ROTAX®

MAINTENANCE MANUAL

FOR ROTAX® ENGINE TYPE 912 i SERIES

HEAVY MAINTENANCE | REF. NO.: MMH-912 i | PART NO.: 898752

A BRP BRAND

WARNING

Before starting any maintenance work, please read the Maintenance Manual completely as it contains important safety relevant information. Failure to do so may result in personal injuries including death. Consult the orginal equipment manufacturers 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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Chapter: INTRO
GENERAL NOTE

Foreword

Before carrying out maintenance work on the engine, read this Maintenance Manual carefully.
If any passages of the Manual are not clearly understood or in case of any questions, please contact your nearest ROTAX® Authorized Aircraft Engines Distributors or their independent Service Centers.

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

The structure of the Manual follows whenever it is possible the structure of the ATA (Air Transport Association) standards. The aim is the compatibility with the aircraft manufacturers documentation, which means they must then adapt the documentation to their standard.

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TABLE OF AMENDMENTS

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

Edition 1/Rev. 3	July 01 2018	Obsolete with Edition 2/Rev. 0, which is a complete new edition.
Edition 2/Rev. 0	June 01 2024	

Current no.	Chapter	Page	Date of change	Remark for approval	Date of approval from authorities	Date of inclusion	Signature
0	INTRO	all	June 01 2024	DOA*			
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Summary of amendments

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

Current no.	Chapter	Page	Date of change	Comment
0	all	all	June 01 2024	New edition of book: new chapters, topics and figures

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Chapter: 00–00–00
<u>GENERAL NOTE</u>

<u>TOPICS IN THIS CHAPTER</u>

GENERAL

Purpose

The purpose of this Maintenance Manual is to acquaint maintenance service staff (iRMT) approved by the local aviation authorities with some basic maintenance and safety information for service work..

Documentation

For more 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, maintenance or parts, you can also contact your nearest ROTAX® authorized Aircraft Engine distributor or their independent Service Center.

ROTAX® Distributors

For ROTAX® Authorized Distributors for aircraft engines see latest Operators Manual or the official website www.FLYROTAX.com.

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.

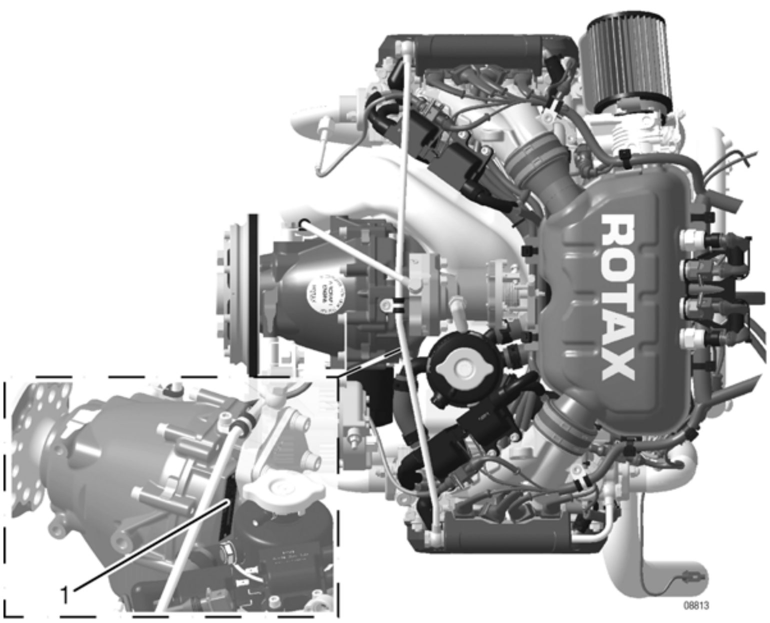

Figure 1.1: Engine serial number

1 Engine serial number

TYPE DESCRIPTION

The type description consists of the following parts:

e. g. **ROTAX**	**912**	**iSc**	**3**	
	type	certification	configuration	additional designation

Designation

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

Options

Available options (optional equipment) for the engine type mentioned above:

	external alternator	vacuum pump	governor	exhaust system
for configuration 2	YES	YES	NO	YES
for configuration 3	YES	NO	YES	YES

NOTE

Conversion of the version 2 to version 3 and vice versa may be accomplished by BRP-Rotax Authorized Distributors or their Service Center.

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
CSA	Constant Speed Actuator
CTS	Cooling Temperature Sensor

Abbreviations	Description
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
FL	Flight Level
Fuse box	Power conditioning and distribution for the Engine Management System
hr.	hours
HIC A	Harness Interface Connector A
HIC B	Harness Interface Connector B
IAT	Indicated Air Temperature
ICA	Instructions for Continued Airworthiness
IFR	Instrument Flight Rules
IFSD	In-flight-shutdown
INJ 1–8	Injector 1–8

Abbreviations	Description
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
MCON 1.2	Sealed electrical connector
MON	Motor Octane Number
MAG	Magneto Side
N	Newton
n.a.	not available
NDT	Non Destructive Testing
NEW	Part must be replaced against NEW (mentioned in figures)
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
PMA	Permanent magnet alternator
POA	Production Organization Approval
PS	Power supply

Abbreviations	Description
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
VFR	Visual Flight Rules
LEP	List of Effective Pages
MM	Maintenance Manual
MEP	Multi Engine Piston

Abbreviations	Description
X3	Connector on Engine Management System wiring harness which serves as an interface for power supply
XXXX	shows the component serial number

WIRING COLOR CODES

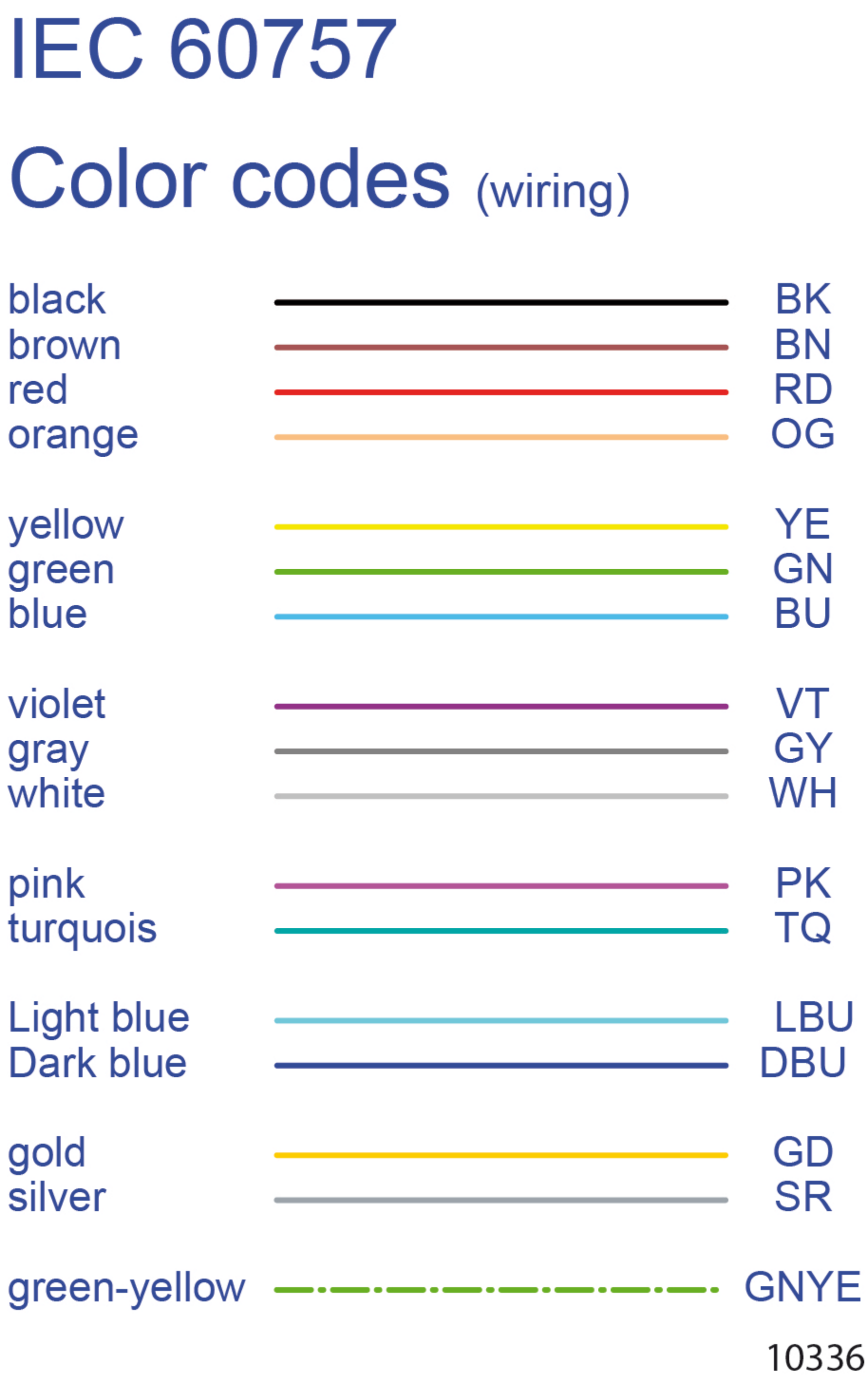

Figure 1.2

CONVERSION TABLE

Units of length:	**Units of power:**
1 mm = 0.03937 in 1 in = 25.4 mm 1 ft = 12 in = 0.3048 m	1 kW = 1.341 hp 1 hp = 0.7457 kW 1 kW = 1.3596 PS 1 PS = 0.7355 kW
Units of area:	**Units of temperature:**
1 cm² = 0.155 sq. in (in²) 1 sq. in (in²) = 6.4516 cm²	0 K = °C – 273,15 °C = (°F – 32) / 1,8 °F = (°C x 1.8) +32
Units of volume:	**Units of velocity:**
1 cm³ = 0.06102 cu in (in³) 1 cu in (in³) = 16.3871 cm³ 1 dm³ = 1 l 1 dm³ = 0.21997 gal (UK) 1 gal (UK) = 4.5461 dm³ 1 dm³ = 0.26417 gal (US) 1 gal (US) = 3.7854 dm³	1 m/s = 3.6 km/h 1 ft/min = 0.3048 m/min = 0.00508 m/sec 1 m/s = 196.85 ft/min 1 kt = 1.852 km/h 1 km/h = 0.53996 kn
Units of mass:	**spec. fuel consumption:**
1 kg = 2.2046 lbs. 1 lb. = 0.45359 kg	1 g/kWh = 0.001644 lb/hph 1 lb/hph = 608.277 g/kWh
Density:	**Units of torque:**
1 g/cm³ = 0.016018 lb/ft³ 1 lb/ft³ = 62.43 g/cm³	1 Nm = 0.737 ft lb = 8.848 in lb 1 ft lb = 1.356 Nm 1 in lb = 0.113 Nm
Units of force:	**Cable cross-section: Conversion table-Wire Gauge: AWG-mm²**
1 N = 0.224809 lbf 1 lbf = 4.4482 N **Units of pressure:** 1 Pa = 1 N/m² 1 bar = 100 000 Pa / 1000 hPa / 100 kPa 1 bar = 14.503 lbf/in² (psi) 1 in Hg = 33.8638 hPa	AWG —> mm² 4 —> 21 6 —> 13 8 —> 8.4 10 —> 5.3 12 —> 3.3 14 —> 2.1 16 —> 1.3 18 —>0.8 20—> 0.52

SAFETY NOTICE

Although reading such information does not eliminate any hazards, it promotes understanding, and applying of 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.

NOTICE
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.

SAFETY INFORMATION

Use for intended purpose

> ⚠ **WARNING**
>
> **Non-compliance can result in serious injuries or death!**
> The user has to assume all risks possibly arising from utilizing auxiliary equipment.

> ⚠ **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 aerobatics (inverted flight, etc.). Flight attitudes outside the permissible limits are not allowed
- This engine has exclusively been developed and tested for fixed wing, 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 or owner/user
- Due to the varying designs, equipment and types of aircraft, BRP-Rotax grants no warranty on the suitability of its engines use on any particular aircraft. Further, BRP-Rotax grants no warranty on this engines suitability with any other part, component 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.

- In addition to observing the instructions in our Manual, general safety and accident precautions, legal regulations and regulations of any aeronautical authority must be observed
- Where differences exist between this Manual and regulations provided by any authority, the more stringent regulation shall be applied
- For continued airworthiness see Maintenance Manual Line (MML)
- Unauthorized modifications of engine or aircraft will automatically exclude any liability of the engine manufacturer for consequential damage

Engine operation

- The engine must always be operated according to the content of the latest Operators Manual (OM)
- To eliminate the risk of injury or damage, ensure any loose equipment or tools are properly secured before starting the engine
- The use of propellers and their fastenings which exceed the specified values of moment of inertia and imbalance is not allowed and releases the engine manufacturer from any liability
- Improper engine installation, use of unsuitable piping for fuel, cooling and lubrication system and use of unsuitable wiring for electric and engine management system releases the engine manufacturer from any liability

INSTRUCTION

Engines require instructions regarding their installation, application, use, operation, maintenance and repair.
Technical documentation and regulations are useful and necessary complementary elements for trainings, but can by no means substitute for theoretical and practical instructions.
These instructions should cover explanation of the technical context, advice for operation, maintenance, installation, use and operational safety of the engine.

Safety notice

In this technical Manual passages concerning safety are especially marked. Pass on safety warnings to other users!

Accessories

This engine must only be operated with accessories supplied, recommended and released by BRP-Rotax. Modifications are only allowed after consent of the engine manufacturer.

Spare parts

See Illustrated Parts Catalog (IPC), latest issue for the respective engine type.

> **NOTICE**
>
> **Only use GENUINE ROTAX® spare parts. Spare parts must meet the requirements defined by the engine manufacturer. This can only be guaranteed when using spare parts and/or accessories. Spare parts are available at Authorized Distributors and their independent Service Centers. Any warranty by will become void if spare parts and/ or accessories other than spare parts and/or accessories are used (see latest Warranty Conditions).**
> See relevant Service Letter on www.flyrotax.com.

Standard tools / Special tools

> **NOTICE**
>
> **Only use tools and appliances which are suitable for the relevant task according to the latest Manuals.**

State of delivery

> **⚠ WARNING**
>
> **Engine and gearbox are delivered in “dry“ conditions (without fuel, oil and coolant).**
> Before putting the engine into operation it must be filled with oil and cooling liquid. Use only oil and coolant as specified.

See latest Operators Manual (OM) and Service Instruction SI-912 i-001 “Selection of suitable operating fluids“, current issue.

MAINTENANCE CONCEPT

General note

The maintenance functions detailed in this Manual are divided into two categories:

- Maintenance I (Line Maintenance)
- Maintenance II (Heavy Maintenance)

Repairs beyond the levels detailed in Manual I and Maintenance Manual II are not recommended as maintenance functions and must be in accordance to the current Overhaul Manual (OHM) for the respective engine type. Overhaul Manual (OHM) and its appendix is available for any appropriately rated person or entity on request and by following the standards of the original manufacturer.

Maintenance I (Line Maintenance)

Chapter 00,05 and 12
The scope of line maintenance consists of servicing and adjustment of engine components (including part wear). All procedures in this Manual are to be considered line maintenance.

NOTE

Where applicable, you will be referred to the Maintenance Manual Heavy (MMH) for work above and beyond line maintenance.

Maintenance II (Heavy Maintenance)

Separate Manual.
Maintenance Manual II details removal, installation and repair of components or parts normally considered beyond the scope of "Line Maintenance".

NOTE

This Manual can only be used in combination with Maintenance Manual I (Line Maintenance), as it builds upon it.

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 MML, Chapter 05–00–00 section “Authorized Personnel”) under normal conditions for engine removal and installation. Concerning design of engine installation in depth knowledge of aircraft design is required.
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 (IM)
- Operators Manual (OM)
- Maintenance Manual Line (MML)
- Maintenance Manual Heavy (MMH)
- Overhaul Manual (OHM)
- Illustrated Parts Catalog (IPC)
- Alert Service Bulletin (ASB)
- Service Bulletin (SB)
- Service Instruction / Service Instruction-Parts and Accessories (SI-PAC)
- Service Letter (SL)

Status

The status of the 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 charge.

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 affected pages is given in the chapter LEP. The particular edition and revision number is given on the footer of each page.

Reference

This Manual is only part of the technical documentation and will be supplemented by the respective Operators Manual (OM), Maintenance Manuals and Illustrated Parts Catalog (IPC).

NOTICE
Pay attention to references to other documentation, found in various parts of this Manual.

If not stated otherwise, any reference to a document refers to the latest edition issued by BRP-Rotax.

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 database system and are provided with a consecutive, irrelevant, number.
This number (e.g. AE 5iS001) is of no significance for the content.

Some measurements are given in the drawings, these are manufacturing dimensions and are subject to corresponding tolerances.

Installation drawings

Installation drawings and a digital mock-up (DMU) model for (virtual) installation analysis are available from the ROTAX® Authorized Distributors or their independent Service Centers on special request and relevant non disclosure and copyright regulations.

The illustrations in this Manual show a possible installation variant including non certified parts.

USE FOR INTENDED PURPOSE

⚠ WARNING
Explosion hazard. Flying components can cause serious injuries. Never run an engine without propeller.

Use

The engine ROTAX® 912 iSc Sport is intended for use in certified aircraft. In case of doubt the regulations of the national authorities or the respective sportive federations have to be observed.

Certified engines

The certified aircraft engine ROTAX® 912 iSc Sport has been tested as per aeronautical standards for safety and time between overhaul. It was developed to conform to the latest technological standards and has been rigorously tested.

