OPERATORS MANUAL

FOR ROTAX ENGINE TYPE 915 i A / C24 SERIES

REF NO.: OM-915 i A / C24 I PART NO.: **898851**

A BRP BRAND

⚠ 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

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INTRO) Introduction

Topics in this chapter

Foreword

BRP-Rotax GmbH & Co KG (hereinafter “BRP-Rotax”) provides “Instructions for Continued Airworthiness”, which are based on the design, 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	July 01 2021
	2	July 01 2021
LEP	1	July 01 2021
	2	July 01 2021
TOA	1	July 01 2021
	2	July 01 2021
1	1	July 01 2021
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	Index	
	rear page	

TOA) Table of amendments

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

Edition 0/Rev. 0	December 01 2017	
Revision 1	June 01 2019	
Revision 2	Dec. 01 2020	Obsolete with Revision 3, which is a complete re-revision
Revision 3	July 01 2021	

rev. no.	chapter	page	date of change	remark for approval	date of approval from authorities	date of inclusion	signature
0	INTRO	all	Dec. 01 2017	DOA*			
0	LEP	all	Dec. 01 2017	DOA*			
0	TOA	all	Dec. 01 2017	DOA*			
0	1 up to 10	all	Dec. 01 2017	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	1–14	June 01 2019	DOA*			
1	3	3–13, 3–16 up to 3–20	June 01 2019 June 01 2019	DOA* DOA*			
1	4	4–3, 4–4	June 01 2019 June 01 2019	DOA* DOA*			
1	5	5–2	June 01 2019	DOA*			

rev. no.	chapter	page	date of change	remark for approval	date of approval from authorities	date of inclusion	signature
1	7	7–2, 7–3, 7–8 7–17	June 01 2019 June 01 2019 June 01 2019 June 01 2019	DOA* DOA* DOA* DOA*			
1	8	8–1	June 01 2019	DOA*			

rev. no.	chapter	page	date of change	remark for approval	date of approval from authorities	date of inclusion	signature
2	LEP	all	Dec. 01 2020	DOA*			
2	TOA	all	Dec. 01 2020	DOA*			
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rev. no.	chapter	page	date of change	remark for approval	date of approval from authorities	date of inclusion	signature
3	LEP	all	July 01 2021	DOA*			
3	TOA	all	July 01 2021	DOA*			
3	1	1–15	July 01 2021	DOA*			

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3	2	2–3, 5	July 01 2021	DOA*			
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3		to 3–10	July 01 2021	DOA*			
3	4	all	July 01 2021	DOA*			
3	7	7–4,	July 01 2021	DOA*			
3		7–11	July 01 2021	DOA*			
3		7–14	July 01 2021	DOA*			
3	8	8–2	July 01 2021	DOA*			

Summary of amendments

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

rev no.	chap-ter	page	date of change	comments
1	1	1–14	June 01 2019	New configuration 2
1	3	3–18	June 01 2019	Fuel pump check: Text correction
1	4	4–3	June 01 2019	New: EMS Warning lamps
1	5	5–2	June 01 2019	Performance data and fuel consumption: Text correction
1	7	7–3	June 01 2019	New figure
		7–8	June 01 2019	New figure
		7–17	June 01 2019	New text

rev no.	chap-ter	page	date of change	comments
2	1	1–15	Dec. 01 2020	Text change
2	2	2–3	Dec. 01 2020	Text change
2		2–4	Dec. 01 2020	Text change
2	3	3–3	Dec. 01 2020	New figure
2		3–5	Dec. 01 2020	Text change
2		3–6	Dec. 01 2020	Text change
2		3–9	Dec. 01 2020	New diagram
2		3–14	Dec. 01 2020	Text change
2	4	4–6	Dec. 01.2020	Text change
2	9	9–2	Dec. 01 2020	New form

rev no.	chap-ter	page	date of change	comments
3	1	15	July 01 2021	New additional designation of engine type (C24)
3	2	3, 4,6	July 01 2021	
3	3	6 up to 23	July 01 2021	New text
3			July 01 2021	Text change
3	4	4–7	July 01 2021	Text change
3	7	9	July 01 2021	Text change
3		4,12,13	July 01 2021	New figure
3		16	July 01 2021	Text change, New figure
3	8	2,3	July 01 2021	Text change

1) General note

Topics in this chapter

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.

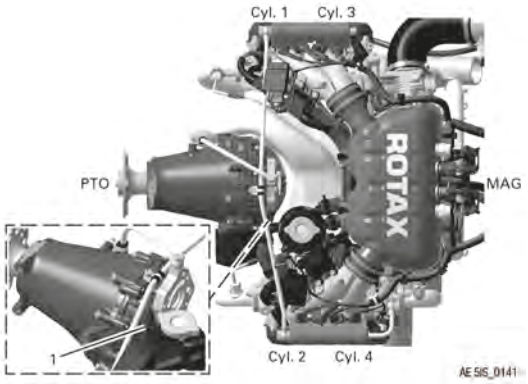


Figure 1: Pos. 1: Engine serial number

1.2) Abbreviations and terms (depending on respective engine type)

Abbreviations	Description
*	Reference to another section
	center of gravity
	The drop symbol indicates use of sealing agents, adhesives or lubricants (only in the Maintenance Manual Heavy)
°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
AC-DC	EMS Modul voltage converter
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
CCS	Camshaft position sensor
Coil 1–4	Ignition coils 1–4
CPS 1+2	Crankshaft Position Sensor 1+2

Abbreviations	Description
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

Abbrevia-tions	Description
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 Technician
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	Outside Air Temperature
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

Abbreviations	Description
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	Shielded twisted pair wire
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 Contents
TPS	Throttle Position Sensor
TSN	Time Since New
TSNP	Time Since New Part
TSO	Time Since Overhaul
V	Volt

Abbreviations	Description
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 component serial 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 regulations 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.

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

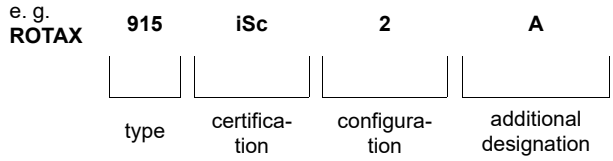
The illustrations in this Manual are merely sketches and show typical arrangements. They may not represent full detail or the exact shape of the parts but should outline the same or similar function. Therefore deriving dimensions or other details from illustrations is not permitted.
TYPICAL indicates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



Designation

Designation		Description
Type	**915**	4-cylinder horizontally opposed, turbo-charged engine.
Certification	**iSc**	Certified to EASA CS-E (TC No.EASA. E.121)
	iS	Approved to according ASTM F2339.
Configuration	**2**	Propeller shaft with flange for fixed pitch propeller.
	3	Propeller shaft with flange for constant speed propeller and drive for hydraulic governor for constant speed propeller.
Additional designation	**A**	Standard version
	C24	24 Volt Board Net Supply Version

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2) Operating instructions

Topics in this chapter

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

Engine speed

Parameter	Min.	Max.
Engine speed at idle	1800 rpm	–
Engine speed	–	5800 rpm (max. 5 minutes)

Performance

The engine performance is approximately proportional to the airflow value and can be calculated as follows:
Observed Power [kW] ~-6.3264+0.0169*Airflow [g/min]

Parameter	Min.	Max.
Take-off Performance (engine speed: 5800 rpm)	–	104 kW
Continuous Performance (engine speed: 5500 rpm)	–	99 kW (without governor)
Critical Altitude (MAT: max. 50 °C (120 °F))	–	15000 ft

NOTE

The max. Continuous performance is available up to the critical altitude.

Parameter	Min.	Max.
Operating Altitude	–	23000 ft

The engine performance is approximately proportional to the air flow value.

The air flow information is available on the Display CAN Bus.

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

The dry sump lubrication system warrants lubrication in every flight situation

Parameter	Min.	Max.
Static roll angle ß	–	40°

Manifold temperature

915 Type A

Parameter	Min.	Max.
Manifold temperature	–	50 °C (122 °F)

Manifold temperature

915 Type C24

Parameter	Min.	Max.
Manifold temperature (Note*)	–	50 °C (122 °F)
Extended Manifold temperature (Note**)	> 50 °C (122 °F)	80 °C (176 °F)

Note* rated power performance is provided
Note** reduced power performance as provided in section "Extended Manifold Temperature Range – Power Performance Impact"

Extended Manifold temperature range

915 Type C24

Power Performance Impact

Power Performance	Continuous Performance	Take-Off Performance
Resulting Power reduction	- 1 kW	- 2.7 kW

Manifold pressure

Parameter	Min.	Max.
Manifold pressure	60 hPa (1.77 in. HG)	1730 hPa (51 in. HG)

NOTE

Target pressure at a temperature from 25 °C (77 °F) to 35 °C (95 °F):
5800 rpm 1520 mbar
5500 rpm 1450 mbar
1730 mbar is the “not to exceed” value which is needed by the boost pressure control in special situations (e.g. 75 °C (167 ° F)).

Boost pressure

Parameter	Min.	Max.
Boost pressure	ambient pressure	1730 hPa (51 in. HG)

Oil pressure

Parameter	
Normal operating range above 3500 rpm	2.0 to 5.0 bar (29 – 72.5 psi)
Minimum below 3500 rpm	0.8 bar (11.6 psi)
At cold start and warming up period (maximum)	7.0 bar (101.5 psi)

Oil temperature

Parameter	Min.	Max.
Engine start	-20 °C (-4 °F)	–
Take-off	50 °C (122 °F)	–
Normal operation	50 °C (122 °F)	130 °C (266 °F)

ATTENTION

Operating the engine below (90 to 110 °C / 194 to 230 °F) may lead to formation of condensation water in the lubrication system. To evaporate possibly accumulated condensation water, at least once a day 100 °C (212 °F) oil temperature must be reached.

Coolant temperature

Parameter	Min.	Max.
Coolant temperature at ground idle, start procedure and warm up	-20 °C (-4 °F)	–
Coolant temperature at normal operation	–	120 °C (248 °F)

Exhaust gas temperature.

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

EGT-Split

EGT- Split is the difference between the actual highest EGT value of the actual lowest EGT value.

Parameter	Min.	Max.
EGT-Split at > 3 Liter/hour (Fuel consumption).	–	200 °C (392 °F)
EGT-Split at < 3 Liter/hour (Fuel consumption).	–	500 °C (932 °F)

Ambient temperature

Parameter	Min.	Max.
Ambient temperature at ground idle, start procedure and warm up.	–	50 °C (122 °F)
Ambient temperature at normal operation	- 40 °C (- 40 °F)	50 °C (122 °F)

Fuel pressure

Parameter	Min.	Max.
Fuel pressure at fuel rail	2.9 bar (42 psi)	3.2 bar (46 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.

