) Propeller gearbox

Reduction ratio

For the engine type 912 iSc/iS Sport one reduction ratio is available.

Reduction ratio	912 iSc/iS Sport
crankshaft: propeller shaft	2.43:1

Governor

Alternatively a hydraulic governor for constant speed propeller can be used. The drive is via the propeller reduction gear.

8) Preservation and storage

Topics in this chapter

8.1 Engine preservation and storage 2
8.2 Engine back to operation 3

Safety

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

As well as the maintenance and special checks, see Maintenance Manual Line for the engine type 912 I Series.

⚠ 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

Other useful information for service and airworthiness of your engine you'll find on www.rotax-owner.com.

ATTENTION

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

8.1) Engine preservation and storage

⚠ WARNING

Risk of burnings and scalds! Hot engine parts!
Conduct checks on the cold engine only!

Due to the special material of the cylinder wall, there is no need for extra protection against corrosion for ROTAX® aircraft engines. At extreme climatic conditions and for long out of service periods we recommend 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	Shut-off engine.
3	Allow the engine to cool down.
4	Change oil.
5	Remove the top spark plugs and spray into openings with corrosion inhibiting oil.
6	Turn the propeller several times by hand in direction of the engine rotation, so that the corrosion inhibiting oil reaches all necessary points.
7	Install the spark plug in accordance to the Maintenance Manual.
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.

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9) Supplement

Topics in this chapter

9.1 Form 2

See Form.

According to the regulation of EASA part 21.A.3 the manufacturer shall evaluate field information and report to the authority. In case of any relevant occurrences that may involve malfunction of the engine, the form on the next page should be filled out and sent to the responsible ROTAX® authorized aircraft engines distributor or their independent Service Center.