Non certified engines

The ROTAX® 912 iS and 912 iS Sport are are not type certified. These engines have not received any aeronautical standards or regulatory safety or durability testing, and do not conform to any aircraft standards. These engines are meant for use in experimental, un-certificated aircraft and vehicles only in which an engine failure will not compromise safety.

NOTE

These engines are technically equivalent to certified engines and have been manufactured by BRP-Rotax using the same quality assurance system.

Engine stoppage

In using the engine the operator assumes all risk of use and acknowledges that he/she knows this engine is subject to sudden stoppage.

Maintenance and repair conditions

Use for intended purpose also includes observation of the operational, maintenance and repair conditions prescribed by the manufacturer. This is a crucial factor concerning the reliability of the engine and can increase the durability of the engine.

INSPECTION OF PARTS AND REPORT OF FINDINGS

General note

Measure all parts listed in the dimension sheets. These are attached directly after each section.
All measurements must be entered in the corresponding dimension sheets as shown.

Filling in the dimension sheets

Following the description how to fill in the dimension sheets.

NOTICE

If the engine is overhauled/repaired before the end of the TBO, the 50 % specified values for wear limits do not apply and must be calculated separately in accordance with section ”Classification of parts for maintenance/repair”.

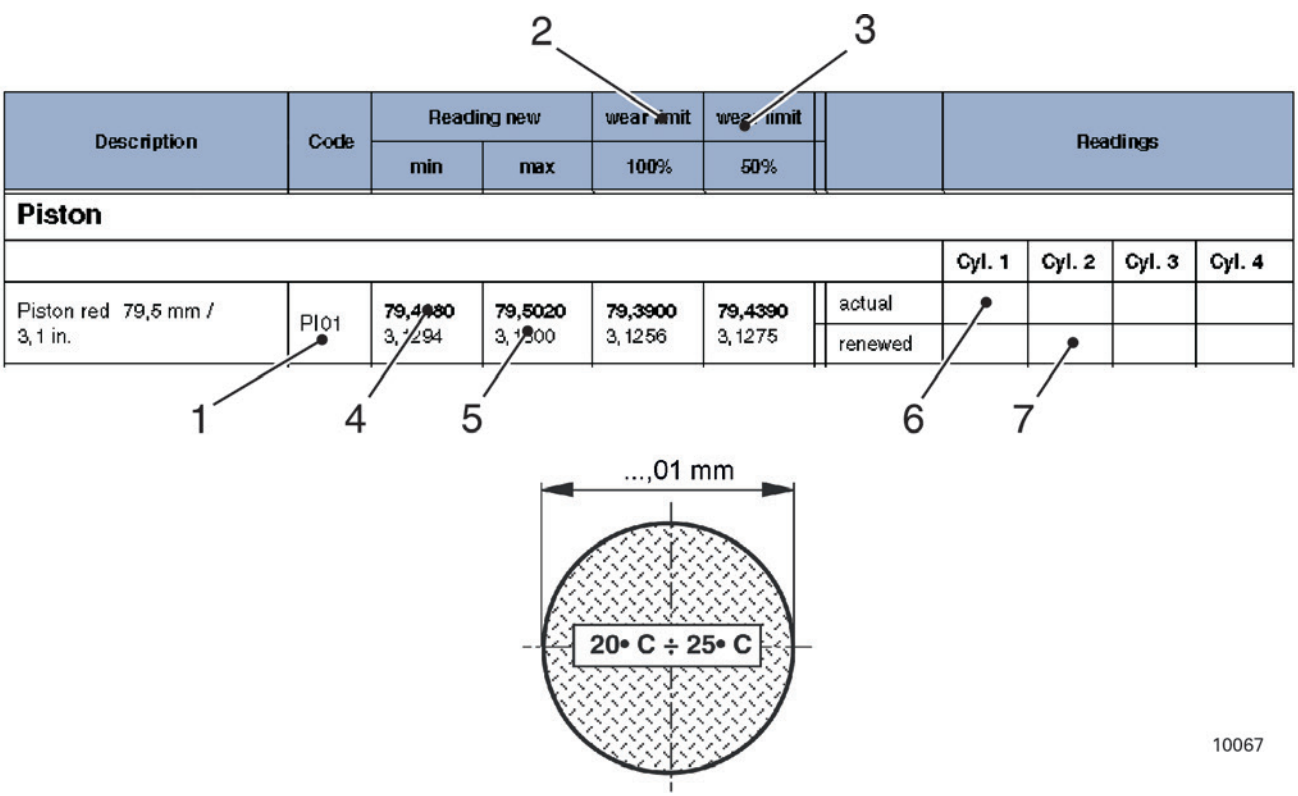

Figure 1.3: EXAMPLE ONLY

- Look up the desired control point code (1) in the illustration in the specified section
- The maximum limits for wear are divided into the columns maximum wear 100 % (2) and 50 % wear (3)
- The first line (4) gives the maximum permissible value in [mm], the second line (5) in [inches]

- The respective actual value must be entered in the corresponding box (6) in [mm] or [inches]
- The actual value for any part which has been replaced must be entered in the corresponding field (7) in [mm] or [inches]

List of abbreviations

The following table shows the abbreviations used for the control points.

Abbreviation	Description
AL	**al**ternator
CA	**ca**mshaft
CC	**c**rank**c**ase
CH	**c**ylinder **h**ead
CR	**c**on**r**od
CS	**c**rank**s**haft
CY	**cy**linder
EL	**el**ectric
ES	**e**lectric **s**tarter
EX	**ex**haust
GB	**g**ear**b**ox
GO	**go**vernor
OP	**o**il **p**ump
PI	**p**iston **pi**n
ST	**st**ator
VT	**v**alve **t**rain
WP	**w**ater **p**ump

NOTICE

Where measurement values are taken in hundredth of a millimeter or more precisely, the temperature of the part must be 20 to 25 °C (68 to 77 °F).

CLASSIFICATION OF PARTS FOR MAINTENANCE/REPAIR

General note

As for an overhaul, parts for maintenance/repair must be classified. They are classified either as “parts usable“ (“On-Condition“) or as “parts to be replaced“ (“100 % Parts“).

Criteria

The classification is made on the basis of following criteria:

- Hours of operation (decisive are the total operating hours of the part/engine or hours since the last overhaul)
- Determined (measured) actual dimension of the respective parts

Max. permissible wear

Proceed as follows:

- Determine the hours of operation for the part in question (logbook etc.)
- Determine wear as a percentage of the wear tolerance (see the dimension sheets attached directly after each section for the wear limit (100 %) of the part in question)
- The classification is carried out as per following table:

TSN [h] Time Since New		max. permissible wear for repair [%]
from	**to**	**TBO 2000 h – 912 i Series**
0	50	4
51	100	12
101	150	18
151	200	24
201	250	30
251	300	36
301	350	42
351	400	46
401	450	52
451	500	56
501	550	60
551	600	62
601	700	67
701	800	72
801	900	76
901	1000	80
1001	1100	83
1101	1200	87

TSN [h] Time Since New		max. permissible wear for repair [%]
from	to	TBO 2000 h – 912 i Series
1201	1300	90
1301	1400	92
1401	1500	94
1501	1600	96
1601	1700	98
1701	1800	98
1801	1900	99
1901	2000	100

Determination of actual wear [%]

- Determine actual dimension F of the part in question
- For new dimension (max.) B and wear limit C see the corresponding dimension sheets attached after each section
- Determine the actual wear [%] with following formula

$$\text{Actual wear} = \frac{\{\text{Actual dimension (F) - New dimension max. (B)}\} \times 100}{\{\text{Wear limit (C) - New dimension max. (B)}\}} \quad [\%]$$

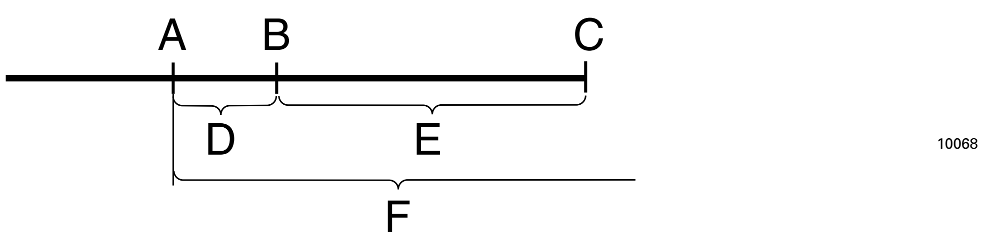

Figure 1.4: Formula

A	*New dimension (min)*	***B***	*New dimension (max)*
C	*Wear limit*	***D***	*New dimension tolerance*
E	*Wear tolerance*	***F***	*Actual dimension*

NOTICE

New dimension (max.) B is always the dimension which is closest to wear limit C.

Classification of “On-Condition“ parts at maintenance/repair:

Actual wear [%] is **greater** than or **equal** to the **max. permissible wear** [%] calculated from the table	Parts must be replaced
Actual wear [%] is **smaller** than the **max. permissible wear** [%] calculated from the table	Parts can be used again

NOTE

*A negative result means that the actual dimension **F** is within the new dimension tolerance **D** and the part can be used again.*

Example

The hours of operation are indicated with 300 h. The determined percentage of maximum permissible wear is therefore 36 %.

New dimension (max.)	**B**	28.03 mm (1.1035 in.)
Wear limit	**C**	28.10 mm (1.1062 in.)
Actual dimension	**F**	28.07 mm (1.1051 in.)
Actual wear		57.1%

This part must be replaced because it is excessively worn for only 300 hours of operation.

MAINTENANCE

General note

Beyond the maintenance and special checks (see therefore Line Maintenance Manual), as well as the system descriptions hitherto, the following sections describe the maintenance procedures for affected engine type. The description is subdivided into subsections and descriptions of the function of the various systems.
Some overlapping maintenance instructions are treated as generally valid information at the beginning of this section.

Troubleshooting

In the Operators Manual (OM) possible problems as well as feasible remedies are listed. At the same time, brief reference is made to the necessary remedial action.

See the respective section in the Operators Manual (OM) for the engine Type 912 i Series.

Tightening torques

Tighten fasteners to the torque specified in the exploded view(s) and/or in the written procedure.

Accepted accuracy for different measuring tools:

Torque: +/- 10%

The changes above are accounting for:

- variations/errors of tools (when used in normal operating conditions)
- accuracy of tools and their related tolerance

⚠ WARNING

Non-compliance can result in serious injuries or death!
Exactly observe the tightening torques for screws and nuts. Overtightening or a connection which is too loose could cause serious engine damage.

In order to avoid a poor assembly, tighten screws, bolts, or nuts in accordance with the following procedure:

- Manually screw all screws, bolts and/or nuts
- Apply half the recommended torque value
- Tighten fastener to the recommended torque value

NOTICE

Be sure to use the recommended tightening torque for the specified fastener.

NOTE

When possible, always apply torque on the nut.

NOTE

Always torque screws, bolts and/or nuts using a crisscross pattern when multiple fasteners are used to secure a part. Some parts must be torqued according to a specific sequence and torque pattern as detailed in the installation procedure.

NOTICE
If not specified otherwise, the threads are not lubricated when fastened.

Calibration

The professional calibration of your torque wrench is an essential prerequisite for ensuring the quality of the tightening torques in the long term. Calibration is also a fundamental part of ISO 9001 certification.

FASTENER INFORMATION

Self locking fasteners procedure

The following describes common procedures used when working with self-locking fasteners (Hardware supplies with pre-applied adhesive).
Use a metal brush on the fastener threads or a tap to clean the hole properly, then use a solvent. Allow the solvent time to act, then wipe off or blow out with shop air. Solvent utilization is to ensure proper adhesion of the product used for locking the fastener.

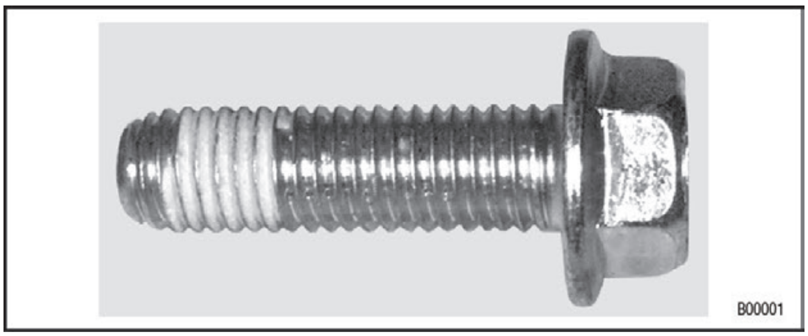

Figure 1.5: Fastener Information

LOCTITE APPLICATION PROCEDURE

The following describes common procedures used when working with LOCTITE products.

NOTE

Always use proper strength LOCTITE product as recommend in this Manual.

Observe the instructions of the manufacturer!

Thread locker application

Thread locker application for uncovered holes (Bolts and nuts).

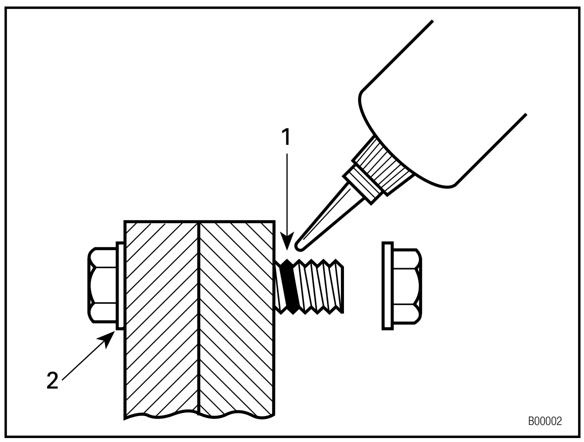

Figure 1.6: Application for uncovered holes (Bolts and nuts)

1 *Apply here* 2 *Do not apply*

Step	Procedure
1	Clean threads (bolt and nut) with solvent.
2	Apply LOCTITE 7063 on threads and allow to dry.
3	Choose proper strength LOCTITE thread locker.
4	Fit bolt in the hole.
5	Apply a few drops of thread locker at proposed tightened nut engagement area.
6	Position nut and tighten as required.

Thread locker for blind holes

Thread locker application for blind holes.

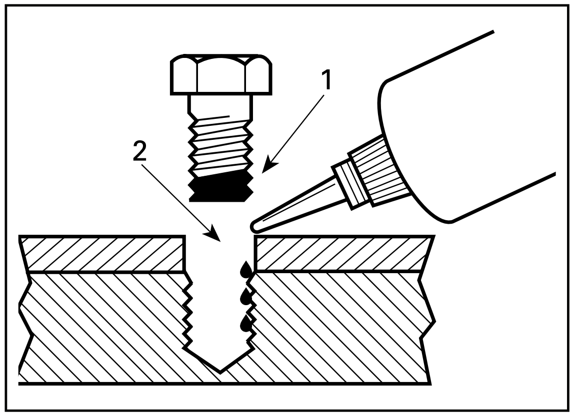

Figure 1.7: Application for blind holes

1 On fastener threads

2 On threads and at the bottom of hole

Step	Procedure
1	Clean threads (bolt and nut) with solvent.
2	Apply LOCTITE 7063 on threads and allow to dry.
3	Choose proper strength LOCTITE thread locker.
4	Apply several drops along the threaded hole and at the bottom of the hole.
5	Apply several drops on bolt threads.
6	Tighten as required.

Thread locker for stud installation

Thread locker application for stud installation in blind holes.

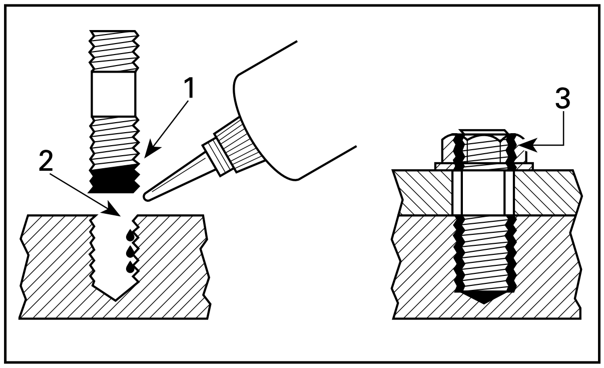

Figure 1.8: Application for stud installation in blind holes

1 On stud threads

2 On threads and in the hole

3 On retaining nut threads

Step	Procedure
1	Clean threads (stud and hole) with solvent.
2	Apply LOCTITE 7063 on threads and allow to dry.
3	Put 2 or 3 drops of proper strength LOCTITE thread locker on female threads and in hole.

NOTE

To avoid a hydro lock situation, do not apply too much LOCTITE.

Step	Procedure
4	Apply several drops of proper strength LOCTITE on stud threads.
5	Install stud.
6	Install cover, part, etc.
7	Apply a few drops of proper strength LOCTITE on uncovered stud threads.
8	Install and tighten retaining nut(s) as required.

Thread locker for pre-assembled parts

Thread locker application for pre-assembled parts.

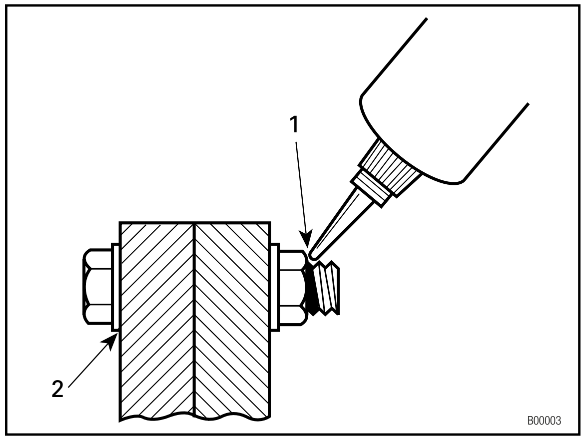

Figure 1.9: Application for pre-assembled parts

1 Apply here

2 Do not apply

Step	Procedure
1	Clean bolts and nuts with solvent.
2	Assemble components.
3	Tighten nuts.
4	Apply a few drops of proper strength LOCTITE on bolt/nut contact surfaces.
5	Avoid touching metal with tip of flask.