2.2) Operating media-Coolant

ATTENTION
Obey the latest edition of Service Instruction SI-915 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 waterless 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 manufacturers documentation.

Mixture

ATTENTION
Obey the operating media manufacturer's instructions!

2.3) Operating media-Fuel

ATTENTION
Obey the latest edition of Service Instruction SI-915 i-001, for the selection of the correct fuel.

ATTENTION
Use only fuel suitable for the respective climatic zone.

NOTE

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

Antiknock properties

Fuels with following specification can be used:

	Usage/Description
Anti knock properties	**915 iSc/iS**
	Min. RON 95

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	**915 iSc/iS**
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	**915 iSc/iS**
Aviation Standard	AVGAS 100 LL (ASTM D910)

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-915 i-001, latest edition.

Oil type

For the selection of suitable lubricants refer to the additional information in the Service Information SI-915 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 all the requirements. These oils are normally not mineral oils but semi- or full synthetic oils.

- 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.

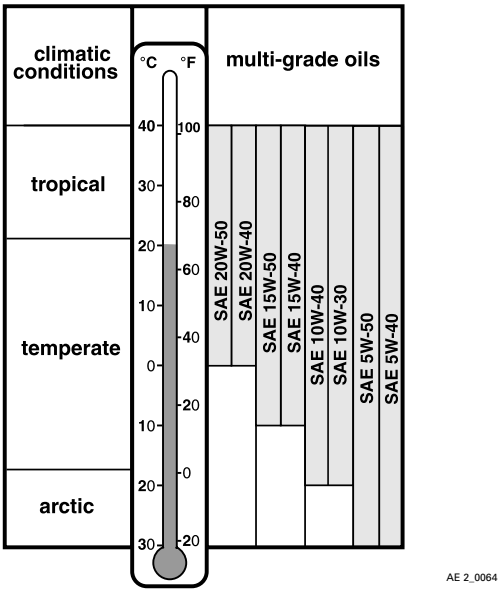

Figure 1: Temperature range

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3) Standard operation

Topics in this chapter

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 burns and scalds! Hot engine parts!
Conduct checks on 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.

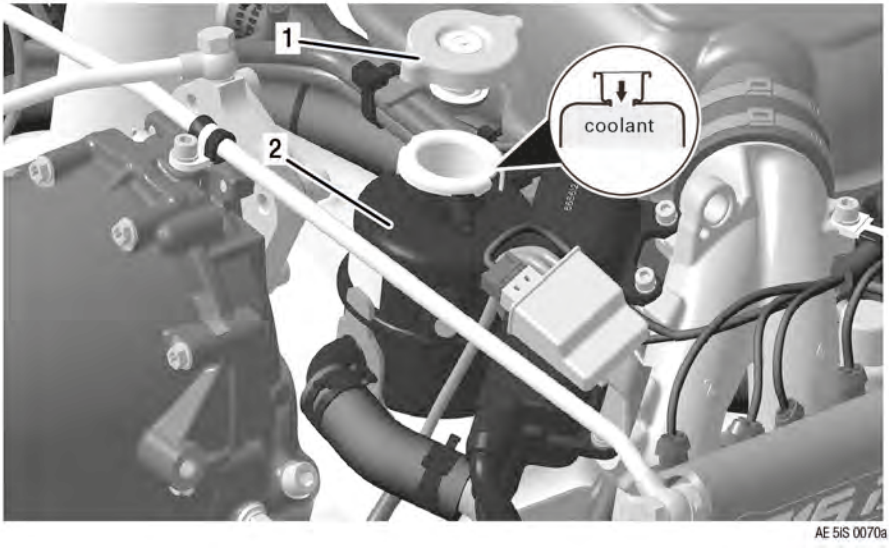

Figure 1: Expansion tank

1 Radiator cap *2 Expansion tank*

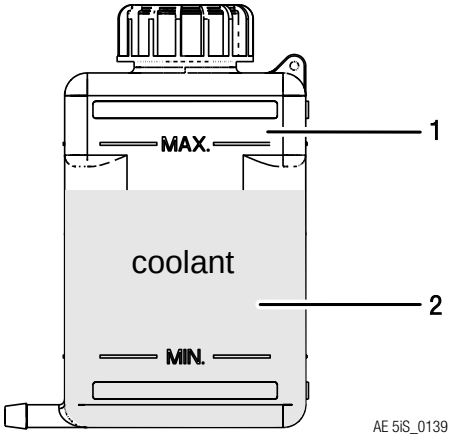

Figure 2: Overflow bottle

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 and turbocharger.
4	Visual inspection for mechanical and thermal damages of sensor, actuators and the wiring harness.
5	Visual inspection for mechanical and thermal damages of pressure control valve, fusebox and ECU.

3.2) Pre-flight checks

Safety

⚠ WARNING

Risk of burns and scalds! Hot engine parts!
Conduct checks on 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	Prior to oil level check, turn the propeller several times by hand in direction of engine rotation to pump all the oil from the engine to the oil tank.
2	This process is completed when air flows back to the oil tank. This air flow can be perceived as a murmur (gurgling) when the oil tank cover of the oil tank is removed.
3	Pull out the oil dipstick.
4	The oil level in the oil tank should be between the two marks (max./min.) on the oil dipstick, but must never fall below the min. mark. During standard engine operation, the oil level should be mid-way between the max. and min. marks, as at higher oil level (over servicing), oil will escape via the venting passage. Difference between max.- and min.- mark = 0.60 l (1.268 liq pt).
5	Replenish oil as required.

Step	Procedure
6	Check oil level - Marks on the oil dipstick.
7	Fit the oil dipstick and tighten the oil tank cover by hand.

ENVIRONMENTAL NOTE

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

3.3) 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

Maintenance CAN Bus (A/B) must not be used during flight. B. U.D.S. aircraft USB-to-CAN converter must be disconnected.

Step	Step Description	Procedure
1	Engine Pre-heating (if necessary)	–
	Example (Symbolic)	–
2	Activate Fuel pumps	HIC A: A connection between Terminal 3 and Terminal 9 at 915 i Type A, or at 915 i Type C24 Terminal E and F, will power Fuel pump 1. HIC B: A connection between Terminal 3 and Terminal 11 at 915 i Type A, or at 915 i Type C24 AC-DC Converter Terminal X4.C and X4.D, will power Fuel pump 2.
	Example (Symbolic)	Fuel pump 1: **ON** Fuel pump 2: **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	Step Description	Procedure
3	Activate ECU	HIC A: A connection between Terminal 1 and Terminal 7 at 915 i Type A, or at 915 i Type C24 Terminal N and P, will power ECU Lane A. HIC B: A connection between Terminal 1 and Terminal 9 at 915 i Type A, or at 915 i Type C24 Terminal N and P, will power ECU Lane B.
	Example (Symbolic)	Lane select Switch A: **ON** Lane select Switch B: **ON**
4	Temporarily supply engine with external power supply	X3: A connection between Terminal 2 and Terminal 3 at 915 i Type A, or at 915 i Type C24 AC-DC Converter Terminal X2.C, and between airframe ground and EMS ground will activate Start Power. The temporary power supply must be maintained during steps 4, 5, 6.
	Example (Symbolic)	Start Power Switch: **HOLD**
5	Check if Warning Indicators illuminate and extinguish after around 3 seconds.	HIC A: 12 V voltage drop between Terminal 2 and Terminal 8 at 915 i Type A, or at 915 i Type C24 Terminal A and D for 3 seconds. HIC B: 12 V voltage drop between Terminal 2 and Terminal 10 at 915 i Type A, or at 915 i Type C24 Terminal A and D for 3 seconds.
	Example (Symbolic)	Warning Lamp A: Check Warning Lamp B: Check
6	Set Throttle Valve	Set linearized throttle position according to diagram section 3.3 Fig. Throttle position.
	Example (Symbolic)	Set Throttle.

Step	Step Description	Procedure
7	Check Caution lamp state 915 i Type C24	AC-DC converter: 24 V provided to Terminal X2.C Caution Lamp: 14 V Output (EMS): **OFF** Caution Lamp: 28 V Output (AC): **ON** Caution Lamp: Start/Backup Power: **ON**
	Example (Symbolic)	Start Power Switch: **HOLD**

ATTENTION

Activate starter for maximum of 10 consecutive seconds only, followed by a cooling period of 2 minutes.

Step	Step Description	Procedure
8	Start Engine	HIC B: A connection between Terminal 4 and Terminal 12 at 915 i Type A, or at 915 i Type C24 Terminal G and H, actuates the starter. The connection must persist until the engine speed exceeds 1500 rpm.
	Example (Symbolic)	Start Power Switch: **HOLD**
9	Reduce Throttle Valve as required	Set linearized throttle position so that the engine runs on idle.
	Example (Symbolic)	Reduce Throttle.

ATTENTION

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

Step	Step Description	Procedure
10	Check engine instruments (Warning Indicators and Operational Limits) and ensure compliance with the operating limits.	HIC A: If a 12 V voltage drop between Terminal 2 and Terminal 8 at 915 i Type A, or at 915 i Type C24 Terminal A and D (permanent or oscillating) is detected perform Lane and Ignition Check. See abnormal operation if the voltage drop still persists. HIC B: If a 12 V voltage drop between Terminal 2 and Terminal 10 at 915 i Type A, or at 915 i Type C24 Terminal A and D (permanent or oscillating) is detected perform a Lane and Ignition Check. See abnormal operation if the voltage drop still persists. Display CAN A/B: Check if oil pressure has risen within 10 seconds after engine start and monitor oil pressure.
	Example (Symbolic)	Warning Lamp A: Check Warning Lamp B: Check Pilot Display: Check
11	Check state Caution lamps 915 i Type C24	”Procedure” AC-DC converter: 24 V drop to 0 Terminal X2.C. Caution Lamp: 14 V Output (EMS): **OFF** Caution Lamp. 28 V Output (AC): **ON** Caution Lamp: Start/Backup Power: **OFF**
	Example (Symbolic)	Start Power Switch: **OFF** Backup Battery Switch: **OFF** Engine running: >1700 rpm<2400 rpm
12	Generator Switching	Increase engine speed above 2400 rpm and hold for 8 seconds.
	Example (Symbolic)	Increase Throttle Position

Step	Step Description	Procedure
13	Check engine instruments (Warning Indicators and Operational Limits) and ensure compliance with the operating limits.	HIC A: If a 12 V voltage drop between Terminal 2 and Terminal 8 at 915 i Type A, or at 915 i Type C24 Terminal A and D (permanent or oscillating) is detected, shut OFF engine and perform troubleshooting. HIC B: If a 12 V voltage drop between Terminal 2 and Terminal 10 at 915 i Type A, or at 915 i Type C24 Terminal A and D (permanent or oscillating) is detected, shut OFF engine and perform troubleshooting. Display CAN A/B: Check and ensure compliance with operational limits.
	Example (Symbolic)	Warning Lamp A: Check Warning Lamp B: Check Pilot Display: Check
14	Check state Caution lamps 915 i Type C24	”Procedure” AC-DC converter: 24 V drop to 0 Terminal X2.C. Caution Lamp: 14 V Output (EMS): **OFF** Caution Lamp: 28 V Output (AC): **ON**[1)] Caution Lamp: Start/Backup Power: **OFF**
	Example (Symbolic)	Start Power Switch: **OFF** Backup Battery Switch: **OFF** Engine running: Step 11 successful

[1)]In case of higher rpm >= 3000 rpm the Caution Lamp: 28 V Output (AC) is **OFF**.