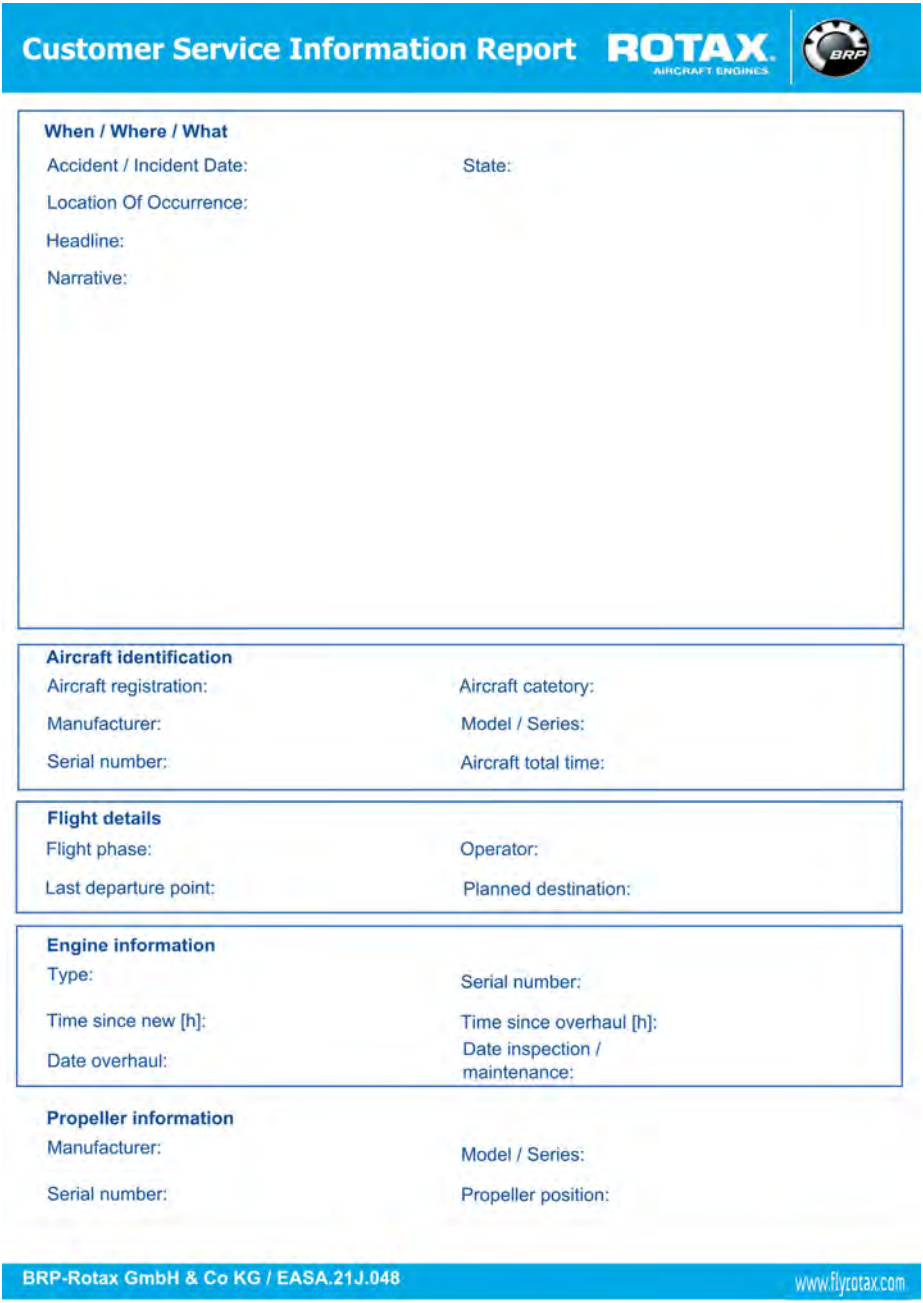
NOTE

The form is also available from the official ROTAX® AIRCRAFT ENGINES Website in electronic version.

Authorized Distributor

Overview of ROTAX® authorized aircraft engines distributor or their independent Service Center.
Refer to the official ROTAX® AIRCRAFT ENGINES Website www.FLYROTAX.com.

9.1) Form



Customer Service Information Report

ROTAX AIRCRAFT ENGINES

When / Where / What

Accident / Incident Date:

State:

Location Of Occurrence:

Headline:

Narrative:

Aircraft identification

Aircraft registration:

Aircraft catetory:

Manufacturer:

Model / Series:

Serial number:

Aircraft total time:

Flight details

Flight phase:

Operator:

Last departure point:

Planned destination:

Engine information

Type:

Serial number:

Time since new [h]:

Time since overhaul [h]:

Date overhaul:

Date inspection / maintenance:

Propeller information

Manufacturer:

Model / Series:

Serial number:

Propeller position:

BRP-Rotax GmbH & Co KG / EASA.21J.048

www.flyrotax.com

Figure 1: Form

10) Proper disposal

ENVIRONMENTAL NOTE

Please observe the disposal regulations applicable in your area.

General

All old/used parts, liquids and chemical agents have to be disposed of according to local ordinance regulations.

Packaging

The disposal of the packaging is the customer's responsibility and has to take place in accordance with the current regulations of the country in which it has been removed.

Liquids

- Engine oil:
  Dispose of engine oil at the respective oil collecting point or hand it over to an approved disposal company
- Coolant:
  Dispose of coolant at the respective collecting point or hand it over to an approved disposal company
- Fuel:
  Dispose of fuel at the respective collecting point or hand it over to an approved disposal company

⚠ WARNING

Flammable material must be placed at a sufficient distance from all sources of ignition, direct and strong sunlight, spotlights and heating devices, so that it cannot be ignited by such items.

ENVIRONMENTAL NOTE

Observe the safety instructions of the manufacturer of hazardous substances (coolant, oil) or fuels and the applicable regional waste disposal regulations.

ENVIRONMENTAL NOTE

Work with the utmost care to ensure that no water pollutants can penetrate into the soil, water or the sewerage system.

Old/used parts	Please return old/used parts (not periodic maintenance parts) from ROTAX® aircraft engines F.O.B to ROTAX® Authorized Distributors or their independent Service Centers.
Chemical agents (cleaner, LOCTITE etc.)	Please observe the safety and disposal instructions of the manufacturer.

A

Abbreviations 3
Abnormal operation.....1
After engine start 10

B

Basic specification 2
Before engine start.....5

C

Cold weather operation 14
Communication interfaces 14
Cooling system.....5
Cruising 13
Cylinder arrangement.....4

D

Daily checks 2
Direction of rotation.....4
disposal 1

E

Electric system 11
EMS 3, 9
Engine back to operation 3
Engine components 3
Engine Management System.....12
Engine preservation and storage.....2
Engine run-up.....10
Engine shut-off 13
Engine start.....5
Engine vibrations 5
Engine, Start 6
Exceeding engine speed 6
Exceeding of max. admissible coolant temperature 6
Exceeding oil temperature 6
Exhaust temperature exceeded 8

F

Failure, EMS 5
Fire, Engine, compartment 8
Form.....2
Fuel injection control 14
Fuel pressure, outside range 8
Fuel system.....6

G

General.....2
General specification.....2

I

Ignition control 13

L

List of effective pages.....1
Lubrication system 9

O

Oil pressure.....7
Oil pressure below minimum.....7
Oil pressure below minimum - on ground 7
Operating limits.....2
Operating media-Coolant 5
Operating media-Fuel 6
Operating media-Lubricants.....7

P

Performance data 2

Power inputs 5
Pre-flight checks 5
Propeller gearbox 14

R

Re-Start during flight 5

S

Safety notice 7, 9
Sprag clutch, Starter 9
Start.....13

T

Table of amendments.....1
Take-off.....13
Technical data 2
Technical documentation 12
Terms 3
Trouble shooting.....9
Type description 14

W

Weights, Engine, Accessories.....2

ROTAX®
AIRCRAFT ENGINES

_____

Engine serial no.

_____

Type of aircraft

_____

Aircraft registration no.

ROTAX® authorized distributor

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