NOTE

For preventive maintenance on existing equipment, retighten nuts and apply proper strength LOCTITE on bolt/nut contact surfaces.

Thread locker for an adjustment screw

Thread locker application for an adjustment screw.

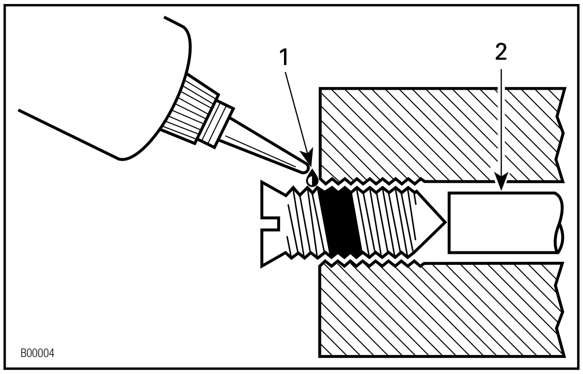

Figure 1.10: Application for an adjustment screw

1 Apply here *2 Plunger*

Step	Procedure
1	Adjust screw to proper setting.
2	Apply a few drops of proper strength LOCTITE thread locker on screw/body contact surfaces.
3	Avoid touching metal with tip of flask.

NOTE

If it is difficult to readjust, heat screw with a soldering iron (232 °C) (450 °F).

CONSUMABLE MATERIALS

NOTICE

Use only the specified or technically equivalent materials for all maintenance work.

NOTICE

When handling chemicals, comply with all the customary regulations and specifications of the producer, including the expiry date and instructions of use.

Consider the curing time of the sealing surface compound as stated by the manufacturers instructions.

The materials listed have undergone long term testing and are suitable for all operating conditions indicated by the manufacturer.

NOTE

All lubricants are non certified.

No.	Part no.	Description, application	Qty.
AC	899796	**LOCTITE 577** Yellow medium duty screw locking agent, oil and coolant tolerant	50 ml
AG	897186	**Silicone heat compound** Application of the heat conduction compound will increase heat transfer. The greaselike, temperature-resistant silicone compound fills cavities between components and cooling elements (e.g.: spark plug - cylinder head), which otherwise do not contribute to heat conduction	150 g
B	897651	**LOCTITE 243** Blue medium duty screw locking agent, oil tolerant	10 ml
C	899788	**LOCTITE 648** Green high temperature screw locking agent + retaining compound	5 ml
E	297434	**LOCTITE ANTI SEIZE 8151** Long-term lubricant for shaft seals	50 ml
F	n.a.	**LOCTITE 7063** For degreasing and cleaning surfaces	AR
H	897870	**FILTER OIL** For optimum filter efficiency and moisture protection	14.8 ml

No.	Part no.	Description, application	Qty.
I	897330	**LITHIUM-BASE GREASE** Electrical isolating	250 g
O	n.a.	**Engine oil** For easier assembly of components or for first lubrication before first engine start	AR
P	899791	**LOCTITE 5910** Flange sealant provides flexibility and adhesion	50 ml
V	898570	**Locking paint**	20 ml
Z	899789	**LOCTITE 603** Oil tolerant retaining compound, heavy-duty	10 ml

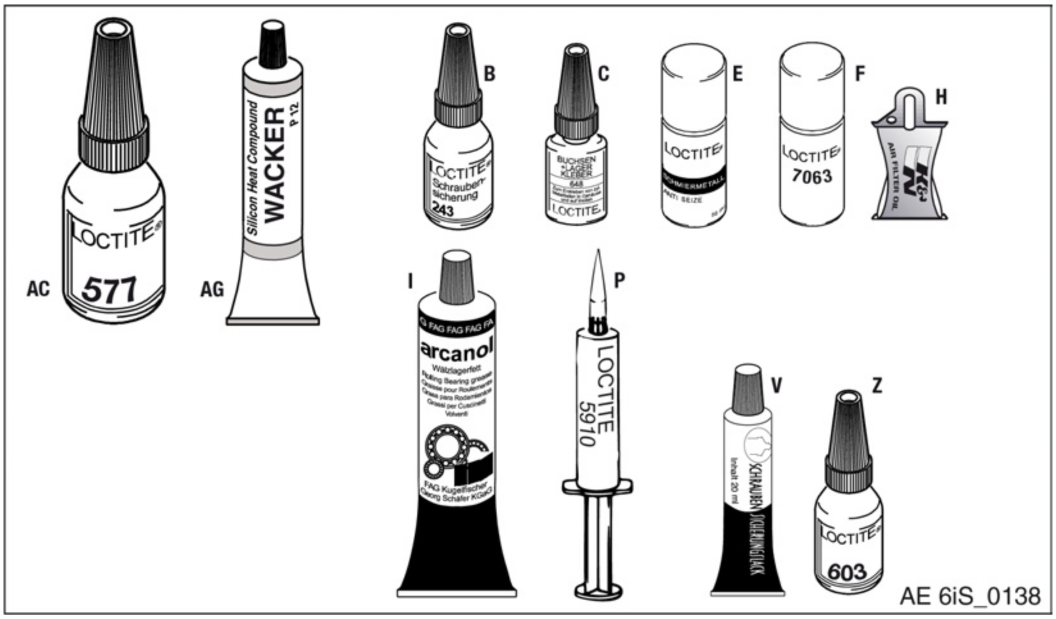

Figure 1.11

Additional materials

NOTICE

All metal and synthetic parts should be cleaned with suitable cleaning agents. Before using new and unknown cleaning agents, check their compatibility with the materials they are being used on.

No.	Part no.	Description, application	Qty.
1	n.a.	**Cleaning agent/solvent/parts cleaner** Use suitable cleaning agent. Never use caustic or corrosive cleaning agents.	AR
2	n.a.	**Multipurpose grease** Generally usable, neutrally colored multipurpose grease, water resistant and highly adherent. Usable for temperatures from -35 °C to +120 °C (-31 °F to 248 °F) and can be subjected to high mechanical loads.	AR
3	n.a.	**Preservation oil** This special oil has excellent penetrating capabilities and reaches even tiny gaps, its highly effective additives protect against corrosion of metal surfaces.	AR
4	n.a.	**Flexible web for surface finishing 3M Scotch-Brite Multi Flex - very fine or ultra fine (or equivalent)** Is sold by the meter and used for manual removal of smaller rust spots or oxidation, especially for optimum ground connections. It is particularly suitable for removing LOCTITE from surfaces or threads to make them metallic clean. Before re-applying LOCTITE, clean surfaces with nitrothinner or degreasing agent (CASTROL ZA 30 or OMV - SOFT SOL). When using solvents, observe the safety regulations for persons and the environment.	AR
5	n.a.	**MS4 / DC4 corning #4 (or equivalent)** Electrical insulation compound for protection of electrical connections.	AR

No.	Part no.	Description, application	Qty.
6	n.a.	**Valve lapping paste** This paste, produced by various manufacturers, is a fine granulate lapping paste for manual lapping of valve seats and valves. The paste is usually available in 3 different granulate sizes. Use as per manufacturers instructions.	AR
7	n.a.	**Compressed air blasting using a solid blasting agent** This method is suitable for local and gradual very fine treatment of steel parts with rust film (propeller shaft). The Compressed air blasting contains no harmful substances, is approved by the competent authorities and guarantees optimum cleaning. The granulates used are of sizes 40 to 60 μ . The achievable surface roughness is between 0.5 and 1 μ, which corresponds to ultra fine machining of surfaces.	AR

NOTICE

Exhaust valves and intake valves may NOT undergo a compressed air blasting treatment with solid blasting, strong abrasive material. Due to this surface treatment one does gain a microscopic surface pitting which does allow as a consequence the adhesion of fuel residues. These deposits are then involved in a chemical reaction (especially of the sulfur and lead content of AVGAS) with the valve material. This effect may cause hot-gas corrosion on the affected parts.

TOOLS

Auxiliary tools

- Differential compression tester or 2 pressure gauges with calibrated orifice, adapter for dial gauge in spark plug thread
- Valve spring mounting pliers
- Step punch for valve guide
- Adjustable reamer 6.5 to 7.5 mm (0.256 to 0.295 in.)
- Valve seat machining device, valve lapping paste
- Gearbox support plate
- Stud extraction tool
- Scraper, very fine emery cloth, grinding tool, cover sheet, adhesive tape
- Cleaning agent, approved cleaners, funnel, graphite marker
- Screw extractor set
- Torque wrench from 0 to 300 Nm (0 to 221 ft.lb)
- Magnetic particle tester – testing to be performed in accordance with ASTM E1444 (current edition)

NOTICE
Obey the manufacturers instructions!

Disassembly device

- Disassembly device for propeller gearbox
  Fig. shows one possible tensioning device for the disassembly of the propeller gearbox.
  The dimensions given are only intended for easier orientation and are not binding.

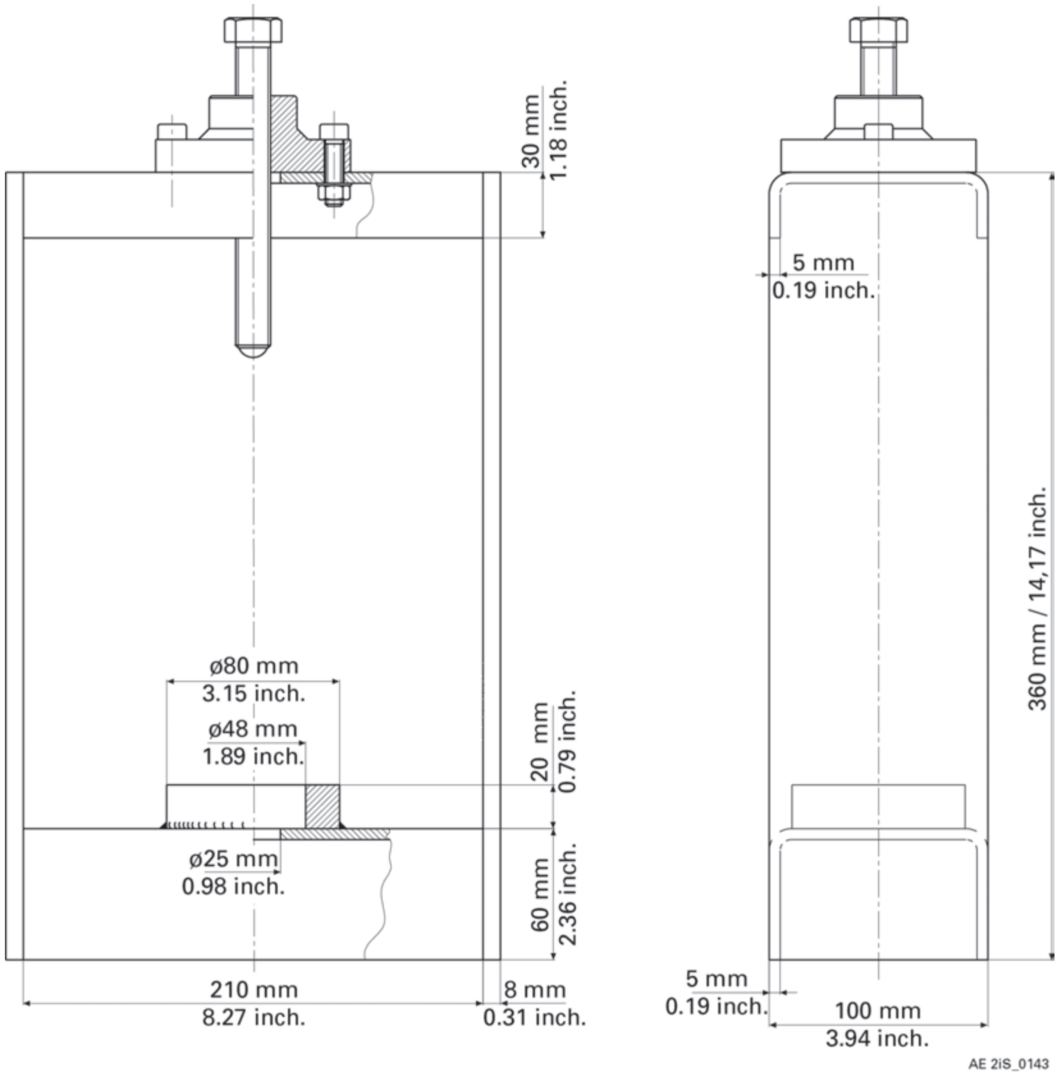

Figure 1.12: Disassembly device

Measuring tools

Calliper rule, dial gauge indicator, micrometer, inner micrometer, inner fine measuring device, feeler gauge, spring scale up to 50 kp (500 N) (112.5 lbf).

Accepted accuracy for different measuring tools:

Pressure: +/- 5%

Distances:

- Inside micrometer or similar: +/- 0.01 mm (0.0004 in.)
- Digital caliper or similar: +/- 0.001 mm (0.00004 in.)
- Bow micrometer or similar: +/- 0.002 mm (0.000079 in.)
- Caliper or similar: +/- 0.03 mm (0.0012 in.)

The changes above are accounting for:

- variations/errors of tools/measurement instruments (when used in normal operating conditions)
- accuracy of tools/measurement instruments and their related tolerance

Multimeter:

- FLUKE Series 70, Series 80 or equivalent
- Electronic, 3 1/2 digit indication
- Current range 10 A
- Direct voltage range 200 V minimum
- Resistance range 200 Ω to 2 MΩ
- Acoustic continuity tester

Oscilloscope:

TEKTRONIX 2225 or equivalent

- 2 channels
- Analog
- Sensitivity 5 mV to 5V/div
- Frequency limit 50 MHz

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Chapter: 24–20–00
INTERNAL GENERATOR

TOPICS IN THIS CHAPTER

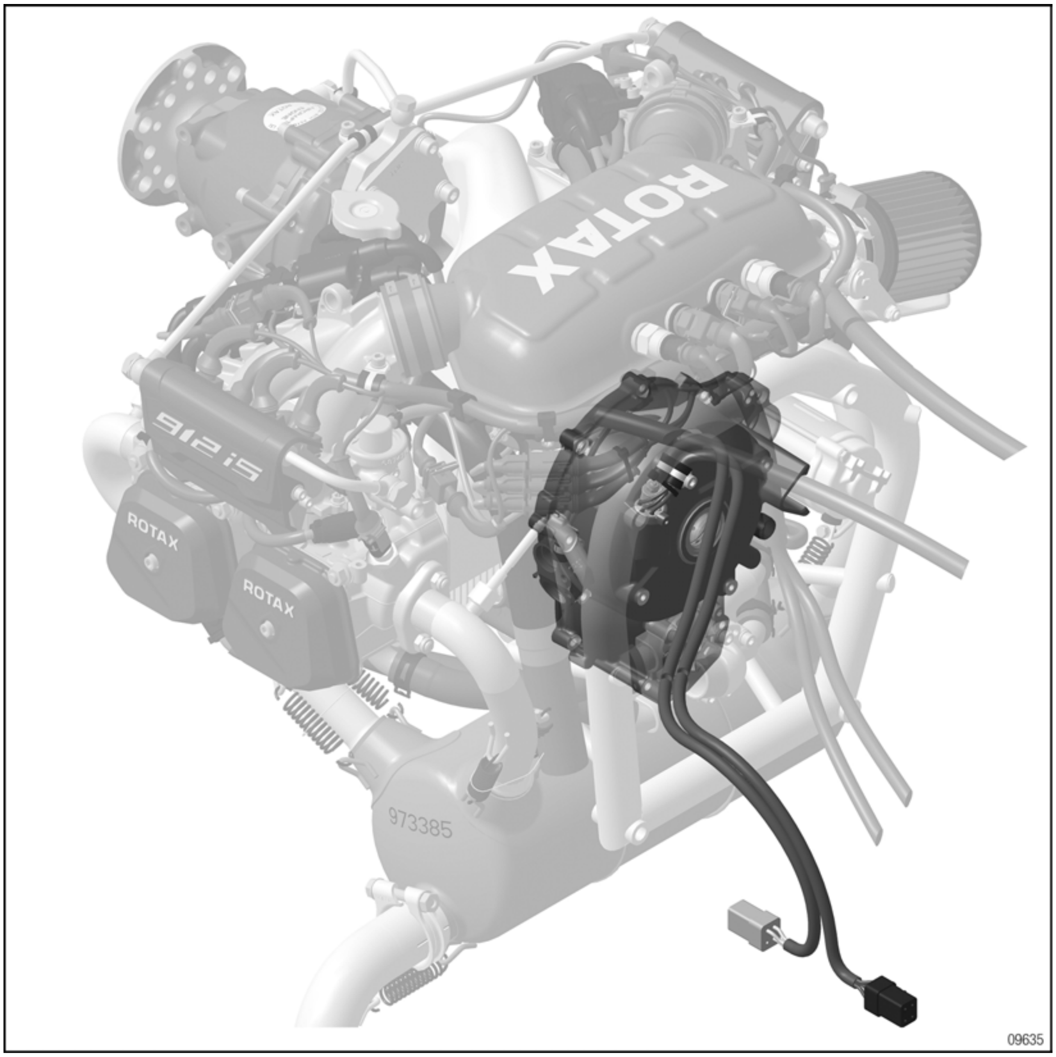

Figure 2.1: Location on the engine, TYPICAL

SPECIAL TOOLS

Description	Part number
Puller assy.	876010
Insertion jig	876020
Protection mushroom	876557
Locking pin	240880
Current measuring clamp	n.a.
Multimeter	n.a.