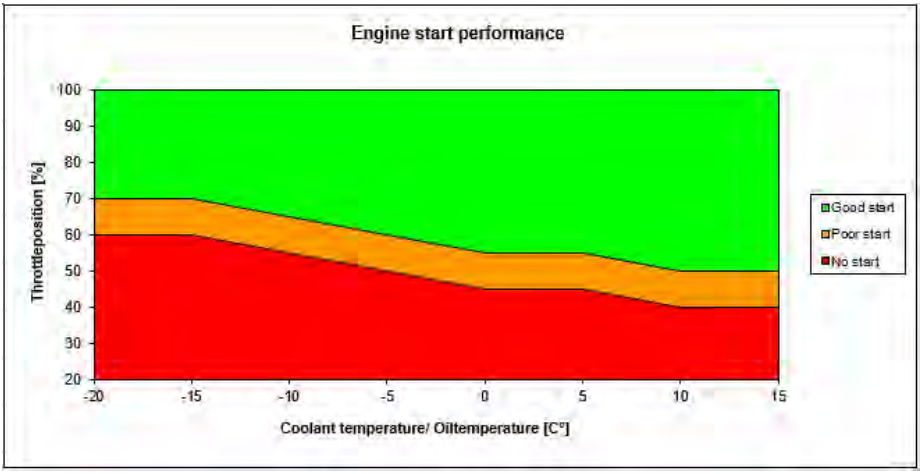

Figure 3: Throttle position

3.4) 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	Step Description	Procedure
1	Check engine instruments (Warning Indicators and Operational Limits) and ensure compliance with the operating limits while step 2 to 4.	HIC A: If a 12 V voltage drop between Terminal 2 and Terminal 8 at 915 i Type A, or at 915 i Type C24 Terminal A and D (permanent or oscillating) is detected, shut OFF engine and perform troubleshooting. HIC B: If a 12 V voltage drop between Terminal 2 and Terminal 10 at 915 i Type A, or at 915 i Type C24 Terminal A and D (permanent or oscillating) is detected, shut OFF engine and perform troubleshooting. Display CAN A/B: Check and ensure compliance with operational limits.
	Example (Symbolic)	Warning Lamp A: Check Warning Lamp B: Check Pilot Display: Check
2	Set Throttle Valve as required.	Set linearized throttle position in a way that the engine runs at approx. 2000 rpm for approx. 2 minutes.
	Example (Symbolic)	Set Throttle
3	Set Throttle Valve as required.	Set linearized throttle position in a way that the engine runs at approx. 2500 rpm until oil temperature reaches 50 °C (120 ° F).
	Example (Symbolic)	Set Throttle
4	Reduce Throttle Valve as required.	Set linearized throttle position so that the engine runs at idle.
	Example (Symbolic)	Reduce Throttle

3.5) Engine run-up

Ground test

ATTENTION
After a full-load ground test allow a cooling run at idle speed to prevent vapour formation in the cylinder head.

Step	Step Description	Procedure
1	Check engine instruments (Warning Indicators and Operational Limits) and ensure compliance with the operating limits while step 2 to 3.	HIC A: If a 12 V voltage drop between Terminal 2 and Terminal 8 at 915 i Type A, or at 915 i Type C24 Terminal A and D (permanent or oscillating) is detected, shut OFF engine and perform troubleshooting. HIC B: If a 12 V voltage drop between Terminal 2 and Terminal 10 at 915 i Type A, or at 915 i Type C24 Terminal A and D (permanent or oscillating) is detected, shut OFF engine and perform troubleshooting Display CAN A/B: Check and ensure compliance with operational limits.
	Example (Symbolic)	Warning Lamp A: Check Warning Lamp B: Check Pilot Display: Check
2	Set Full Throttle	Set linearized throttle position to WOT and check if maximum performance can be reached.
	Example (Symbolic)	Set Throttle.
3	Set Throttle Valve as required	Set linearized throttle position to reach an engine speed of 2500 rpm and continue with Lane check 2500 rpm and Ignition check.
	Example (Symbolic)	Set Throttle.

Lane and Ignition check

During the Lane and Ignition check Engine Speed must always show plausible values no matter if one or both lanes are active. Otherwise maintenance is required.

Step	Step Description	Procedure
1	Check engine instruments (Warning Indicators and Operational Limits) and ensure compliance with the operating limits while step 2 to 11.	HIC A: If a 12 V voltage drop between Terminal 2 and Terminal 8 at 915 i Type A, or at 915 i Type C24 Terminal A and D (permanent or oscillating) is detected, shut OFF engine and perform troubleshooting. HIC B: If a 12 V voltage drop between Terminal 2 and Terminal 10 at 915 i Type A, or at 915 i Type C24 Terminal A and D (permanent or oscillating) is detected, shut OFF engine and perform troubleshooting Display CAN A/B: Check and ensure compliance with operational limits.
	Example (Symbolic)	Warning Lamp A: Check Warning Lamp B: Check Pilot Display: Check
2	Set Throttle Valve as required.	Set linearized throttle position so that engine speed is approx 2500 rpm.
	Example (Symbolic)	Set Throttle
3	Deactivate ECU Lane A	HIC A: Disconnect Terminal 1 and Terminal 7 at 915 i Type A, or at 915 i Type C24 Terminal N and P, to turn OFF ECU Lane A.
	Example (Symbolic)	Lane select Switch A: **OFF**
4	Observe engine speed	Display CAN A/B; Check engine speed.
	Example (Symbolic)	Pilot Display: Check

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	Step Description	Procedure
5	Activate ECU Lane A	HIC A: Connect Terminal 1 and Terminal 7 at 915 i Type A, or at 915 i Type C24 Terminal N and P, to power ECU Lane A.
	Example (Symbolic)	Lane select Switch A: **ON**
6	Await Warning Indicator A to extinguish and note how long this takes.	HIC A: 12 V voltage drop between Terminal 2 and Terminal 8 at 915 i Type A, or at 915 i Type C24 Terminal A and D for 3 seconds.
	NOTE *After the voltage drop between Terminal 2 and Terminal 8 changes back to 0 V wait approx. 3 seconds until continuing with the next step.*	
	Example (Symbolic)	Warning Lamp A: Check
7	Deactivate ECU Lane B	HIC B: Disconnect Terminal 1 and Terminal 9 at 915 i Type A, or at 915 i Type C24 Terminal N and P, to turn OFF ECU Lane B.
	Example (Symbolic)	Lane select Switch B: **OFF**
8	Observe engine speed	Display CAN A/B: Check engine speed.
	Example (Symbolic)	Pilot Display: Check

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	Step Description	Procedure
9	Activate ECU Lane B	HIC B: Connect Terminal 1 and Terminal 9 at 915 i Type A, or at 915 i Type C24 Terminal N and P, to power ECU Lane B.
	Example (Symbolic)	Lane select Switch B: **ON**

Step	Step Description	Procedure
10	Await Warning Indicator B to extinguish and note how long this takes.	HIC A: 12 V voltage drop between Terminal 2 and Terminal 10 at 915 i Type A, or at 915 i C24 Terminal A and D for 3 seconds.
	NOTE *After the voltage drop between Terminal 2 and Terminal 10 changes back to 0 V wait approx. 3 seconds until continuing with the next step.*	
	Example (Symbolic)	Set Throttle
11	Reduce Throttle Valve as required.	Set linearized throttle position to reach an engine speed of 2000 rpm and continue with wastegate and PCV check.
	Example (Symbolic)	Set Throttle

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

Following sensor values are not available if Lane A is turned OFF and Lane B is activated:

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

Following sensor values are not available if Lane B is turned OFF and Lane A is activated:

- Oil temperature
- Oil pressure

Wastegate and PCV check

Manifold Air Temperature (MAT) must be <65 °C during the check procedure. Otherwise the ECU internal check of the Pressure Control Valve and Wastegate will not be executed.

NOTE

If possible the PCV Check and the Lane and Ignition Check might be combined in one check.

Step	Step Description	Procedure
1	Check engine instruments (Warning Indicators and Operational Limits) and ensure compliance with the operating limits while step 2 –13.	HIC A: If a 12 V voltage drop between Terminal 2 and Terminal 8 at 915 i Type A, or at 915 i Type C24 Terminal A and D (permanent or oscillating) is detected, shut OFF engine and perform troubleshooting. HIC B: If a 12 V voltage drop between Terminal 2 and Terminal 10 at 915 i Type A, or at 915 i Type C24 Terminal A and D (permanent or oscillating) is detected, shut OFF engine and perform troubleshooting. Display CAN A/B: Check and ensure compliance with operational limits.
	Example (Symbolic)	Warning Lamp A: Check Warning Lamp B: Check Pilot Display: Check
2	Set Throttle valve to WOT	Set linearized throttle position to 100%. Governor must be set in a way that engine speed >4700 rpm.
	Example (Symbolic)	Set Throttle
3	Deactivate ECU Lane A	HIC A: Disconnect Terminal 1 and Terminal 7 at 915 i Type A, or at 915 i Type C24 Terminal N and P, to turn OFF ECU Lane A
	Example (Symbolic)	Lane Select Switch A: **OFF**
4	Wait > 15 seconds	–
	Example (Symbolic)	Wait