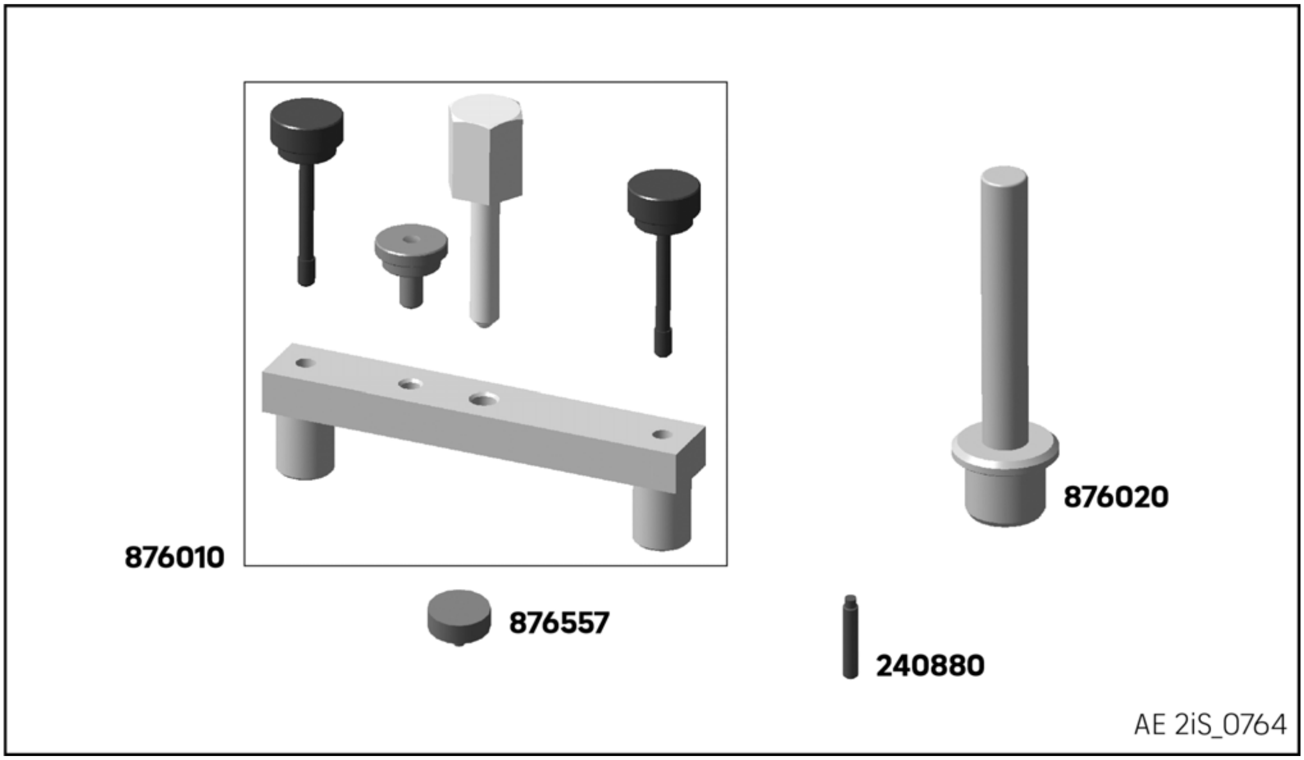

Figure 2.2: Special Tools

SERVICE PRODUCTS

Description	Part number
LOCTITE 243	897651
LOCTITE 648	899788
LOCTITE 603	899789
LOCTITE 5910	899791
LOCTITE 7063	n. a.
Engine oil	n. a.
Abrasive pad	n. a.

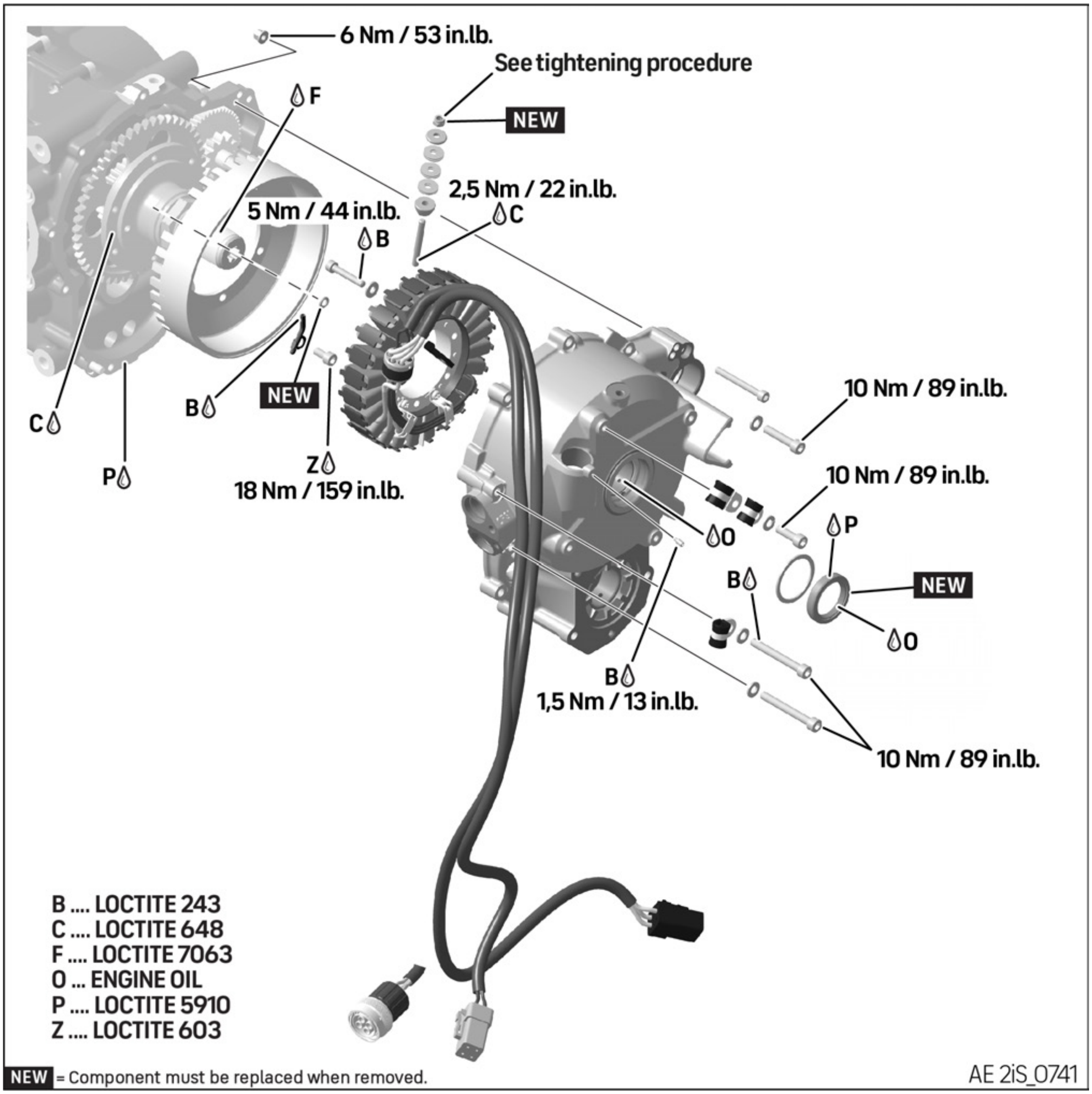
6 Nm / 53 in.lb.
See tightening procedure
NEW
2,5 Nm / 22 in.lb.
C
5 Nm / 44 in.lb.
F
B
C
B
NEW
P
Z
18 Nm / 159 in.lb.
10 Nm / 89 in.lb.
10 Nm / 89 in.lb.
P
O
B
NEW
O
B
1,5 Nm / 13 in.lb.
10 Nm / 89 in.lb.
B .... LOCTITE 243
C .... LOCTITE 648
F .... LOCTITE 7063
O ... ENGINE OIL
P .... LOCTITE 5910
Z .... LOCTITE 603
NEW = Component must be replaced when removed.
AE 2iS_0741

Figure 2.3

SYSTEM DESCRIPTION

This ROTAX® aircraft engine has an electronically controlled double-ignition system with an integrated generator.

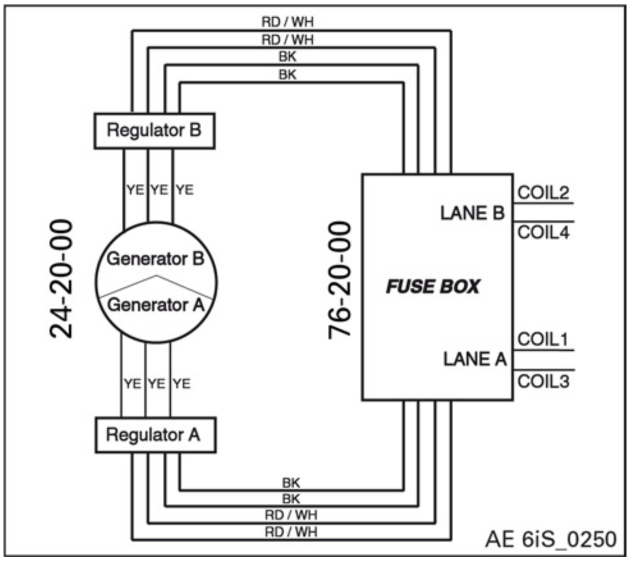

Figure 2.4: Schematic

EMS POWER SUPPLY

The EMS power supply consists essentially of 2 permanent magnet generators. The two 3-phase AC generators are physically separate power supplies which are integrated in the engine. One of the generators is used for the ECU and the other is available to the aircraft frame.

DRIVE

They are driven by the crank drive and do not need an external power supply once the engine has reached idle speed.

NOTE

Until idle speed is reached, a 12 V external power supply of the EMS from the aircraft's on-board power system is required.

SAFETY INSTRUCTION

⚠ WARNING

Danger of damage to engine! There is a risk of short circuits and cable fires during work on the electric system.
All installation work on the electric system should be carried out with the engine switched off and the battery (negative terminal) disconnected. Ignition, main and LANE selector switches must be “OFF””!

⚠ WARNING

Danger of severe burns and scalds! Always allow the engine to cool down to ambient temperature before starting any work.

ENVIRONMENTAL NOTE

Please observe the disposal regulations applicable in your area.

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.

MAINTENANCE

GENERAL INFORMATION – REMOVAL

Before the component is removed, the work described below must be carried out to identify any further faults in the component and rectify them as part of repair work.

BEFORE THE INTERNAL GENERATOR IS REMOVED

NOTICE

If these checks are omitted, it may be necessary to dismantle the product again to rectify any faults after repair work.

General visual inspection.
See Maintenance Manual Line (MML) for the respective engine type.

Engine cleaning.
See Maintenance Manual Line (MML) for the respective engine type.

Carry out an engine test run.
See Maintenance Manual Line (MML) for the respective engine type.

MEASUREMENT OF GENERATOR A AND B

General

NOTE

The engine must run during the measuring period (except resistance measurement) and the oil temperature must be > 80 °C (176 °F).

⚠ WARNING

Danger of death due to high voltage!
Only carry out work on the ignition unit with the appropriate protective measures and devices!

⚠ WARNING

Danger of life threatening injuries caused by the propeller, rotating and stressed parts of the engine!
Always observe the engine from a safe place while it is running. Check that the cockpit is occupied by a competent operator.

Voltage - measurement

NOTE

To perform the following tests on Generator B, the Battery Back-Up switch must be activated (see the aircraft manufactures operating instructions).

NOTE

All measurements must be performed at an engine speed from 2000 rpm to 5000 rpm in 1000 rpm steps.

Step	Procedure
1	Use a multimeter to check the voltage of each generator side one after the other. Disconnect stator connector A (Deutsch) from the regulator on the fuse box.
2	Measure the voltage between phase 1 and 2 on stator connector A.
3	Measure the voltage between phase 1 and 3 on stator connector A.
4	Connect the stator connector A to the regulator on the fuse box.
5	Disconnect stator connector B (amphenol) from the regulator on the fuse box.
6	Measure the voltage between phase 1 and 2 on stator connector B.
7	Measure the voltage between phase 1 and 3 on stator connector B.
8	Connect the stator connector B to the regulator on the fuse box.

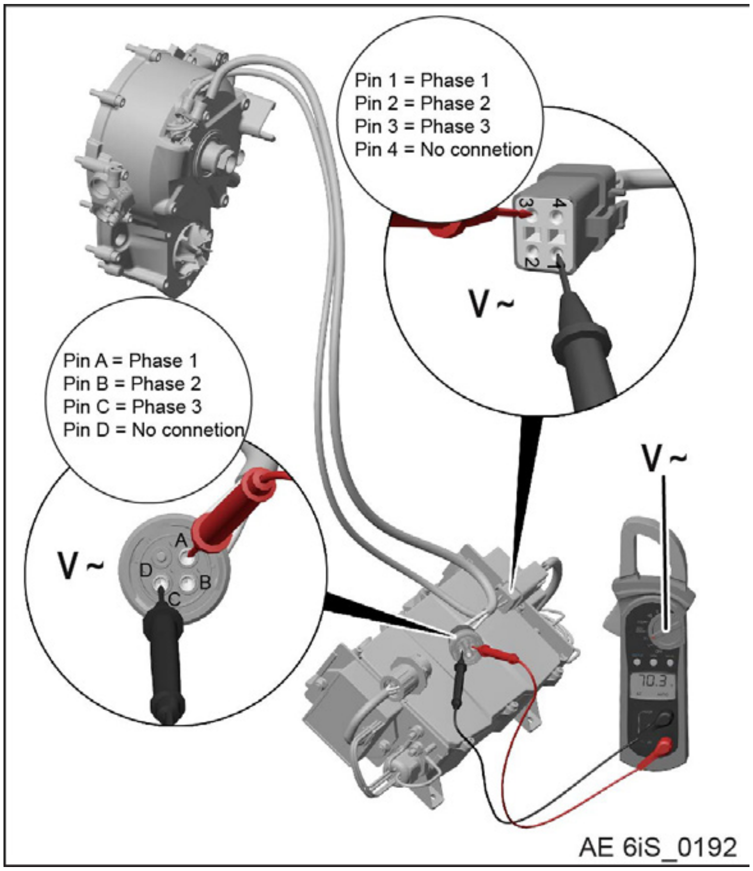

Figure 2.5: Check voltage of generator A and B

	Engine speed [rpm]	(Phase 1 to Phase 2) [Volts]			(Phase 1 to Phase 3) [Volts]	
		Min.	**Max.**	**Average**	**Min.**	**Max.**
GEN A	2000	32.40	33.50	33.10	32.70	33.70
	3000	50.00	50.40	50.20		
	4000	65.80	66.30	66.05	64.90	65.50
	5000	81.90	82.20	82.05		
GEN B	2000	31.50	32.60	32.05	31.60	32.60
	3000	46.50	46.70	46.60		
	4000	61.50	62.00	61.75	61.20	61.80
	5000	76.30	77.00	76.65		

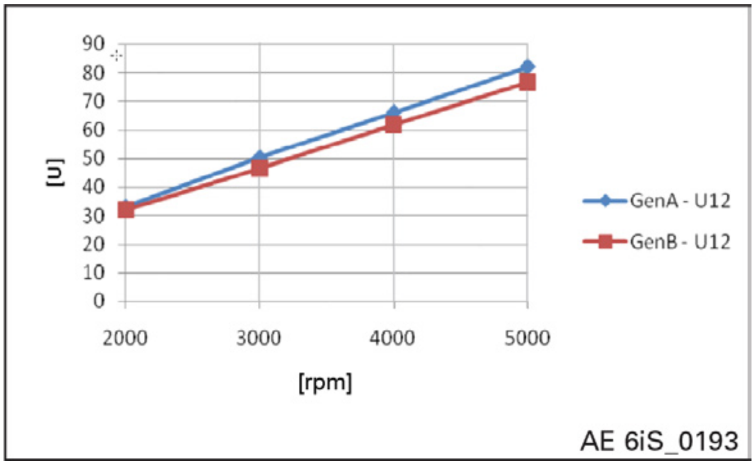

Figure 2.6: Diagram

Current - measurement

NOTE

For this measurement the generator must not be disconnected from the regulators.

NOTE

All measurements must be performed at an engine speed from 2000 rpm to 5000 rpm in 1000 rpm steps.

Step	Procedure
1	Use the current measuring clamp and place it over each phase, first P1 then P2 and at least P3 (on both stator connectors).

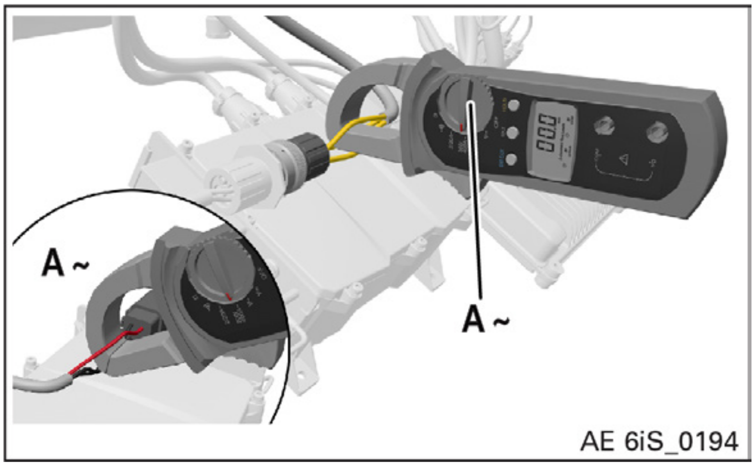

Figure 2.7: Check current of generator A and B

	Engine speed [rpm]	(Phase-1) [Amps]			(Phase-2) [Amps]		(Phase-3) [Amps]	
		Min.	**Max.**	**Aver.**	**Min.**	**Max.**	**Min.**	**Max.**
GEN A	2000	14.00	14.10	14.10	14.00	14.10	13.90	13.90
	3000	13.80	13.80	13.80				
	4000	13.70	13.70	13.70	13.50	13.50	13.70	13.70
	5000	13.50	13.50	13.50				
GEN B	2000	22.70	22.80	22.80	22.50	22.60		
	3000	23.50	23.60	23.60				
	4000	23.60	23.60	23.60	23.30	23.30		
	5000	23.00	23.00	23.00				

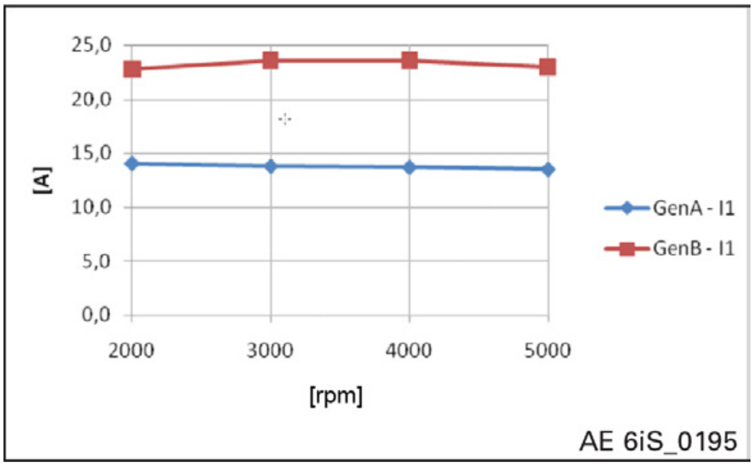

Figure 2.8: Diagram

Resistance - measurement

NOTE

At resistance measurements the engine must not run.

NOTE

This measurement can also be done on a disassembled stator.

Step	Procedure
1	Disconnect stator connectors A and B from the regulators on the fuse box.
2	Measure the resistance between phase 1 and 2, 1 and 3, 2 and 3 on stator connector A.
3	Measure the resistance between phase 1 and 2, 1 and 3, 2 and 3 on stator connector B.
4	Connect stator connectors A and B on the regulators on the fuse box.

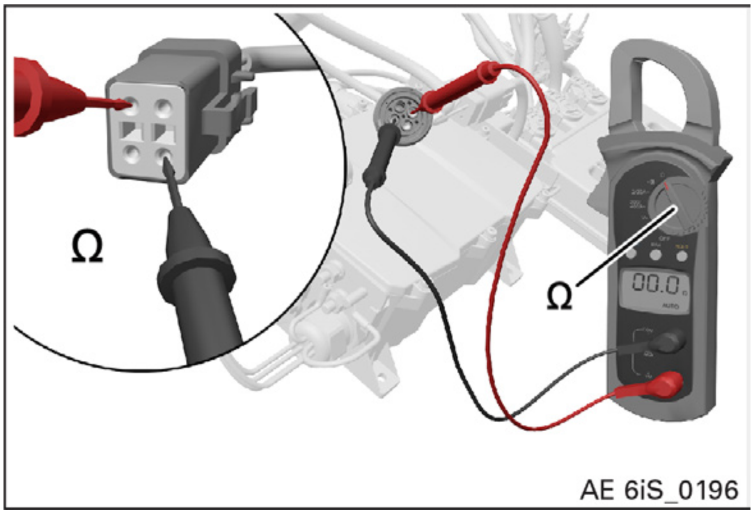

Figure 2.9: Check resistance of generator A and B

Limit	(Phase -1 to Phase -2) [Ohms]	(Phase -1 to Phase -3) [Ohms]	(Phase -2 to Phase -3) [Ohms]
GEN A	0.6	0.6	0.6
GEN B	0.3 - 0.4	0.3 - 0.4	0.3 - 0.4

REMOVAL

Preparation

NOTICE
Use appropriate protective coverings to prevent the ingress of foreign bodies into connected lines and connections.

Drain coolant. See current Maintenance Manual Line (MML) for the respective engine type.

Drain oil. See current Maintenance Manual Line (MML) for the respective engine type.

- Turn the ignition switch OFF.
- Remove coolant hoses from cylinder head, water inlet elbow and water pump housing. See Chapter 75-00-00 section Water pump housing with lower form hoses — removal
- Remove the electric starter. See Chapter 80-00-00 section
- Remove crankshaft position sensors (CPS_1/2). See Chapter 76-70-00 section Crankshaft position sensor (CPS_1/CPS_2) — removal.

NOTE

The assemblies and lines are only to be removed if necessary.

IGNITION HOUSING – REMOVAL

NOTE

Engines produced 2019 and later have for generator B a round Amphenol connector.

Step	Procedure
1	Detach the electrical connection to the stator by disconnecting the connector (stator).
2	Press in the latch on the top of the connector (Generator A Deutsch black and Generator B Deutsch gray) or unscrew the connector (Generator B Amphenol) and disconnect the connectors.

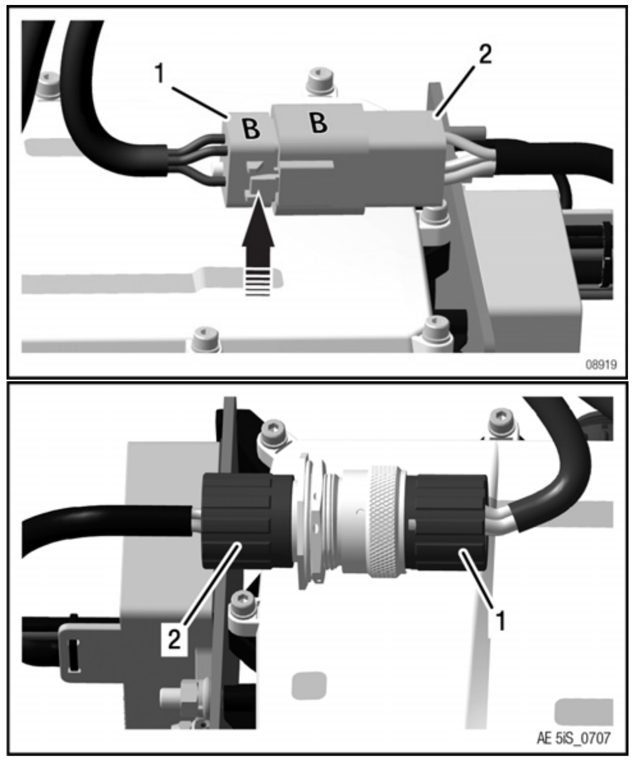

Figure 2.10

1 Controller connector *2 Connection socket*

Step	Procedure
3	Loosen the airbox bracket. Loosen the lock nut and remove it along with the washer.

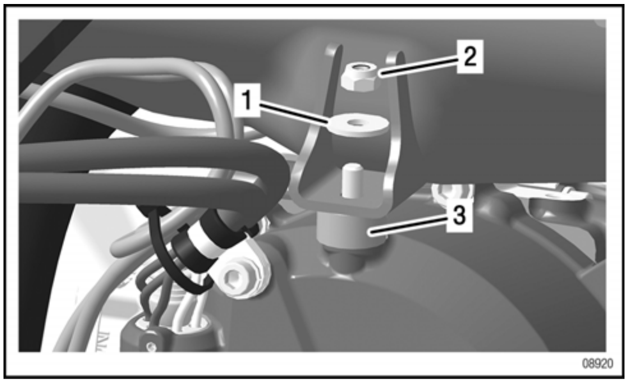

Figure 2.11

1	*Washer A 6.4*	2	*Lock. nut M6*
3	*Rubber buffer*		

NOTE

Push airbox upwards and wedge in place.

Step	Procedure
4	Loosen 2 Allen screws and hex. nuts on electric starter position.

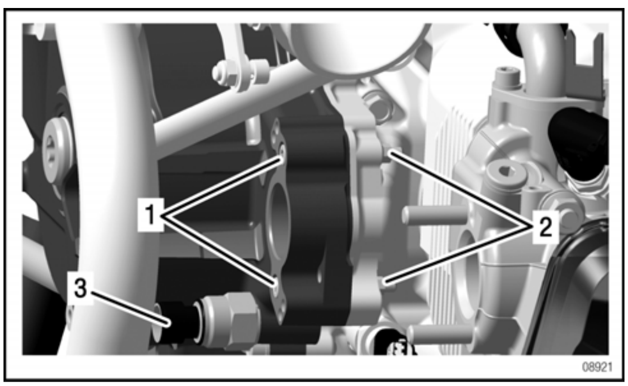

Figure 2.12

1	*Allen screw*	2	*Hex. nut*
3	*Oil pressure sensor (OPS)*		

Step	Procedure
5	Loosen 5 Allen screws M6x30 and 2 Allen screws M6x50 with washers 6.4.
6	Disconnect Oil Pressure Sensor (OPS).

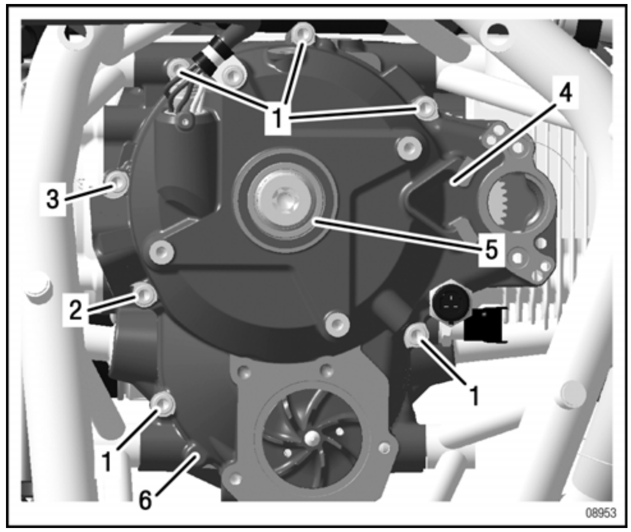

Figure 2.13

1	*Allen screws M6x30*	2	*Allen screws M6x50*
3	*Allen scree M6x50*	4	*Ignition housing assy.*
5	*Oil seal*	6	*Dowel pin*

Step	Procedure
7	Place the protection mushroom part no. 876557 with a little bit of grease on the crankshaft and use a puller part no. 876010 to take off the ignition housing.

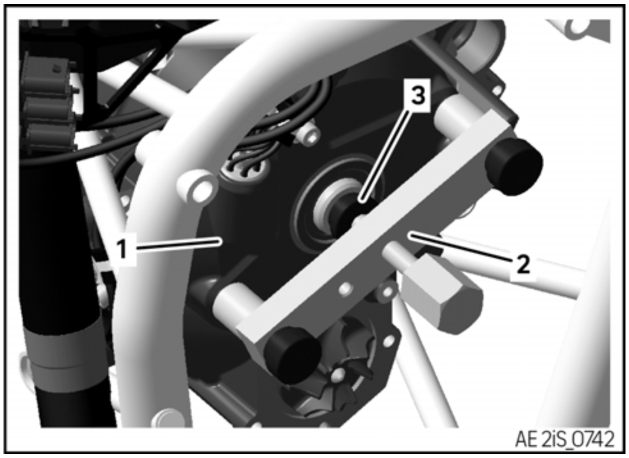

Figure 2.14

1	*Ignition housing assy.*	2	*Puller assy. part. no. 876010*
3	*Protection mushroom part no. 876557*		

Step	Procedure
8	Remove O-ring from the crankcase or the ignition housing.

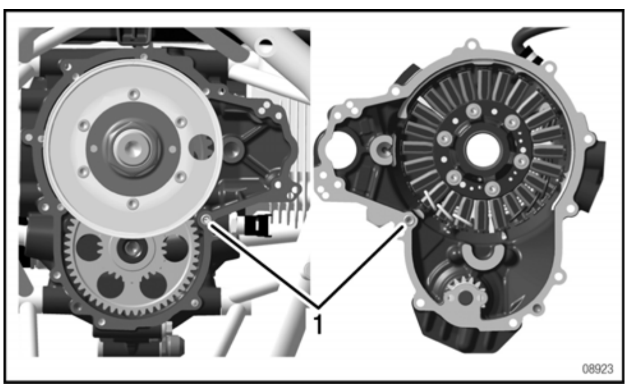

Figure 2.15: TYPICAL

1 O-ring 5x2

SEALING OF THE PLUG SCREWS

NOTE

Only for the first engine series.

Step	Procedure
1	The plug screws must be removed and degreased for possible leaks.
2	Secure plug screws with LOCTITE 243 and tighten it. Tightening torque 6 Nm (53 in.lb.).

NOTICE

Take care not to damage the oil seal contact surface in the ignition housing.

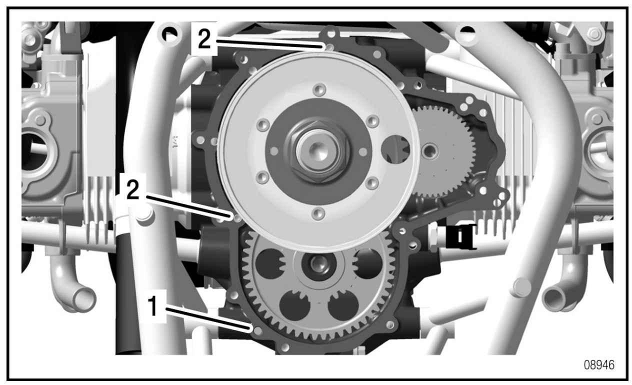

Figure 2.16: TYPICAL

1	*Dowel pin*	2	*Plug screws*

FLY WHEEL ASSY. REMOVAL

Preparation

NOTE

The fly wheel assy. does not have to be disassembled for changing the sprag clutch. For instructions see Chapter 72–20–00, section Removal.

Step	Procedure
1	Loosen 6 Allen screws.
2	If necessary, remove oil spray nozzle from the oil outlet of the sprag clutch housing. See also current SI-912 i-028 for further information.
3	Remove the fly wheel.

NOTE

The location of the fly wheel does not have to be marked on the freehub body.

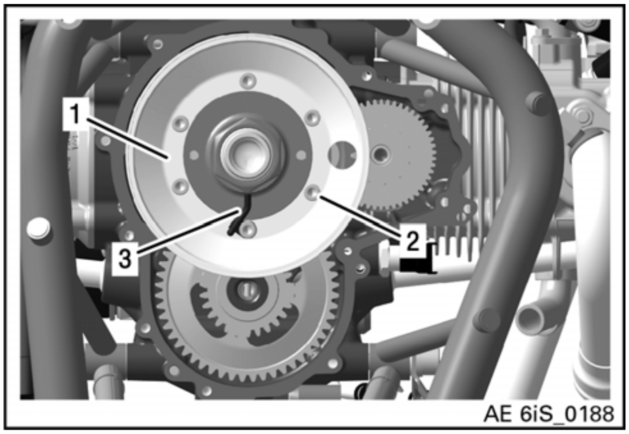

Figure 2.17: TYPICAL

1	*Fly wheel*	2	*Allen screw*
3	*Oil spray nozzle*		

STATOR ASSY. — REMOVAL

NOTICE

Mark cables and connectors before removing the connector receptacle. Generator A and B have different sizes and power.

Step	Procedure
1	Mark cables and connectors. See following Figures.

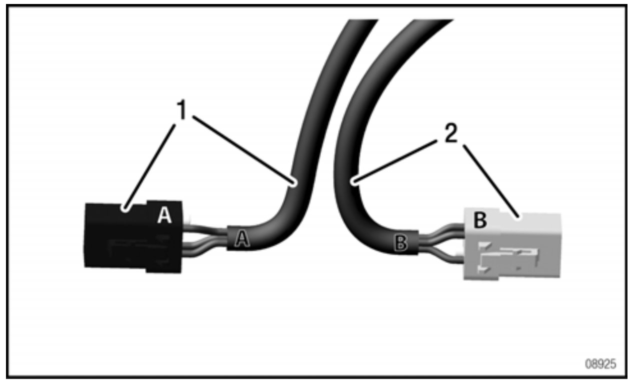

Figure 2.18

1	*Generator coil A (black connector)*	2	*Generator coil B (gray connector)*

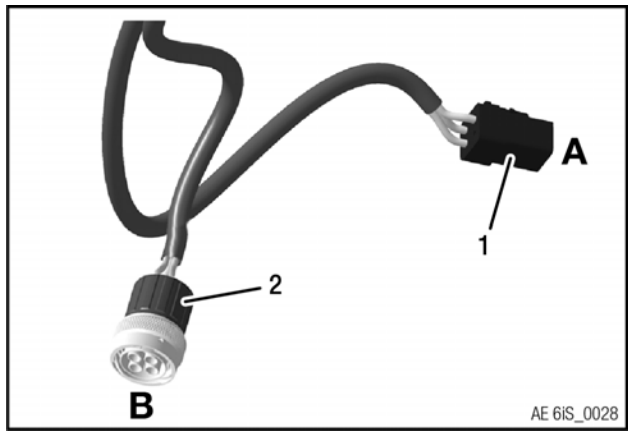

Figure 2.19

1	*Stator connector A (DEUTSCH)*	2	*Stator connector B (AMPHENOL)*

Stator connector A and B (DEUTSCH) - disassembly

Step	Procedure
2	Pull out the orange latch with a needle nose pliers.