Step	Step Description	Procedure
5	Check engine instruments (Warning Indicators and Operational Limits) and ensure compliance with the operating limits.	HIC A: If a 12 V voltage drop between Terminal 2 and Terminal 8 at 915 i Type A, or at 915 i Type C24 Terminal A and D (permanent or oscillating) is detected, shut OFF engine and perform troubleshooting. HIC B: If a 12 V voltage drop between Terminal 2 and Terminal 10 at 915 i Type A, or at 915 i Type C24 Terminal A and D (permanent or oscillating) is detected, shut OFF engine and perform troubleshooting. Display CAN A/B: Check and ensure compliance with operational limits.
	Example (Symbolic)	Warning Lamp A: Check Warning Lamp B: Check Pilot Display: Check
6	Activate ECU Lane A	HIC A: Connect Terminal 1 and Terminal 7 at 915 i Type A, or at 915 i Type C24 Terminal N and P, to power ECU Lane A
	Example (Symbolic)	Lane Select Switch A: **ON**
7	Await Warning Indicator A to extinguish and note how long this takes.	HIC A: If a 12 V voltage drop between Terminal 2 and Terminal 8 at 915 i Type A, or at 915 i Type C24 Terminal A and D for 3 second.
	NOTE *After the voltage drop between Terminal 2 and Terminal 8 changes back to 0 V wait approx 3 seconds until continuing with the next step.*	
	Example (Symbolic)	Warning Lamp A: Check
8	Deactivate ECU Lane B	HIC B: Disconnect Terminal 1 and Terminal 9 at 915 i Type A, or at 915 i Type C24 Terminal N and P, to turn OFF ECU Lane B.
	Example (Symbolic)	Lane Select Switch B: OFF
9	Wait > 15 seconds	–
	Example (Symbolic)	Wait

Step	Step Description	Procedure
10	Check engine instruments (Warning Indicators and Operational Limits) and ensure compliance with the operating limits.	HIC A: If a 12 V voltage drop between Terminal 2 and Terminal 8 at 915 i Type A, or at 915 i Type C24 Terminal A and D (permanent or oscillating) is detected, shut off engine and perform troubleshooting. HIC B: If a 12 V voltage drop between Terminal 2 and Terminal 10 at 915 i Type A, or at 915 i Type C24 Terminal A and D (permanent or oscillating) is detected, shut off engine and perform troubleshooting. Display CAN A/B: Check and ensure compliance with operational limits.
	Example (Symbolic)	Warning Lamp A: Check Warning Lamp B: Check Pilot Display: Check
11	Activate ECU Lane B	HIC B: Connect Terminal 1 and Terminal 9 at 915 i Type A, or at 915 i Type C24 Terminal N and P, to power ECU Lane B.
	Example (Symbolic)	Lane select Switch B: **ON**
12	Await Warning Indicator B to extinguish and note how long this takes.	HIC A: 12 V voltage drop between Terminal 2 and Terminal 10 at 915 i Type A, or at 915 i Type C24 Terminal A and D for 3 seconds.
	NOTE *After the voltage drop between Terminal 2 and terminal 10 changes back to 0 V wait approx 3 seconds until continuing with the next step.*	
	Example (Symbolic)	Warning Lamp B: Check
13	Reduce Throttle Valve as required	Set linearized throttle position to reach an engine speed of 2000 rpm and continue with Fuel pump check
	Example (Symbolic)	Set Throttle

Fuel pump check

Verify that both fuel pumps are working and that no loss of power or irregular running occurs during deactivation of one fuel pump. The limits for fuel pressure must not be exceeded.

Step	Step Description	Procedure
1	Check engine instruments (Warning Indicators and Operational Limits) and ensure compliance with the operating limits while step 2 – 8.	HIC A: If a 12 V voltage drop between Terminal 2 and Terminal 8 at 915 i Type A, or at 915 i Type C24 Terminal A and D (permanent or oscillating) is detected, shut OFF engine and perform troubleshooting. HIC B: If a 12 V voltage drop between Terminal 2 and Terminal 10 at 915 i Type A, or at 915 i Type C24 Terminal A and D (permanent or oscillating) is detected, shut OFF engine and perform troubleshooting. Display CAN A/B: Check and ensure compliance with operational limits.
	Example (Symbolic)	Warning Lamp A: Check Warning Lamp B: Check Pilot Display: Check

Step	Step Description	Procedure
2	Set Throttle valve as required	Set linearized throttle position so that the engine speed is approx 2000 rpm.
	Example (Symbolic)	Set Throttle
3	Deactivate Fuel pump 1	HIC A: Disconnect Terminal 3 and Terminal 9 at 915 i Type A, or at 915 i Type C24 Terminal E and F, to deactivate Fuel pump 1
	Example (Symbolic)	Fuel pump 1: **OFF**
4	Observe Fuel pressure	
	Example (Symbolic)	Pilot Display: Check

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.

Step	Step Description	Procedure
5	Activate Fuel pump 1	HIC A: Connect Terminal 3 and Terminal 9 at 915 i Type A, or at 915 i Type C24 Terminal E and F, to activate Fuel pump 1
	Example (Symbolic)	Fuel pump 1: **ON**
6	Deactivate Fuel pump 2	HIC A: Disconnect Terminal 3 and Terminal 11 at 915 i Type A, or at 915 i Type C24 AC-DC Converter Terminal X4.C and X4.D, to deactivate Fuel pump 2.
	Example (Symbolic)	Fuel pump 2: **OFF**
7	Observe Fuel pressure	
	Example (Symbolic)	Pilot Display: Check

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.

Step	Step Description	Procedure
8	Activate Fuel pump 2	HIC A: Connect Terminal 3 and Terminal 11 at 915 i Type A, or at 915 i Type C24 AC-DC Converter Terminal X4.C and X4.D, to activate Fuel pump 2.
	Example (Symbolic)	Fuel pump 2: **ON**

NOTE

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

3.6) Engine shut-off

Step	Step Description	Procedure
1	Check the engine instruments (Warning Indicators and Operational Limits) and ensure compliance with the operating limits while step 2 to 5.	HIC A: If a 12 V voltage drop between Terminal 2 and Terminal 8 at 915 i Type A, or at 915 i Type C24 Terminal A and D (permanent or oscillating) is detected, shut OFF engine and perform troubleshooting. HIC B: If a 12 V voltage drop between Terminal 2 and Terminal 10 at 915 i Type A, or at 915 i Type C24 Terminal A and D (permanent or oscillating) is detected, shut OFF engine and perform troubleshooting. Display CAN A/B: Check and ensure compliance with operational limits
	Example (Symbolic)	Warning Lamp A: Check Warning Lamp B: Check Pilot Display: Check
2	Reduce Throttle valve as required.	Set linearized throttle position so that the engine runs on idle.
	Example (Symbolic)	Reduce Throttle.
3	Await cooling down phase.	Wait > 2 minutes.
4	Deactivate ECU	HIC A: Disconnect Terminal 1 and Terminal 7 at 915 i Type A, or at 915 i Type C24 Terminal N and P, to turn OFF ECU Lane A. HIC B: Disconnect Terminal 1 and Terminal 9 at 915 i Type A, or at 915 i Type C24 Terminal N and P, to turn OFF ECU Lane B.
	Example (Symbolic)	Lane select Switch A: **OFF** Lane select Switch B: **OFF**

NOTE

The ECU needs to be deactivated before the fuel pumps. Shutting off the engine by deactivating the fuel supply may result in fault and failure entries in the ECU. Shutting down the engine by shutting off the fuel pumps is only allowed in emergency situations.

Step	Step Description	Procedure
5	Deactivate Fuel pumps	HIC A: Disconnect Terminal 3 and terminal 9 at 915 i Type A, or at 915 i Type C24 Terminal E and F, to turn OFF Fuel pump 1 HIC B: Disconnect Terminal 3 and terminal 11 at 915 i Type A, or at 915 i Type C24 AC-DC Converter Terminal X4.C and X4.D, turn OFF Fuel pump 2
	Example (Symbolic)	Fuel pump 1: **OFF** Fuel pump 2: **OFF**

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4) Abnormal operation

Topics in this chapter

⚠ WARNING

Non-compliance can result in serious injuries or death!
Unless stated otherwise in this chapter, operating an engine with limited airworthiness is not permitted. 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 manufacturer's level.
**) HIC A: Voltage between Terminal 2 and Terminal 8 at 915 i Type A, or at 915 i Type C24 Terminal A and D (Warning Indicator A)
**) HIC B: Voltage between Terminal 2 and Terminal 10 at 915 i Type A, or at 915 i Type C24 Terminal A and D (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 an 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.

915 i TYPE C24

Caution Lamps

On the engine Type C24 AC-DC Converter Version, three caution lamps are implemented in the system:

- Caution lamp Output 14 V (EMS)
  The Caution lamp indicates the status of the Output 14 V (EMS) on the AC-DC converter which get supplied by Generator 2. The Output 14 V (EMS) lamp may be **ON** during engine start, until the voltage is bigger then >11.9 V. As long as Voltage stay within 11.9 V and 14.46 V the lamp remains **OFF**. In the unlikely event that the voltage is not longer within this range the lamp will come **ON**. If voltage will get back into normal operating range the Output 14 V (EMS) will go **OFF** again. No effect on engine power, rely on alternate power supply system. If Output 14 V (EMS) show up on ground a Maintenance action is required, if the lamp show up in flight - Check EMS Warning lamps and the Caution lamp Output 28 V (AC), also the Current and Voltage of the Battery. Flight is possible to your destination at your own discretion.
- Caution Lamp Output 28 V (AC)
  If engine is not running or rpm is below generator switching rpm the Output 28 V (AC) lamp indicates that the power supply of 28 V side is not active. In this state the charging of the battery is not given. If voltage will get back into normal operating range the Output 28 V (AC) will go **OFF** again. If Output 28 V (AC) show up on ground a Maintenance action is required, if the lamp show up in flight - Check EMS Warning lamps and the Caution lamp Output 14 V (EMS), also the

Current and Voltage of the Battery. Flight is possible to your destination at your own discretion.

- Caution Lamp Start / Backup Battery Switch
  If Start Power Switch or Backup Battery Switch or both are activated the this Caution lamp will be **ON**. So please check with Aircraft manufacturer on witch condition the switches need to be activated during flight. If lamp show up without having activated Start power or Backup Battery Switch a Maintenance action is required.

4.1.1) Failure of internal generators

915 i TYPE A and TYPE C24

Failure of Generator 1

If during normal operation (Generator 1 is supplying the EMS) Generator 1 fails, the ECU automatically switches over to supply the EMS by using Generator 2.
If the engine is supplied by Generator 2 the engine is able to deliver full performance. No performance drop can be recognized while the engine switches the supply from Generator 1 to Generator 2.

ATTENTION

If Generator 2 is used for supplying the EMS, the airframe will not be supplied with electrical power by an internal generator.

This failure condition will be detected by the EMS. Therefore see section “Failures detected by the EMS” for appropriate action.

Failure of Generator 2

If during normal operation (Generator 1 is supplying the EMS) Generator 2 fails, the ECU is not able to detect this condition.

915 i TYPE C24

Caution lamp 14 V and 28 V Output **ON**

ATTENTION

If Generator 2 fails the Airframe will not be supplied with electrical power by an internal generator

Aircraft Manufacturer is responsible for defining a procedure for this failure condition.

Failure of both Generators

A failure of both Generators (Generator 1/Generator 2) will result in engine stoppage unless the EMS is powered by an external power source (12 V voltage drop between X3 Terminal 1 and Aircraft ground).