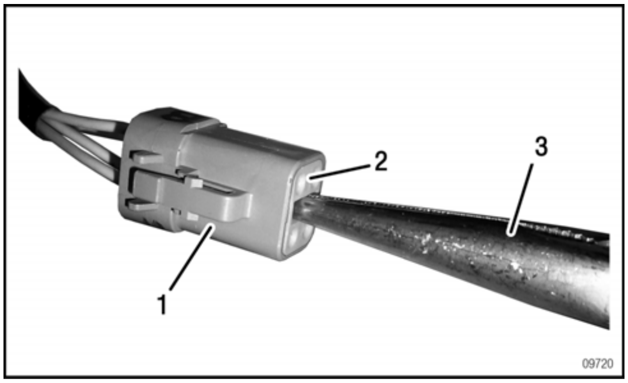

Figure 2.20

1 *Connector*	2 *Latch*
3 *Needle nose pliers*	

Step	Procedure
3	Bend back the retaining tab and at the same time carefully pull on the cable until the terminal is detached.

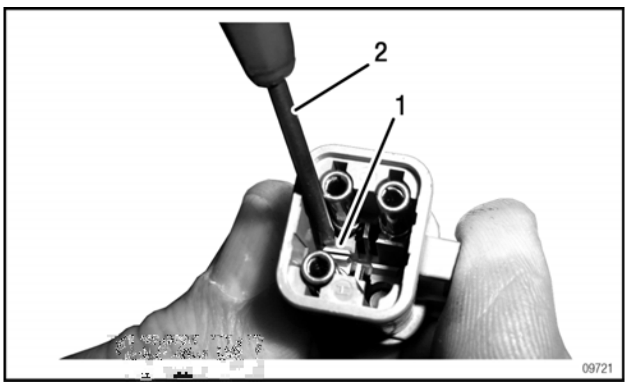

Figure 2.21

1 *Retaining tab*	2 *Screwdriver*

Step	Procedure
4	Pull off the rubber seal.

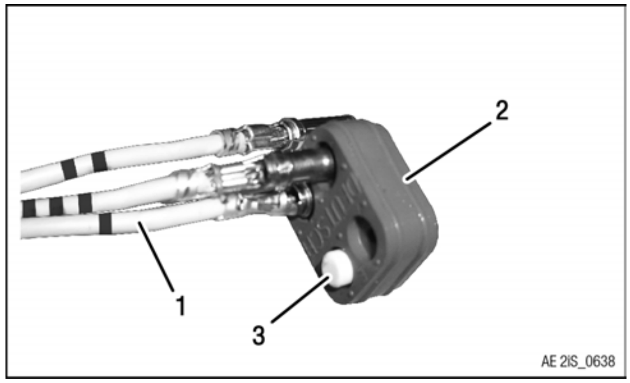

Figure 2.22

1 *Cable*	2 *Rubber seal*
3 *Filler plug*	

Stator connector B (AMPHENOL) - disassembly

NOTE

Note the location and orientation of the cable clamps for reassembly! (Back to Back)

Step	Procedure
5	Unscrew the connector cap and remove the rubber seal out of the sleeve.
6	Mark the position of wires.
7	Push each pin out using a pin extractor tool.

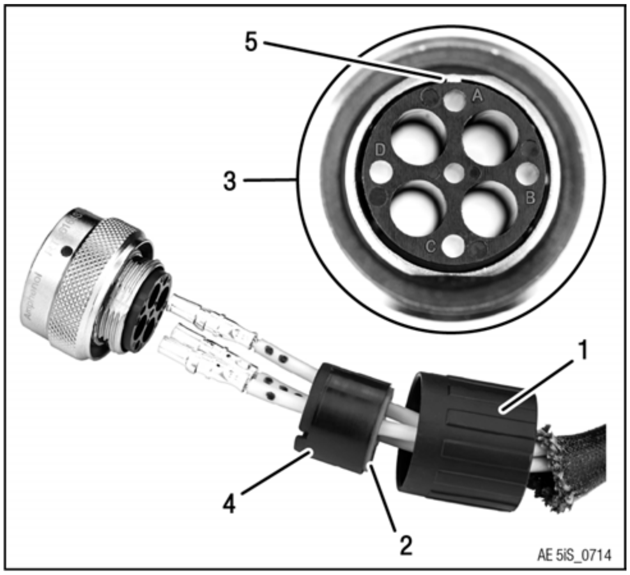

Figure 2.23

1	*Connector cap*	2	*Rubber seal*
3	*Position letter*	4	*Sleeve*
5	*Key slot*		

Step	Procedure
8	Unscrew Allen screw and remove with lock washer and cable clamps.
9	Unscrew lock nut and remove the washer, disk springs and distance sleeve.

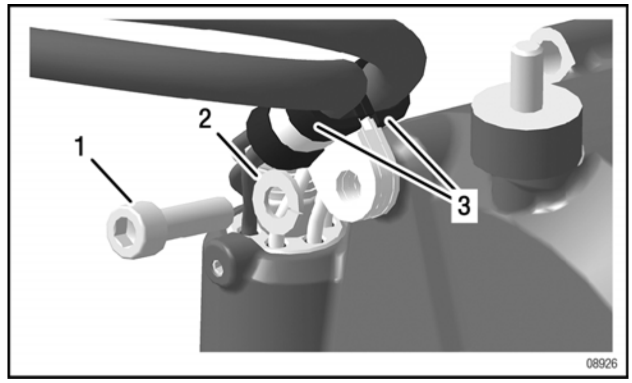

Figure 2.24

1	*Allen screw*	2	*Lock washer*
3	*Cable clamp*		

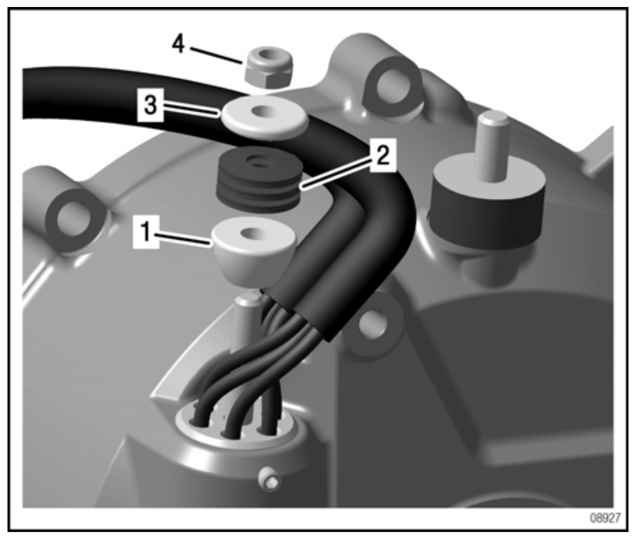

Figure 2.25: TYPICAL

1	*Distance sleeve*	2	*Disk springs (6 pcs.)*
3	*Washer 5.1/15.5/2.5*	4	*Lock nut M5*

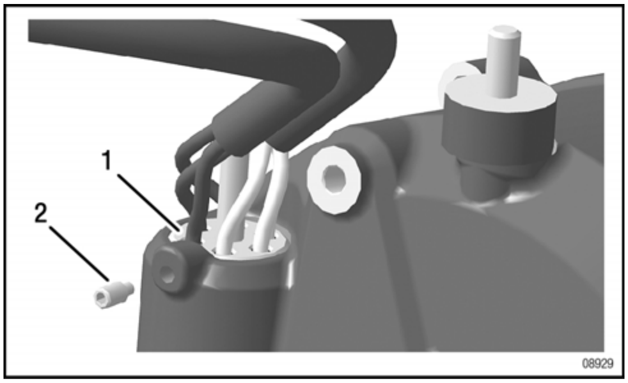

Figure 2.26

1	*Grommet*	*2*	*Adjustment screw M4x8*

Step	Procedure
10	Remove the adjustment screw.
11	Loosen 6 Allen screws with washers and remove stator assy.

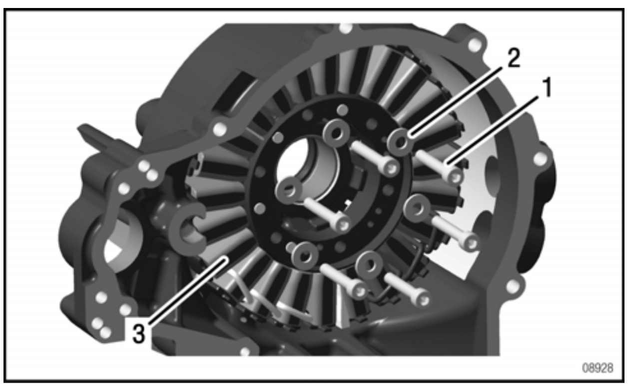

Figure 2.27

1	*Allen screw M5x30*	*2*	*Washer A 5.5*
3	*Stator assy.*		

Step	Procedure
12	Push the grommet in and pull the cable out.

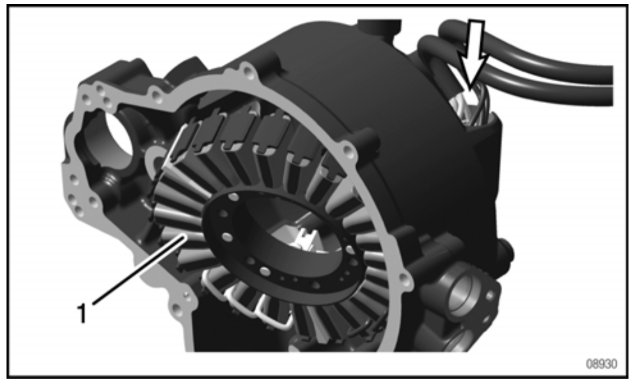

Figure 2.28

1 *Stator assy.*

INSPECTION

IGNITION HOUSING — CHECK

Clean all parts carefully. See current Maintenance Manual Line (MML) for the respective engine type.

Step	Procedure
1	Carry out visual inspection of sealing surfaces.
2	Unscrew oil pressure sensor (OPS). To do this, see Chapter 76-70-00 section Sensors and actuators.

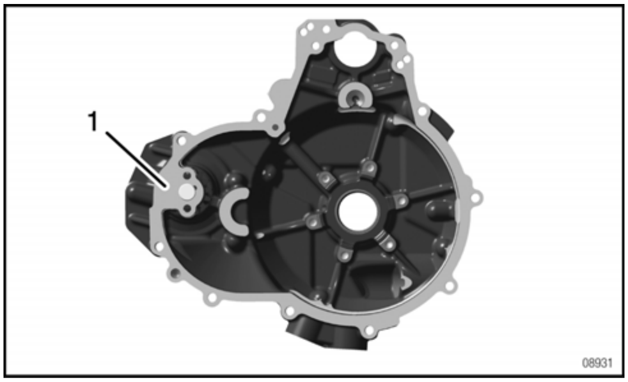

Figure 2.29

1 Sealing surface

Step	Procedure
3	Blow compressed air through the lubrication bore and check it is clear.
4	Check that the pressed–in ball is sealed.

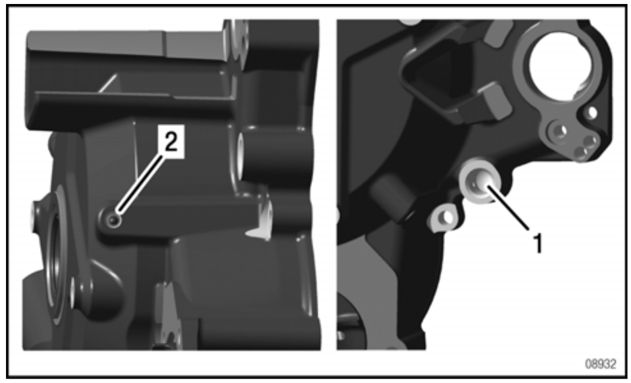

Figure 2.30

1 Lubrication bore
2 Caulked ball

Step	Procedure
5	Check the sealing surface of the rubber grommet for scratches (especially lengthways).

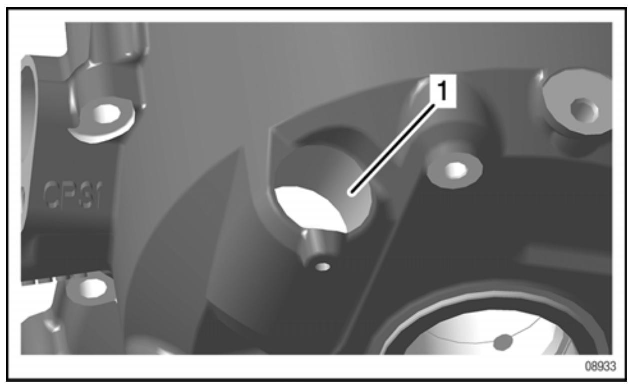

Figure 2.31

1 Sealing surface for rubber grommet

BEARING BUSHING — INSPECTION

NOTE

It is not possible to replace the bearing bushing, as the inner bore and the lubrication bore are machined after the bushing has been pressed. If the bearing bushing is worn, the entire ignition housing must be replaced.

Step	Procedure
1	Check the bearing bushing for damage and wear.
2	Check that the oil bore is clear.

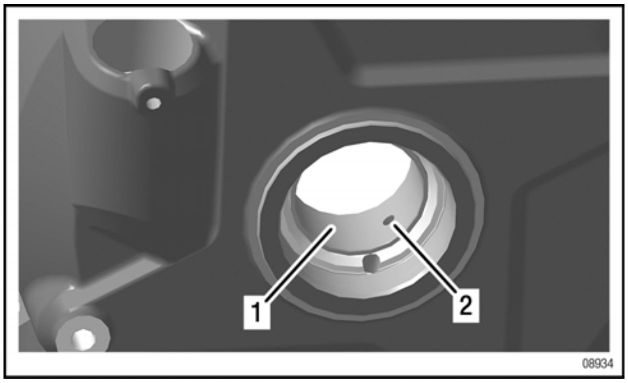

Figure 2.32

1 Bearing bushing *2 Oil bore*

STATOR ASSY. AND FLYWHEEL ASSY. — INSPECTION

NOTICE

Danger of consequent damage to engine!
The stator may not be repaired! If the stator or its wiring is damaged or worn, it must be replaced with a new part.

NOTICE

Signs of wear on the magnets are not permissible!
If the fly wheel or its magnets are damaged or worn, replace the whole part.

Step	Procedure
1	Carry out a visual inspection of the fly wheel assy. and stator assy. and wiring, checking for damage and wear.

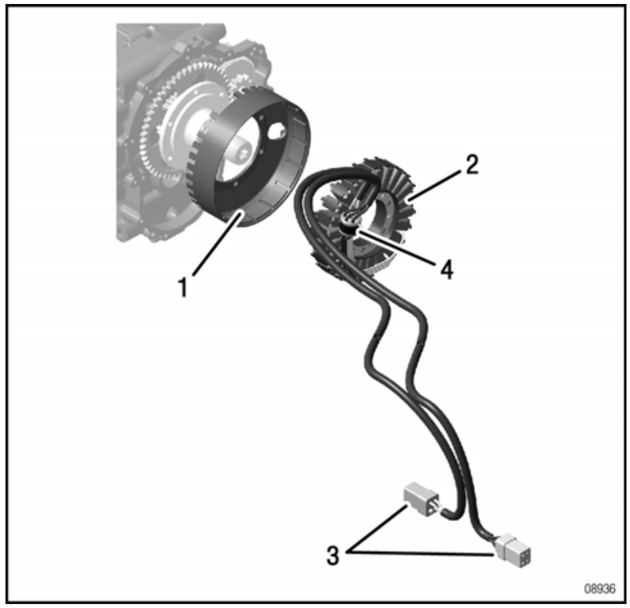

Figure 2.33: TYPICAL

1 Fly wheel assy. *2 Stator assy.*

3 Stator connectors A, B *4 Grommet*

CRANKSHAFT POSITION SENSOR (CPS_1/CPS_2) — INSPECTION

To inspect the crankshaft position sensor see Chapter 76-70-00 section Crankshaft position sensor (CPS_1/CPS_2) — inspection.

OIL PRESSURE SENSOR (OPS) – INSPECTION

To inspect the oil pressure sensor see Chapter 76-70-00, section Oil pressure sensor (OPS) — inspection.

WEAR LIMITS

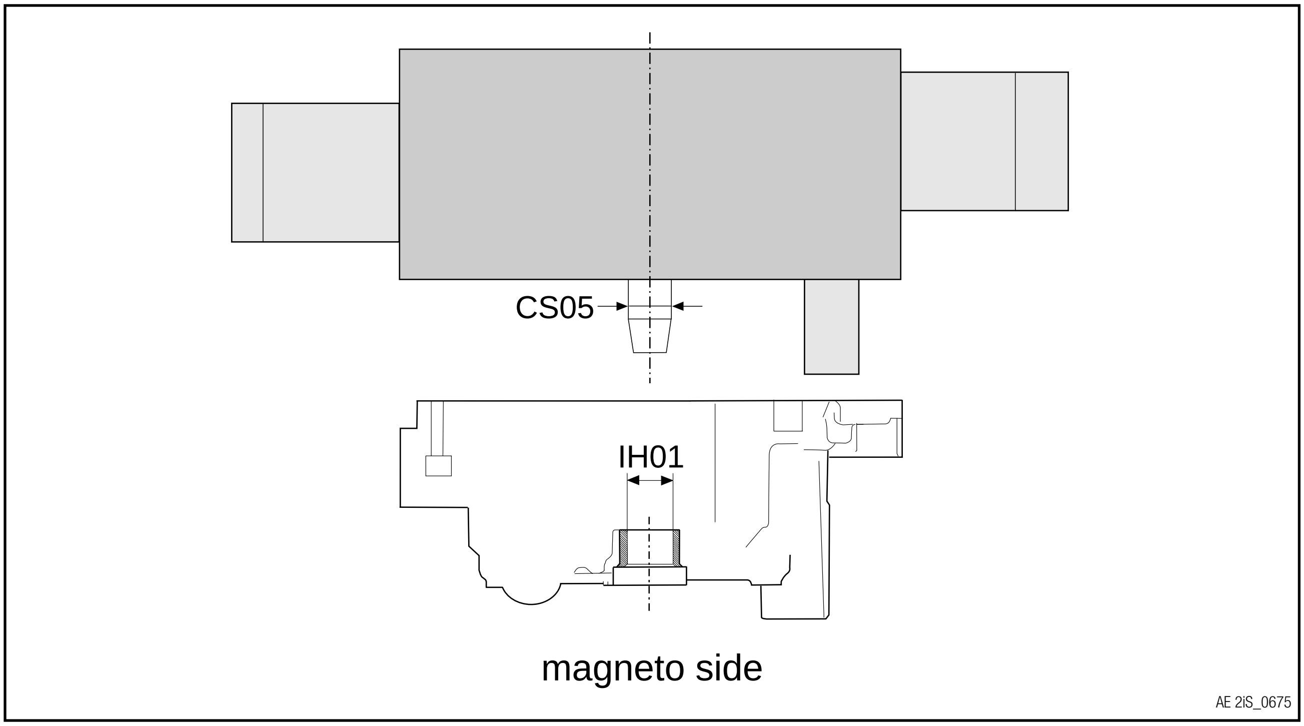

Figure 2.34: Ignition housing

Description	Code	Current measurement value		Tolerance limit	Tolerance limit		Measure-ments
		min	max	100 %	50 %		
Bearing bush-ing in ignition housing	IH01	28.04 mm 1.104 in.	28.05 mm 1.1044 in.	28.11 mm 1.1067 in.	28.08 mm 1.1055 in.	current replaced	
Radial clearance	IH01/ CS05	0.03 mm 0.0012 in.	0.05 mm 0.0020 in.	0.12 mm 0.0047 in.	0.09 mm 0.0033 in.	current replaced	
Crankshaft end	CS05	27.970 mm 1.1012 in.	28.000 mm 1.103 in.	27.930 mm 1.0996 in.	27.950 mm 1.1004 in.	current replaced	

ASSEMBLY

IGNITION HOUSING — ASSEMBLY

NOTICE
All gaskets, O-rings and oil seals must be replaced!

NOTE

Polish and then clean the contact surface for the oil seal.

OIL SEAL REPLACEMENT

NOTE

There is a 1.5 mm (0.06 in.) washer behind the oil seal.

Step	Procedure
1	If the crankshaft is damaged or worn in the area of the oil seal sealing lip, the channel in the sealing lip can be moved 1.5 mm (0.06 in.) by omitting the washer.

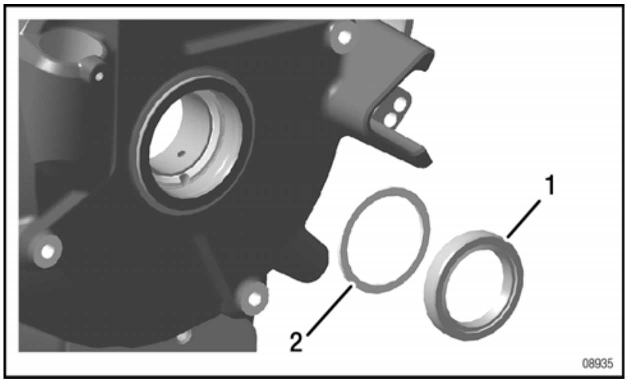

Figure 2.35

1 Oil seal *2 Washer*

OIL SEAL — INSTALLATION

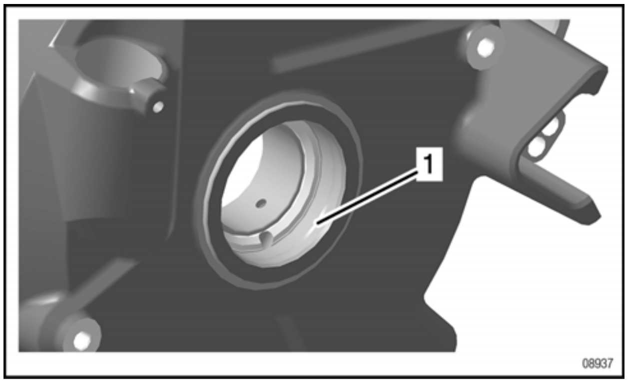

Figure 2.36

1 Contact surface

Step	Procedure
1	Place new oil seal on insertion jig part no. 876020 and lubricate. Outer: LOCTITE 5910. Inner: Engine oil.

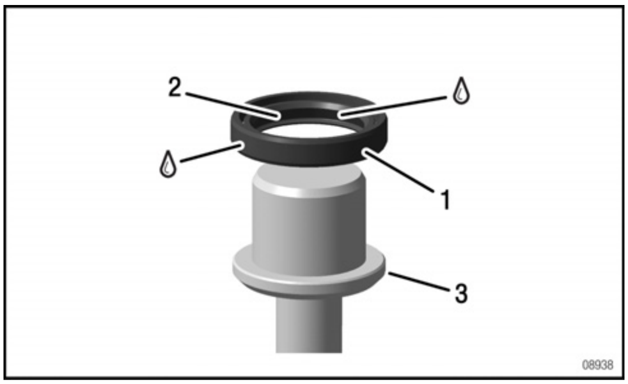

Figure 2.37

1 Outer oil seal *2 Inner oil seal*

3 Insertion jig part no. 876020

Step	Procedure
2	Using a soft-faced hammer, tap the oil seal with the insertion jig to press it in to the ignition housing as far as it will go.

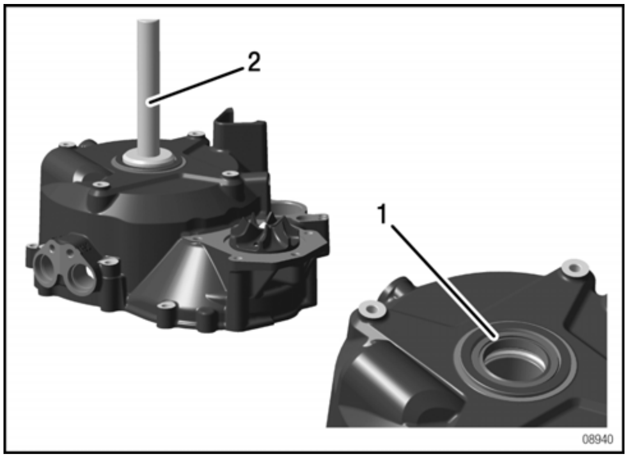

Figure 2.38: TYPICAL

1 Oil seal positioned *2 Insertion jig part no. 876020*

STATOR ASSY. — INSTALLATION

Step	Procedure
1	Thread in the cable and position the rubber grommet, then secure adjustment screw M4x8 with LOCTITE 243 and tighten it. Tightening torque 1.5 Nm (13 in.lb.).

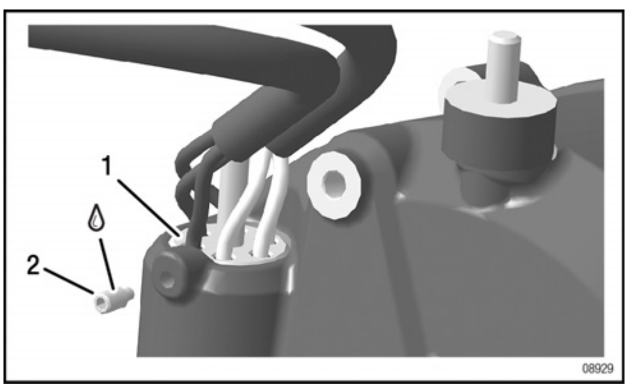

Figure 2.39

1 Rubber grommet *2 Adjustment screw M4x8*

Step	Procedure
2	Position the stator assy. Then secure 6 Allen screws M5x30 including washers A 5.5 with LOCTITE 243 and tighten them. Tightening torque 5 Nm (44 in.lb.).

NOTE

The separation paper of the two generator coils are in proximity with the water pump gear.

NOTE

When positioning, make sure there is as little spacing possible between the cable lead-through in the ignition cover and the cable connection to the coils.

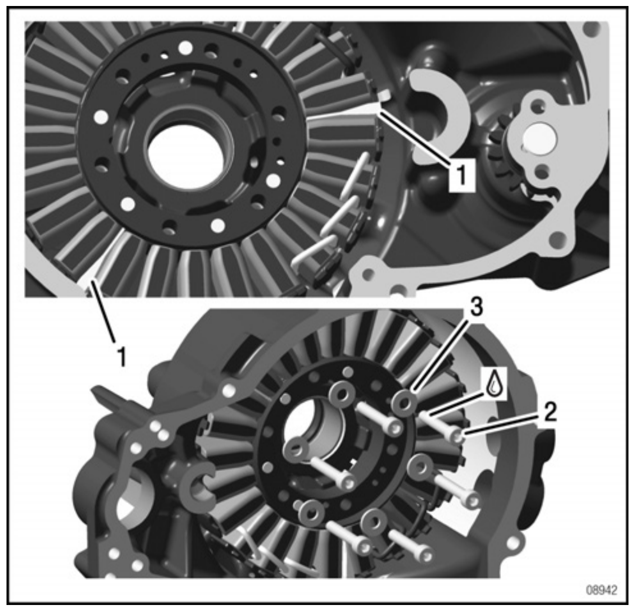

Figure 2.40

1 Separation paper between the two generator coils

3 Allen screw M5x30 *4 Washer A 5.5*

Step	Procedure
3	If necessary, tighten stud M5x44 with the shorter thread into the grommet using LOCTITE 648. Tightening torque 2.5 Nm (22 in. lb).

4	Install the distance sleeve, disk springs 15x5.2x0.7 and washer 5.1/15.5/2.5.
5	Tighten new lock nut M5. Tightening torque 3 Nm (27 in. lb.) and then open counter-clockwise by 1.5 turns.
6	Slip on the full length of the black protection hoses.

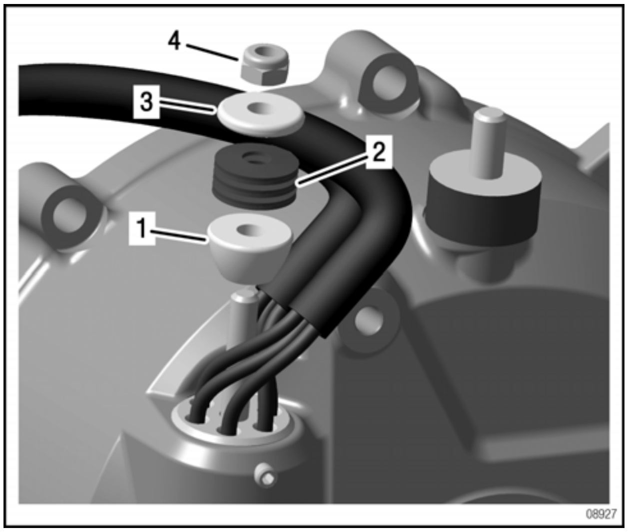

Figure 2.41: TYPICAL

1	*Distance sleeve*	2	*Disk springs 15x5.2x0.7*
3	*Washer 5.1/15.5/2.5*	4	*Lock nut M5*

STATOR CONNECTORS - INSTALLATION

Stator connector A, black (Deutsch) - installation

NOTE

Engines produced before 2019 also have a gray stator connector B (Deutsch).

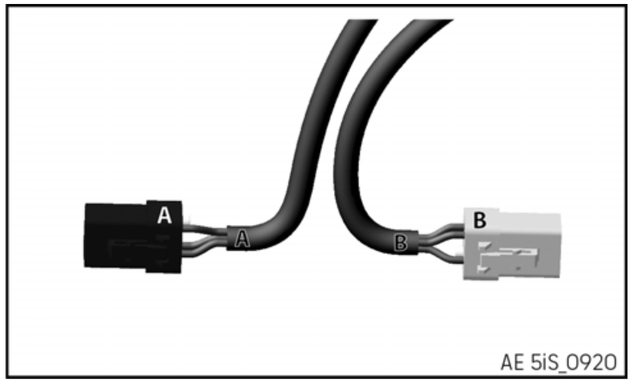

Figure 2.42

Step	Procedure
1	Position the filler plug correctly. Position wires correctly to connector pin labels, using previously applies marks on wire insulation.
2	Thread the lines through the insulator (rubber).
3	Make the cable pins latch.

NOTE

Cables of generator B are thicker than cables of generator A. Cables of generator B are yellow.

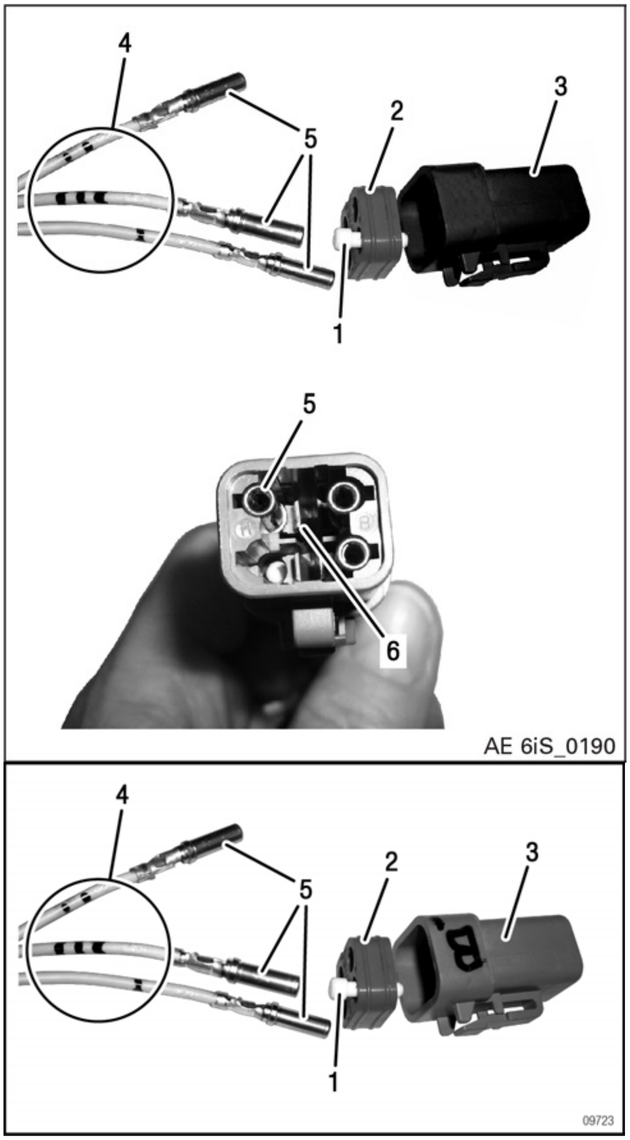

Figure 2.43

1	*Filler plug*	2	*Insulator (rubber)*
3	*Connector receptacle*	4	*Marks*
5	*Cable pins*	6	*Latch*

Step	Procedure
4	Install the orange lock

Part no. of connector set	Corresponding tool
866420 (black)	DEUTSCH HDT- 48 - 00
866422 (gray)	DEUTSCH HDT- 48 - 00

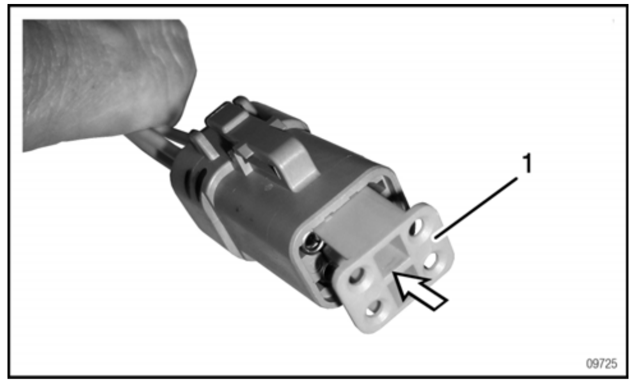

Figure 2.44: TYPICAL

1 *Lock*

NOTE

At malfunctions such as wire breakage and faulty plugs, the particular damage can be repaired.
Cable must be long enough after repair is made. Repair of malfunctions with the tools mentioned here must conform to the aircraft standards of the respective country.

See also relevant Illustrated Parts Catalog (IPC) for the respective engine type.

Stator connector B (Amphenol) - installation

NOTE

Engines produced before 2019 also have a gray stator connector B (Deutsch).

NOTE

Cables of generator B are thicker than cables of generator A. Cables of generator B are yellow.

Step	Procedure
1	Install connector cap, push the rubber seal into the sleeve and push it onto the cables.
2	Push each wire into connector until its pin snaps securely in place.

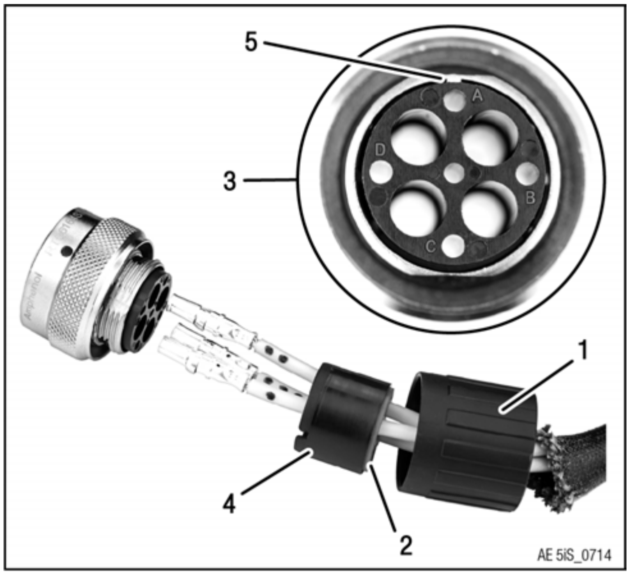

Figure 2.45

1 Connector cap *2 Rubber seal*
3 Position letter *4 Sleeve*
5 Key slot

NOTE

Correctly secured pins will travel further into connector and lock in place.