915 i TYPE C24

Battery Backup Switch is activated engine is running – then Warning lamp flashing, Caution lamp 28 V **ON**, 14 V **OFF** and Caution Lamp Start/Backup Battery Switch **ON**.

Aircraft Manufacturer is responsible for defining a procedure for this failure condition.

4.1.2) Failure of AC-DC Converter

915 Type C24

Failure of the Output 14 V (EMS) side

If Caution lamp Output 14 V (EMS) is **ON** during normal operation (Generator 1 is supplying the EMS) – it indicates a problem on the AC-DC converter 14 V (EMS) output side. As long as the Caution lamp Output 28 V (AC) is not **ON**, the problem is related to the AC-DC converter output, not to Generator 2.

NOTE

The aux fuel pump is supplied from the Generator 2/AC-DC converter side.

Failure of the Output 28 V (AC) side

If Caution lamp Output 28 V (AC) is **ON** during normal operation >3000 rpm (Generator 1 is supplying the EMS) – it indicates no power to the airframe on the AC-DC converter 28 V (AC) output side. As long as the Caution lamp Output 28 V (AC) is not **ON**, the problem is related to the AC-DC converter output, not to Generator 2.

ATTENTION

If Caution lamp 28 V (AC) is ON the airframe will not be supplied with electrical power by the AC-DC converter 28 V output side.

As long as the Caution lamp Output 14 V (EMS) is not **ON**, the problem is related to heat transfer (high temperature), over current, over voltage on the 28 V output (AC) side.

NOTE

The aux fuel pump is supplied from the Generator 2/AC-DC converter side.

4.1.3) Engine not responding to throttle position commands

Possible breakage/blockage of throttle valve actuation/linkage. In case of a breakage of the throttle valve actuation the valve will jump to wide open position.

⚠ WARNING

Non-compliance can result in serious injuries or death!
Never attempt starting the engine with a disconnected, broken or blocked throttle valve actuation. This may lead to excessive engine speeds.

For shutting off the engine proceed according to Engine shut-OFF procedure (see Chapter 3.6). As part of an abnormal operation, it might be required to shut down the engine at higher engine speeds.

4.1.4) Engine on fire or fire in the engine compartment

ATTENTION

Carry out emergency procedures as prescribed in the flight manual of the aircraft 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

Aircraft Manufacturer is responsible for defining a procedure for this failure condition. Depending on the installation shutting off the fuel supply first might be required.

Emergency Engine shut-off

Step	Step Description	Procedure
1	Deactivate ECU	HIC A: Disconnect Terminal 1 and Terminal 7 at 915 i Type A, or at 915 i Type C24 Terminal N and P, to turn OFF ECU Lane A HIC B: Disconnect Terminal 1 and Terminal 9 at 915 i Type A, or at 915 i Type C24 Terminal N and P, to turn OFF ECU Lane B Display CAN A/B: Check and ensure compliance with operational limits.
	Example (Symbolic)	Lane select Switch A: OFF Lane select Switch B: OFF

Loss of Display CAN Information

If Display CAN Bus A or B fail, all information is still available on the working CAN Bus. In case Display CAN A and B fail and no engine parameters are available, land the aircraft. Aircraft Manufacturer is responsible for defining a procedure for both failure conditions.

Loss of Power

Aircraft Manufacturer is responsible for defining a procedure for this failure condition.

4.2) Failures during engine start

4.2.1) Engine does not start

Insufficient supply from electrical power source.

- Ensure that Engine starter and EMS system is supplied by an external power source until engine reaches idle speed

Insufficient fuel supply.

- Ensure that Engine is supplied with fuel in appropriate quality

Starting at low oil temperature.

- Use high quality oil without friction modifier see Chapter 2.4).

4.3) 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.

4.4) The sprag clutch fails to decouple from the starter

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

Follow engine shut OFF procedure (see Chapter 3.6).

4.5) Exceedance of operational limits

ATTENTION
When exceeding an operating limit, adapt engine power setting.

Any exceeding of an operating limit has to be entered by the pilot into engine logbook, stating duration of this omit condition. Unscheduled maintenance action may be required (see Maintenance Manual Line).

Aircraft Manufacturer is responsible for defining an abnormal operation procedure for each operating limit.

4.6) 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.

5) Performance and Fuel consumption

Topics in this chapter

5.1) Performance data and fuel consumption

Information on performance and fuel consumption are summarized in the ROTAX® Performance and Fuel Consumption Model.
The Performance and Fuel consumption model for this engine is only available in the electronic version of this document (see Appendix) which can be downloaded on our website.
www.flyrotax.com/service/technical-documentation.html

Note that all information provided is model based and therefore subject to tolerances. This chapter summarizes the parameters and the constraints that need to be considered when working with this data.

The actual power and fuel consumption is highly dependant upon the installation, the compliance to predefined maintenance events, and the way the engine is operated. Those values need to be determined and provided by the aircraft manufacturer.

Ambient Conditions

Ambient conditions are given by the pressure in the ambient (p_ambient) and the temperature in the ambient (T_ambient).

Engine Conditions

Engine conditions are given by the engine speed (rpm) and throttle position (ECU_throttle_lin).

Critical Altitude

The engine was designed for a critical altitude up to 15000 ft.

5.2) Explanation of the parameters

Parameters	Explanation
Case Number [No Unit]	Sequential number
rpm [RPM]	Engine speed
p_ambient [bar]	Pressure at ambient depending on altitude and weather conditions. The pressure was calculated according to ISA conditions at altitude. Engine deck was calculated with different altitudes from sea level to max operation altitude.
T_ambient [°C]	Temperature at ambient depending on altitude and weather conditions. The temperature was calculated according to ISA conditions and additional temperature variation -15 °C (5 °F), +15 °C (59 °F) and +30 °C (86 °F).
ECU_thottle_lin [%]	Linearized throttle position as given by the ECU.
Altitude [ft]	Altitude correlates to the ambient pressure (p_ambient) according ISA.

Parameters	Explanation
power_observ-ered [kW]	Power observed (certified) at the propeller shaft at given ambient conditions and engine conditions. This value means the LOWER LIMIT of the power tolerance range. Depending on circumstances the delivered power can be up to 6% higher but not lower than the power stated in the engine deck. The power stated in the engine deck accounts for: • The use of different certified fuels • Maximum allowed temperatures of oil and coolant • Losses due to gear and governor • Tolerances of the engine The observed power depends on: • MAT (T_Plenum):If the MAT exceeds the given limits power will decrease below stated values of the engine deck (not specified). For given ambient and engine conditions the MAT and the pressure in the plenum (p_Ple-num) can be used to evaluate the air path from the intake to the plenum. • Fuel: With MOGAS the delivered power will be up to 1.4 [kW] higher than the stated power in the engine deck. Therefore power loss due to the use of AVGAS is taken into account.
Fuel Flow [kg/h]	Fuel flow at given ambient/engine conditions, tolerance range at stationary flight conditions (5500-5800 rpm > 55 [kW, 4000-5000 rpm >35 [kW]): 10%. Flight range must be evaluated by the manufacturer in real plane application.
p_plenum [bar]	At given ambient/engine conditions the pressure and temperature in the plenum correlates to engine power. Deviation more than +20 mbar (at 5800 rpm/at sea level) indicates failure in the air supply to the engine.
T_plenum [K]	At given ambient/engine conditions the temperature and pressure in the plenum correlates to engine power. Deviation more than +5 °C (41 °F) (at 5800 rpm/at sea level) indicates failure in the air supply to the engine.

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7) System Description

Topics in this chapter

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

- 4-stroke-, 4 cylinder flat engine
- 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 shock absorber and overload clutch
- Oil tank
- Electric starter
- Turbocharged
- Electronic/pneumatic control of boost pressure

Optional

- Preparation for hydraulic governor for constant speed propeller (configuration 3 only)
- Cooling air baffle

7.1.2) Technical data

Description	Value
Bore	84 mm (3.31 in)
Stroke	61 mm (2.40 in)
Displacement	1352 cm^3 (82.5 in^3)
Compression ratio.	8.2:1

7.1.3) Engine components

915 i TYPE A

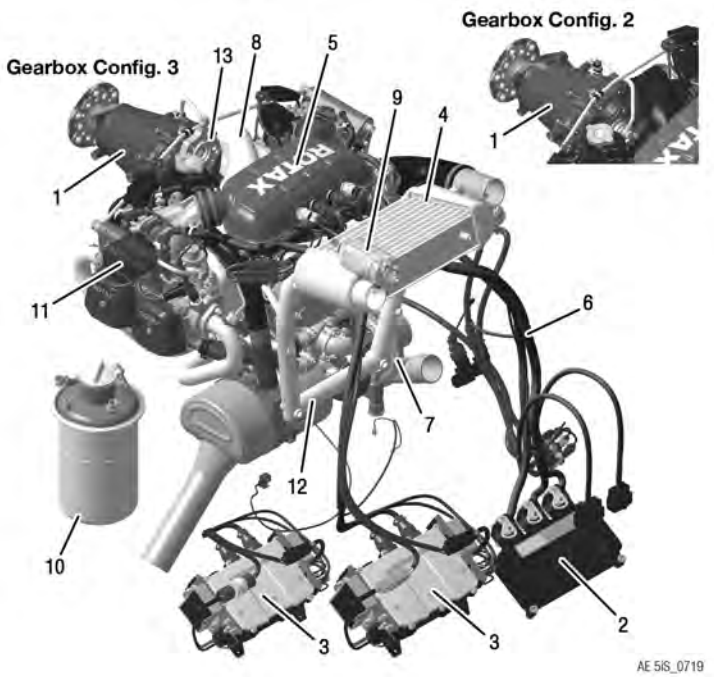

Figure 1: Engine components

1	*Propeller gearbox*	*2*	*ECU*	*3*	*Fusebox*
4	*Intercooler*	*5*	*Airbox*	*6*	*Wiring harness*
7	*Turbocharger*	*8*	*Air baffle*	*9*	*Electric starter*
10	*Oil tank*	*11*	*Oil filter*	*12*	*Suspen-sion frame*
13	*Flange for governor*				

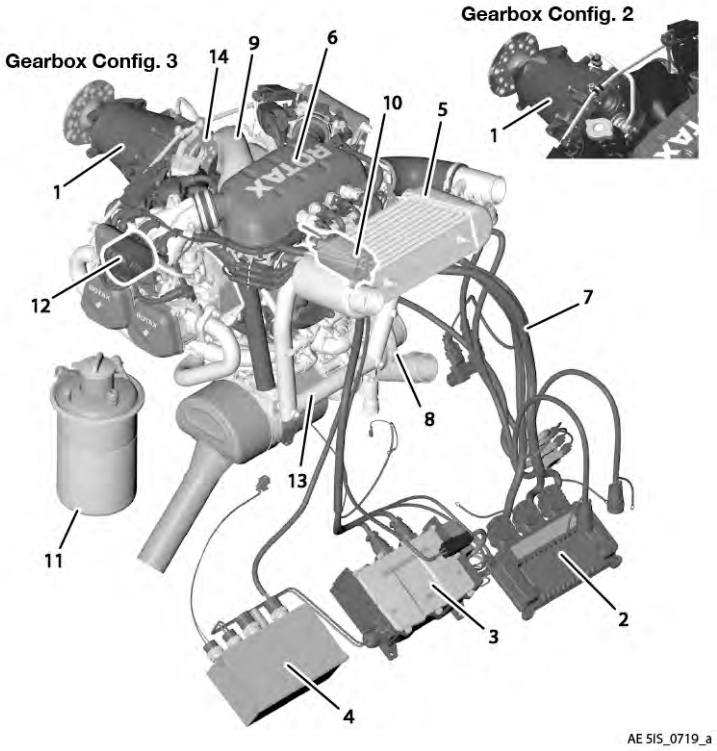

Figure 2: Engine components

1	*Propeller gearbox*	*2*	*ECU*	*3*	*Fusebox*
4	*24 V AC/DC converter*	*5*	*Inter-cooler*	*6*	*Airbox*
7	*Wiring harness*	*8*	*Turbo-charger*	*9*	*Air baffle*
10	*Electric starter*	*11*	*Oil tank*	*12*	*Oil filter*
13	*Suspension frame*	*14*	*Flange for gov-ernor*		

7.1.4) Cylinder arrangement

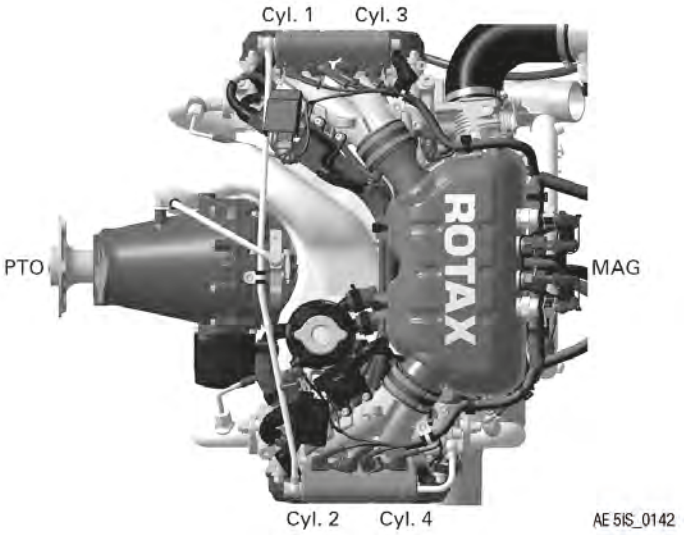

Figure 3: Cylinder arrangement

7.1.5) Direction of rotation

Direction of rotation on propeller shaft

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

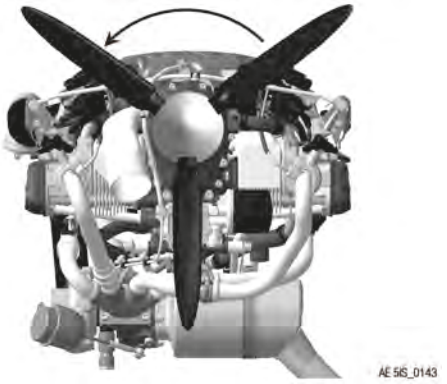

Figure 4: Normal direction of propeller rotation (engine)

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 the coolant to be sucked back into the cooling circuit as the engine is cooling down.

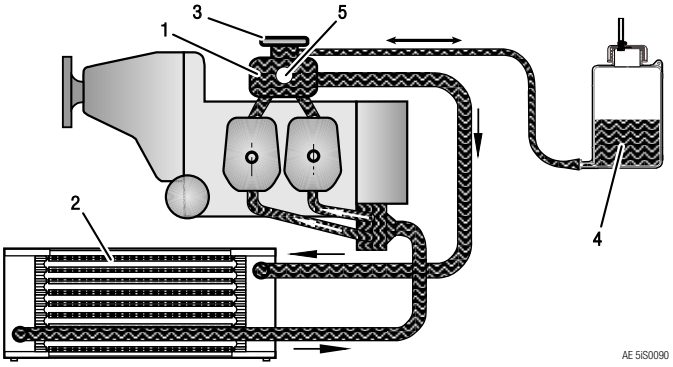

Figure 5: Cooling system (symbolic)

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

7.3) Fuel system

Fuel flow

The fuel is pumped in the fuel rail 1/3 feed line (2). From there it passes the both fuel rails (connected by the fuel line (4)), the fuel regulator and escapes thru fuel rail 2/4 outlet line (1). The supply of the injectors (5) is done by the fuel rails. The fuel pressure regulator (6) ensures that the pressure differential between the fuel injectors and the intake manifold remains constant. This allows injecting same quantity of fuel independent from the operational state.

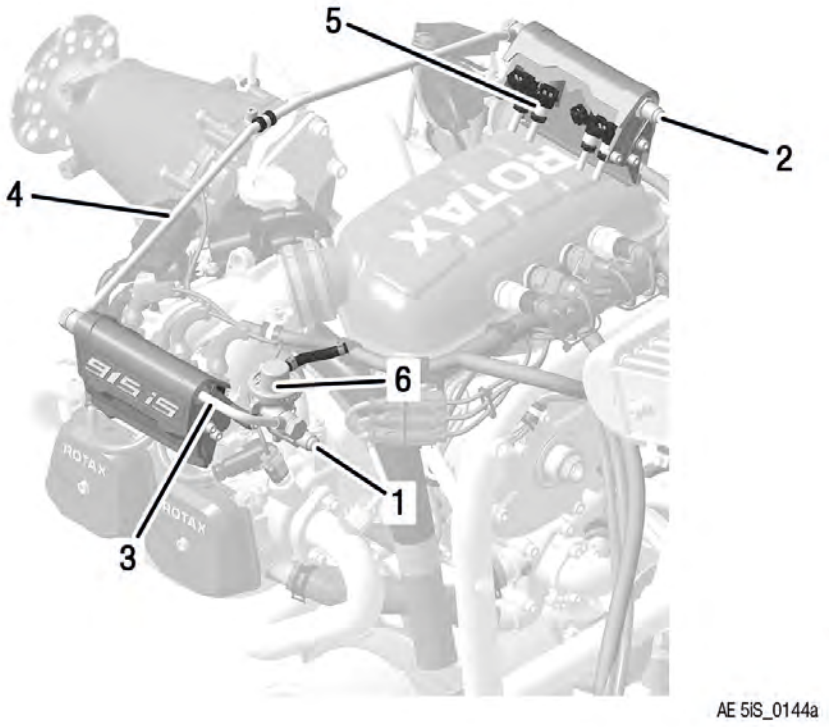

Figure 6: Fuel system

1	*Fuel rail 2/4 outlet line*	*2*	*Fuel rail 1/3 feed line*
3	*Fuel rail*	*4*	*Fuel line*
5	*Injection valves*	*6*	*Fuel pressure regulator*

7.4) Lubrication system

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

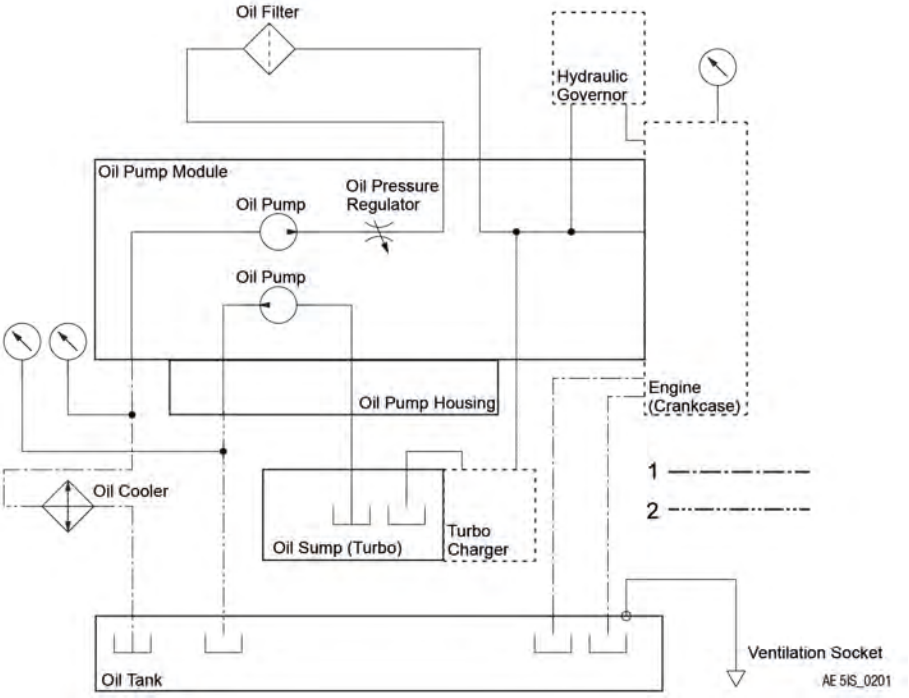

Figure 7: Lubrication system (symbolic)

Oil flow

The oil pump (driven by the camshaft) (2) sucks the motor oil from the oil tank (4) and forces it through the oil filter (3) and, depending on the engine installation, through the oil cooler, to the points of lubrication in the engine and the turbocharger.
The escaping 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.
The ventilation of the oil system is done by the vent socket on the oil tank

Turbocharger

The turbocharger is lubricated via a separate oil line (from the main oil pump).
The oil emerging from the turbocharger oil sump and is sucked back to the secondary oil pump and then pumped back to the main oil tank via an oil hose

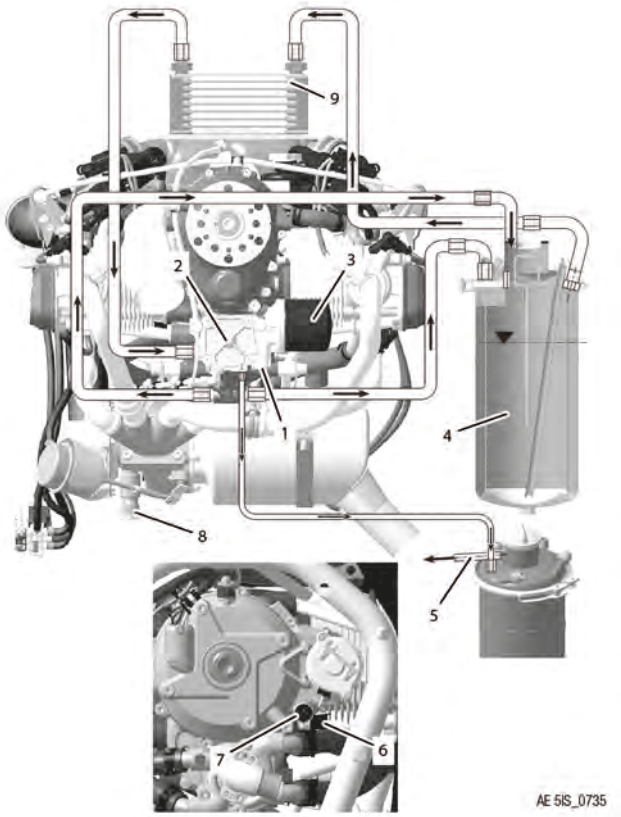

Figure 8: Lubrication system

1	*Pressure regulator*	*2*	*Oil pump*
3	*Oil filter*	*4*	*Oil tank*
5	*Venting hose*	*6*	*Oil temperature sensor*
7	*Oil pressure sensor*	*8*	*Turbocharger oil sump (with oil screen)*
9	*Oil cooler*		

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.

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.

915 i TYPE A

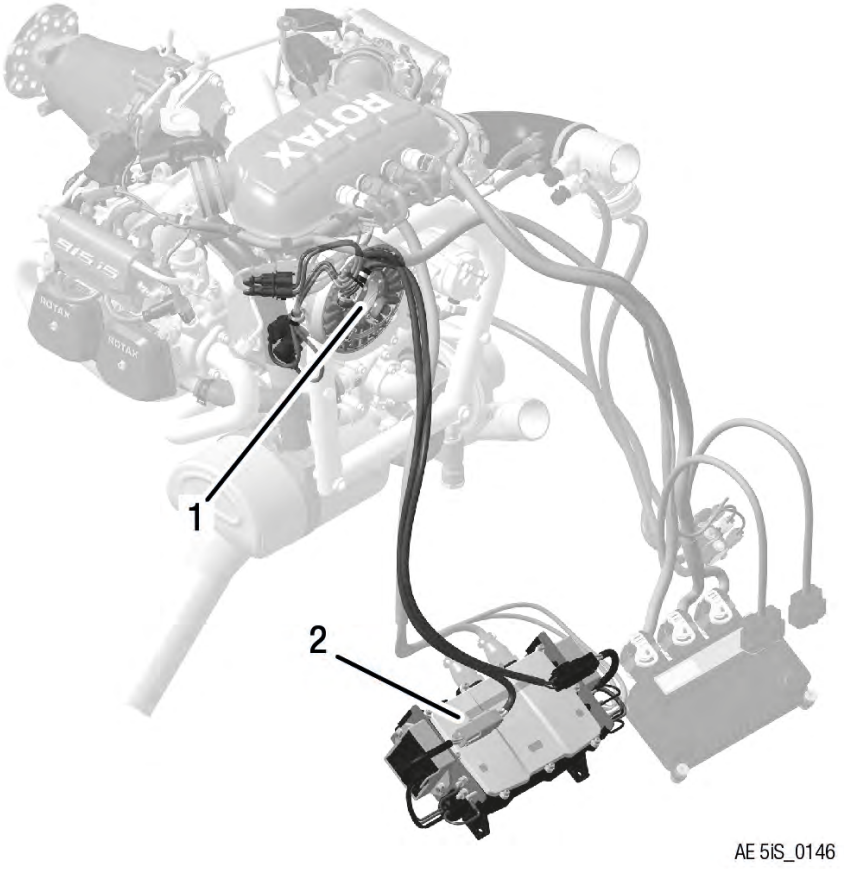

Figure 9: Internal power supply

1 Stator *2 Fusebox*

Generators 1 and 2

The two generators (Generator 1 and Generator 2) are mounted electrically isolated 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 of which generator 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 can Generator 1 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 2 fails; no indication is provided from engine side.

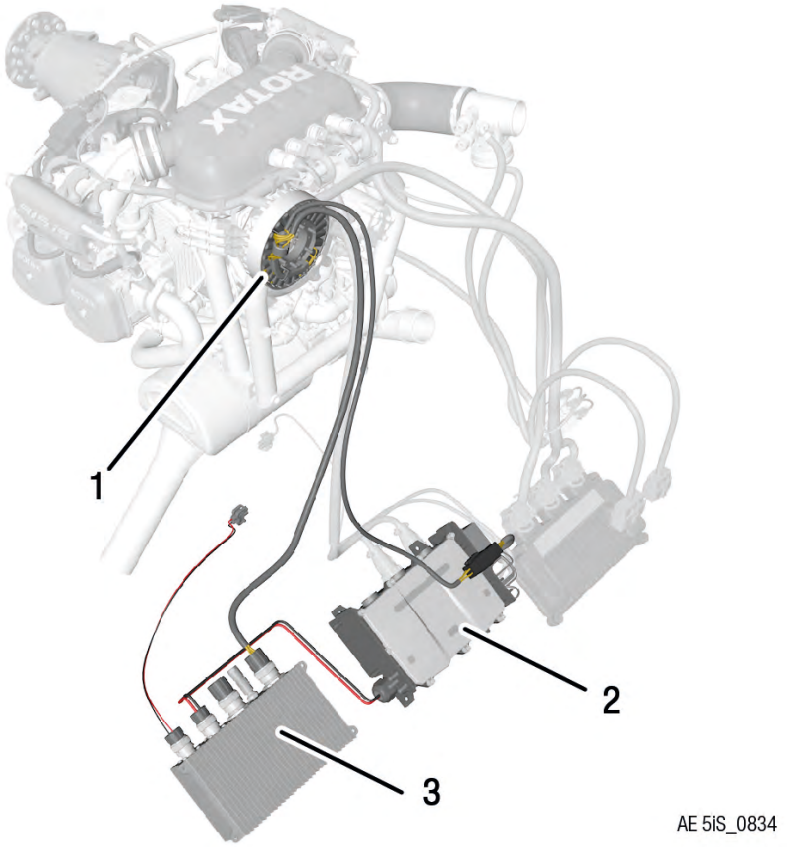

Figure 10: Internal power supply

1	*Stator*	*2*	*Fusebox*
3	*28 V AC-DC Converter assy.*		

Generators 1 and 2

The two generators (Generator 1 and Generator 2) are mounted electrically isolated on one stator. Generator A is connected with a regulator mounted on the Fusebox, Generator B is connected with the AC-DC converter. 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 of which generator 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.

NOTE

The aux fuel pump is supplied from the Generator 2/AC-DC converter side. If a defined engine speed threshold has been reached for a certain time Generator 1 takes over to supply the EMS. Generator 2 can fully power the Airframe (e.g. instrumentation) when reaching 3000 rpm.
Generator 1 does not supply the Airframe in any operation mode.

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 still able to cover a certain power on the Airframe side.

NOTE

*But it is needed to minimize the power on the Airframe side (switch **OFF** some instruments, air-condition, etc....), please check with Pilot Operating Handbook of the relevant Airframe manufacturer.*

The EMS is not capable of supervising the power provided to the airframe. If the EMS is powered by Generator 1 and Generator 2 fails; the Caution lamp 14 V (EMS) and Caution lamp 28 V (AC) are **ON**.

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).

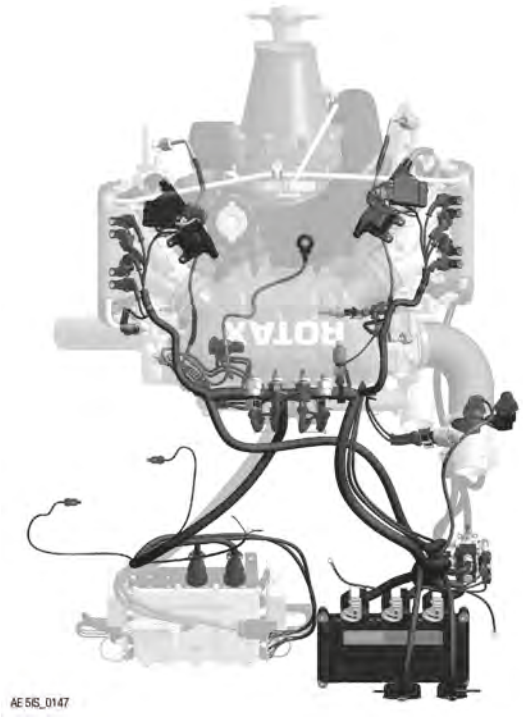

Figure 11: Management System

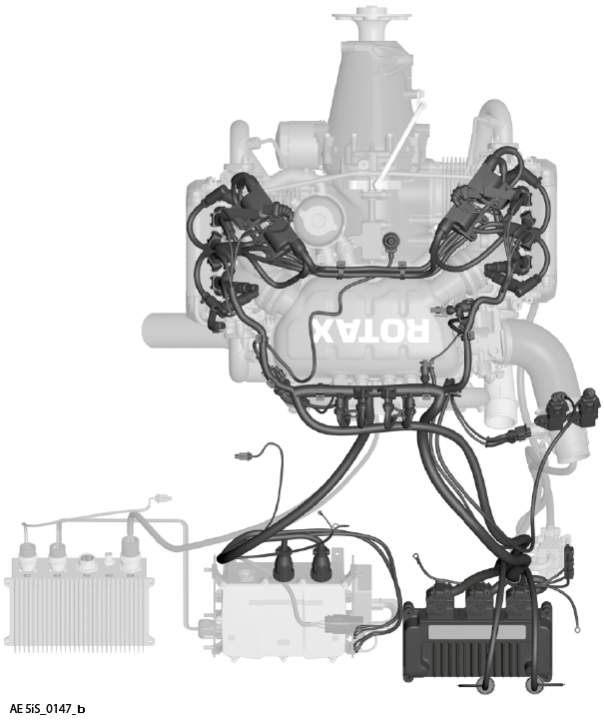

Figure 12: Management System

7.5.2) Ignition control

The 915 iSc/iS 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.

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® 915 i A Series, the maintenance and BUDS Aircraft Diagnostic Software is available. This provides not only the reading of ECU logs, it also provides 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) Air intake system and Boost pressure control

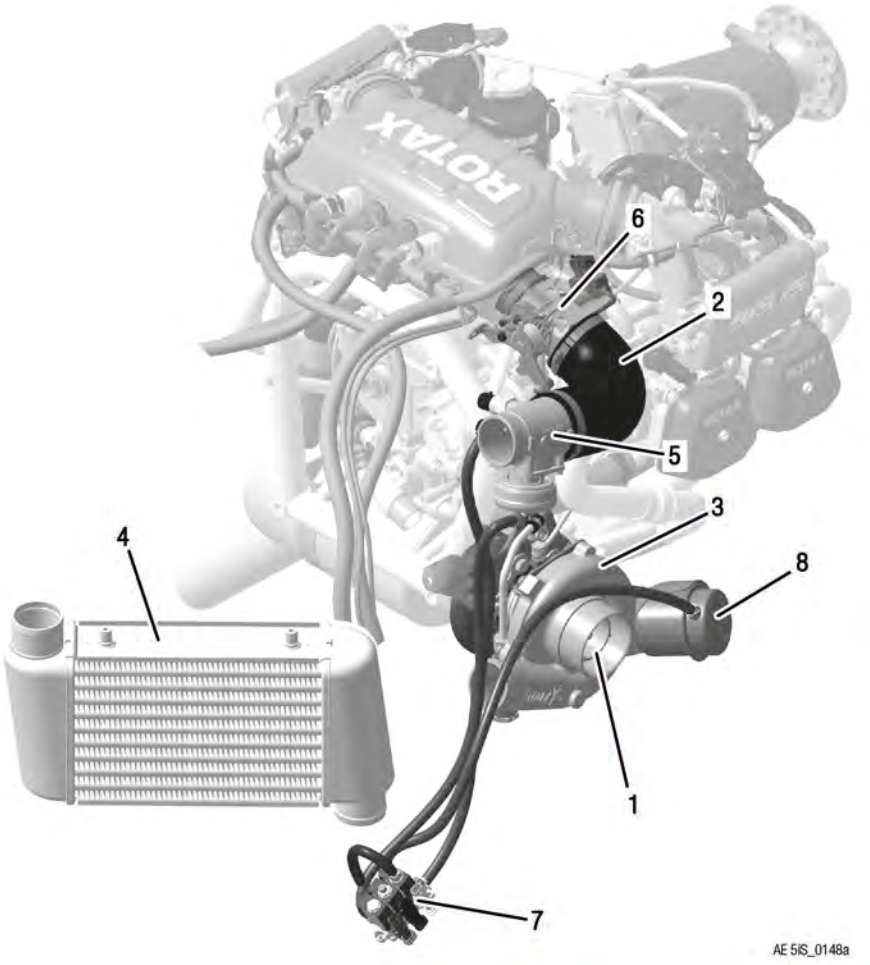

Figure 13: Air intake system

1	*Airfilter connection*	*2*	*Air intake hose*
3	*Turbocharger*	*4*	*Intercooler*
5	*Pop OFF valve*	*6*	*Throttle*
7	*Solenoid valve*	*8*	*Waste gate*

Air Flow

The compressor side of the turbocharger sucks air thru the air-filter and pushes it thru the Intercooler into the airbox. The pressure in the airbox is controlled by the Throttle. From the airbox the compressed air moves thru the intake manifolds into the four cylinders.

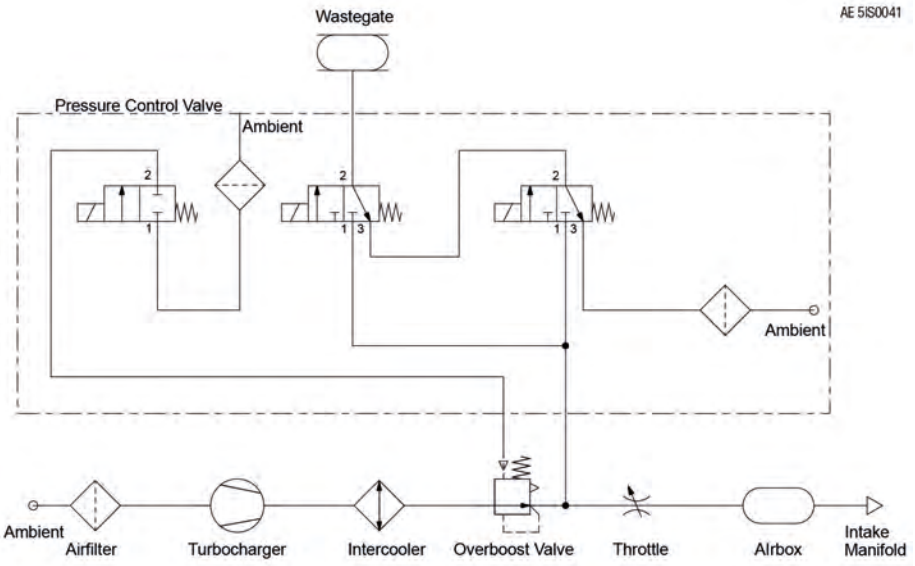

Figure 14

Boost pressure control

The compression rate of air is depending on the amount of exhaust gases passing the compression side of the turbocharger. For controlling this compression rate the waste gate has an important role. If the wastegate is fully closed the complete flow of exhaust gases must pass the turbine. The more the wastegate is opened, the less exhaust gases have to pass the turbine. The waste gate is powered by the boost pressure from the compressor. Pneumatic valves actuated by the ECU control the amount of the boost pressure necessary to adjust the waste gate to reach the requested boost pressure. The PCV, as well as Wastegate, are normally closed

Over boost valve

In case of overboost conditions the overboost valve is opened to relieve the excessive pressure.

Ambient Air Pressure and Temperature Sensor (AAPTS)

The two Ambient Air Pressure and Temperature Sensors (AAPTS) are all-in-one sensors for engine ambient temperature and engine ambient pressure. In cowled engine installations they have to be mounted in the engine compartment in a ram-air-free area and close to the air inlet. The sensors must

measure the correct air inlet temperature and the air pressure right before the air filter.

Boost Pressure Sensor (BPS)

The boost pressure sensors for reading of the boost pressure are located right before the throttle near the overboost valve.

Manifold Air Pressure Sensor (MAP)

The manifold air pressure sensors are located on the airbox.

Manifold Air Temperature Sensor (MAT)

The manifold air temperature sensors are located on the airbox.

7.7) Exhaust system

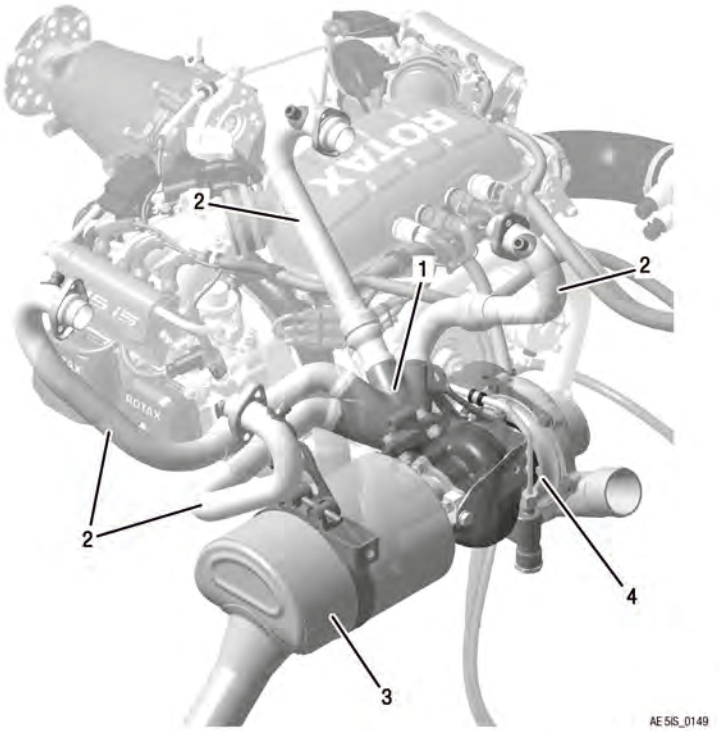

Figure 15: Turbocharger/Exhaust system

1	*Exhaust manifold*	*2*	*Exhaust pipes*
3	*Muffler*	*4*	*Turbocharger*

Exhaust flow

The Exhaust gases are pushed out of the cylinders thru the exhaust pipes and are brought together in the exhaust manifold. From there the exhaust gases pass the turbine side of the turbocharger (depending on the waste gate position). From there the exhaust gases leave the engine thru the muffler.

Exhaust Gas Temperature Sensors (EGT)

The sensors for reading the exhaust gas temperature are located on the exhaust pipes near the cylinder outlet.

7.8) Propeller gearbox

Reduction ratio

Reduction ratio	915 iSc/iS
crankshaft: propeller shaft	2.54:1

The propeller shaft is driven by the crankshaft by means of a spur gear unit.

The power transmission from the crankshaft to the propeller consists of:

- Overload clutch
- Damper clutch
- Torsion shaft

The damper clutch and torsion shaft absorbs vibrations and/or shocks caused by engine running and/or the propeller. The overload clutch protects the crankshaft in case of a propeller strike.

Governor

Alternatively a hydraulic governor for constant speed propeller can be used. (only for configuration 3). The drive is via the propeller reduction gear.

8) Preservation and storage

Topics in this chapter

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 915 i A 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

General

Environmental corrosion (on the external surfaces) is a naturally occurring process which can inevitably affect the continued airworthiness of the engine, engine mounted components and accessories. Susceptibility to corrosion is influenced by a number of factors, including but not limited to, geographical location, season and usage. All general preventive (technical) measures, identification, control and treatment of corrosive attack on aircraft structures and engine materials has to be carried out in accordance with Advisory Circular AC 43-4B from FAA and also in accordance with the information of the aircraft manufacturer´s Instruction for Continued Airworthiness. Furthermore the preservation procedures for stored and inactive aircraft (engines) provides an effective means for combating and minimizing the corrosion condition and should be adhered to.

Advisory Circular AC 43-4B: This advisory circular (AC) is a summary of the current available data regarding identification and treatment of corrosive attack on aircraft structures and engine materials. Corrosion inspection frequency, corrosion identification, and especially corrosion treatment continues to be the responsibility of the operator. These inspections should be accomplished per this AC, the manufacturer's recommendations, or the operator's own maintenance program. The procedures in this AC are an acceptable means, but not the only acceptable means, of corrosion treatment. The information in this AC is applicable to aircraft for which the manufacturer has not published corrosion control information.

⚠ WARNING

Risk of burns and scalds! Hot engine parts!
Conduct checks on 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.

Step	Procedure
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 plugs 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.

9) Supplement

Topics in this chapter

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

ROTAX.

CUSTOMER SERVICE INFORMATION REPORT

WHEN / WHERE / WHAT

Accident / Incident Date _____ State / Country _____

Location of Occurence _____

Headline _____

Narrative

AIRCRAFT IDENTIFICATION

Aircraft registration _____ Aircraft category _____

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 _____

FLYROTAX.COM

MMZ1UAE

Figure 1: Form

10) Proper disposal

ENVIRONMENTAL NOTE

Pleaseobservethedisposal regulationsapplicable in your area.

General

All old/used parts, liquids and chemical agents 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 fuel) 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.

Index

R

S

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ROTAX®

Engine serial no.

Type of aircraft

Aircraft registration no.

Rotax® authorized distributor

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