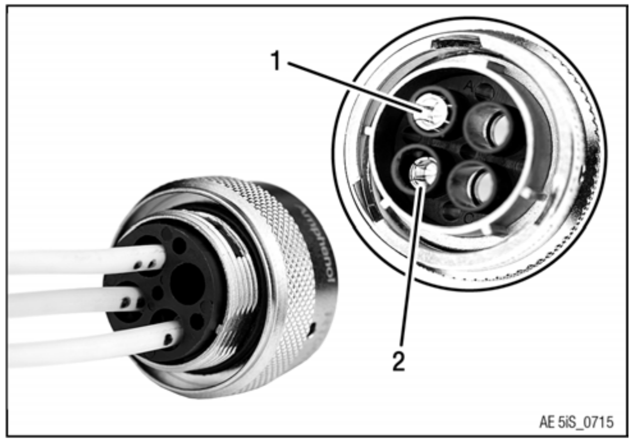

Figure 2.46

1 Secured pin *2 Un-secured pin*

Step	Procedure
3	With all connector pins secured, push the sleeve and screw on the connector cap. **NOTE** *The sleeve and the key slot have to be aligned.*
4	Place plastic sealing plug into empty position of the rubber seal.

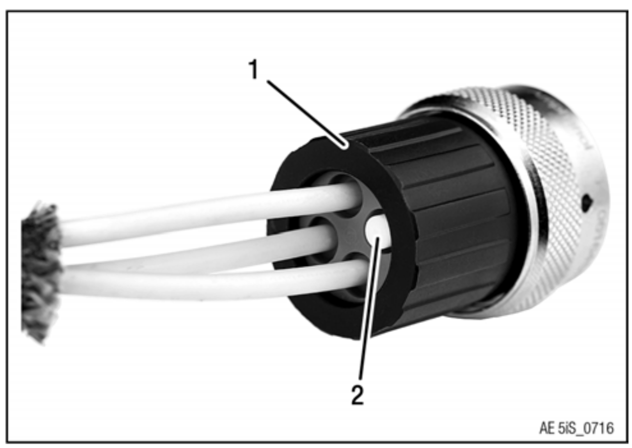

Figure 2.47

1 Connector cap *2 Plastic sealing plug*

Step	Procedure
5	Install cable clamps 8/M6.

NOTE

The bends of the cable clamps must be installed in an opposed manner (back to back).

Step	Procedure
6	Adjust cables. Tighten Allen screw M6x20 with lock washer A6. Tightening torque 10 Nm (89 in. lb.).

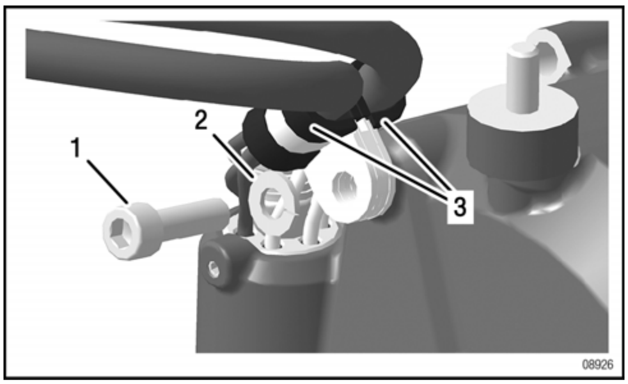

Figure 2.48

1 *Allen screw M6x20*
2 *Lock washer A6*
3 *Cable clamps 8/M6*

INSTALLATION

FLY WHEEL ASSY. — INSTALLATION

NOTE

Clean all flat surfaces of the sprag clutch housing.

Step	Procedure
1	Apply a small thin layer of LOCTITE 648 to the flat surface of the sprag clutch housing.
2	Place fly wheel on top.
3	If necessary, install oil spray nozzle at oil outlet of the sprag clutch housing using LOCTITE 243 and screw it together with the magneto fly wheel. **NOTE** *Use only a thin amount of LOCTITE 243 to be sure not to clog the oil spray nozzle. See also relevant SI-912 i-028 for further information.*
4	Secure 6 Allen screws M6x12 (12.9 screw strength) with LOCTITE 603 and tighten them. Tightening torque 18 Nm (159 in. lb.).

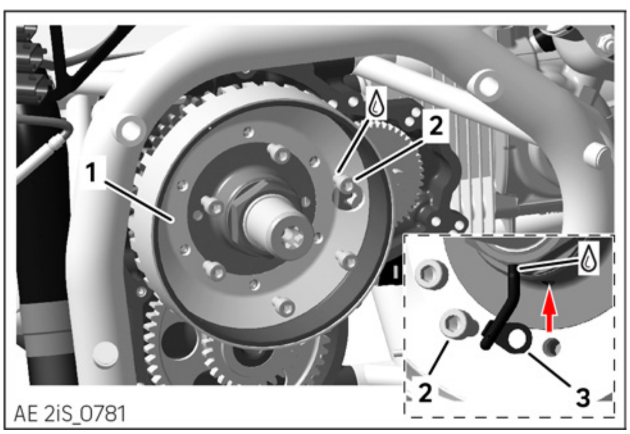

Figure 2.49

1 Magneto fly wheel *2 Allen screw M6x12*

3 Oil spray nozzle

IGNITION HOUSING ASSY. — INSTALLATION

Preparation

- Check whether dowel pin has been inserted

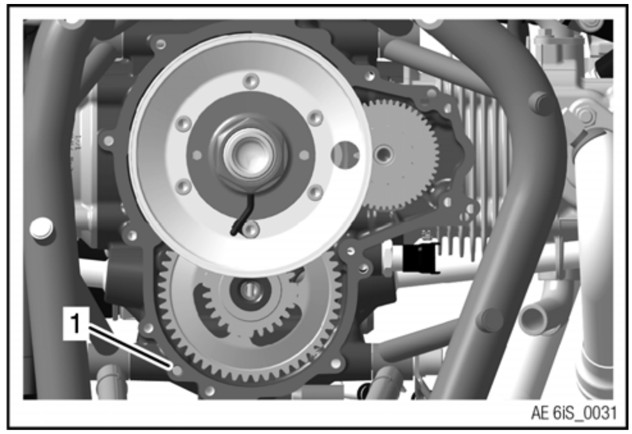

Figure 2.50: : TYPICAL

1 Dowel pin 6x20

Step	Procedure
1	Lubricate oil seal, bearing bushing and crankshaft stub with Engine oil.
2	Insert new O-ring 5x2 into the crankcase and lubricate with Lithium-base grease to hold in position.

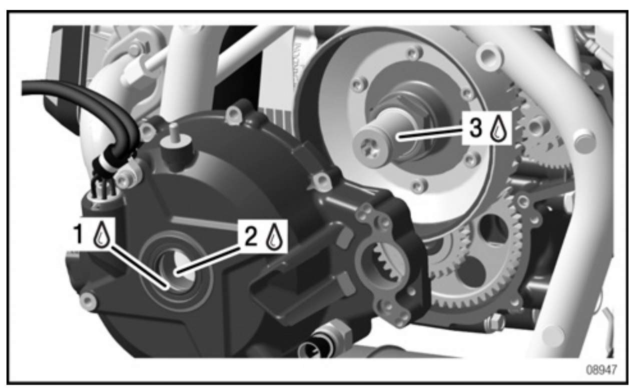

Figure 2.51: TYPICAL

1 Oil seal *2 Bearing bushing*

3 Crankshaft stub

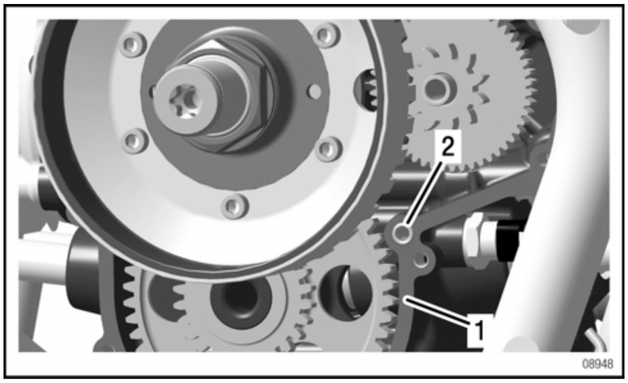

Figure 2.52: TYPICAL

1 Crankcase *2 O-ring 5x2*

Step	Procedure
3	Install puller assy. part no. 876010 on ignition housing. Lubricate the sealing surface of the ignition housing with LOC-TITE 5910.

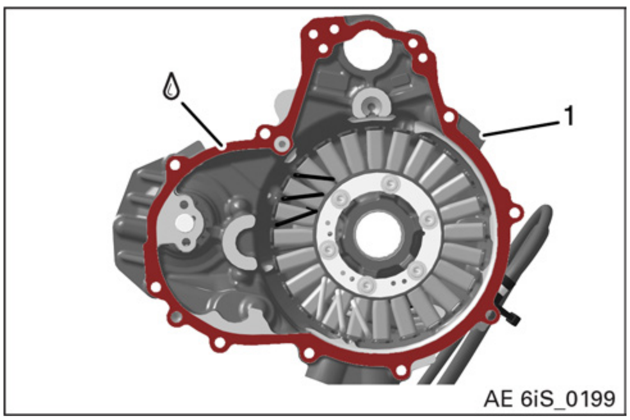

Figure 2.53

1 Ignition housing

⚠ WARNING

Danger of injury!The magnet of the fly wheel pulls the ignition cover towards the engine/ sealing surface with high force.Fingers can be crushed.

Make sure screw of puller assy. is rotated inwards so the ignition cover is not pulled towards the engine.

Step	Procedure
4	Place the protection mushroom part no. 876557 with a little bit of grease on the crankshaft and install ignition housing on the crankcase with puller assy. part no. 876010.

NOTICE

The ignition housing must be attached manually without tapping.

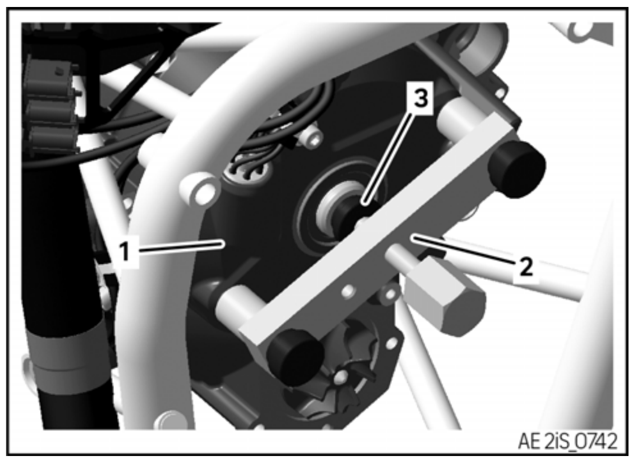

Figure 2.54

1 Ignition housing *2 Puller assy. part no. 876010*

3 Protection mushroom part no. 876557

Step	Procedure
5	Turn the water pump wheel slightly so that the gear wheels can match.

6	To install the crankshaft position sensor see Chapter 76-70-00 section .
7	Fasten the ignition housing to the crankcase using 5 Allen screws M6x30 and 2 Allen screws M6x50 with Washers 6.4. Tightening torque 10 Nm (89 in. lb.). **NOTE** *Line CPS_1/ 2 cables through the cable clamp and tighten upper Allen screw M6x50 with LOCTITE 243.*

NOTICE

Do not use a longer screw! The screw would press on the cylinder sleeve and cause damage to piston and cylinder.

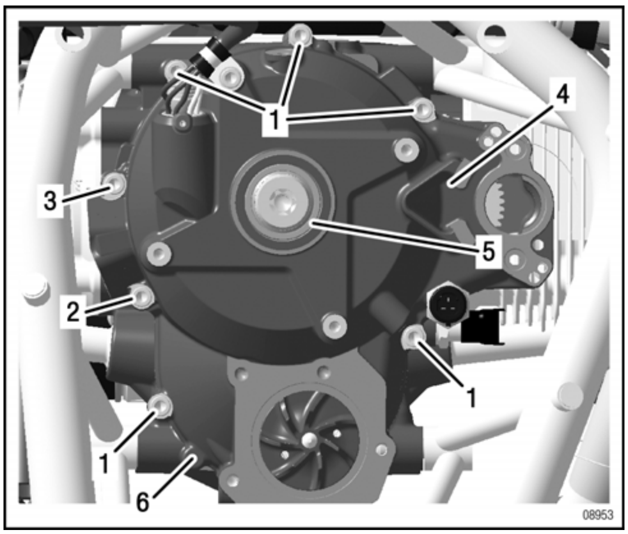

Figure 2.55

1 *Allen screws M6x30*   2 *Allen screws M6x50*
3 *Ignition housing assy.*

NOTE

The through-bore of the Allen screw M6x50 penetrates as far as the crankcase.
The engine is not leakproof if this screw is not seated with LOCTITE 243.

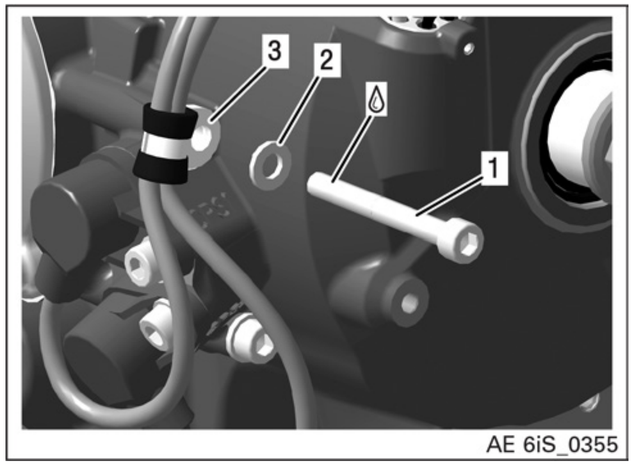

Figure 2.56: TYPICAL

1 *Allen screw M6x50*   2 *Washer A 6.4*
3 *Cable clamp*

NOTICE

If the water pump is not installed straight away, then 2 M6x65 temporary screws with washers must be screwed in so that the sealing surface is evenly clamped.

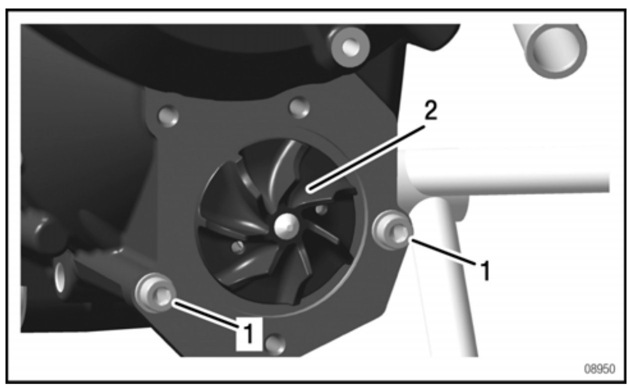

Figure 2.57

1 *Allen screw M6x65*   2 *Water pump wheel*

Step	Procedure
8	Fasten hex. screws M5x45 for the starter. Tightening torque 6 Nm (53 in. lb.)

NOTE

No washers are used for these screws, as otherwise the starter does not lie flat on the flange surface.

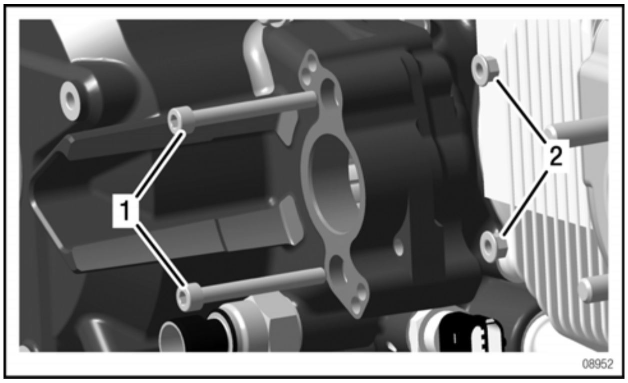

Figure 2.58

1 Hex. screw M5x45 *2 Hex. collar nut M5*

Step	Procedure
9	Connect the stator connectors (Generator A, B) with the connector socket (Regulator A, B) on the fuse box. See Chapter 76-10-00, section Fuse box – installation.

FINISHING WORK

- Install water pump housing.
  See Chapter 75-00-00 section Cooling system.
- Install electric starter.
  See Chapter 80-00-00 section Electric starter.
- Install pressure sensor.
  See Chapter 76-70-00 section Sensors and actuators.
- Install airbox on ignition housing.
  See Chapter 73-00-00 section Fuel system.
- Install CPS sensors.
  See Chapter 76-70-00 section Sensors and actuators.

Unlock the crankshaft.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-10-00 section Adding operating fluids.

Fill with operating fluids or check filling levels.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-10-00 section Adding operating fluids.

Flush the engine cooling system.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Flushing the engine cooling system.

Purge the oil system.
See current Installation Manual (IM) for the respective engine type, Chapter 79-00-00 section Purging the lubrication system.

Carry out an engine test run.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Planned maintenance

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Chapter: 24–30–00
EXTERNAL ALTERNATOR

TOPICS IN THIS CHAPTER

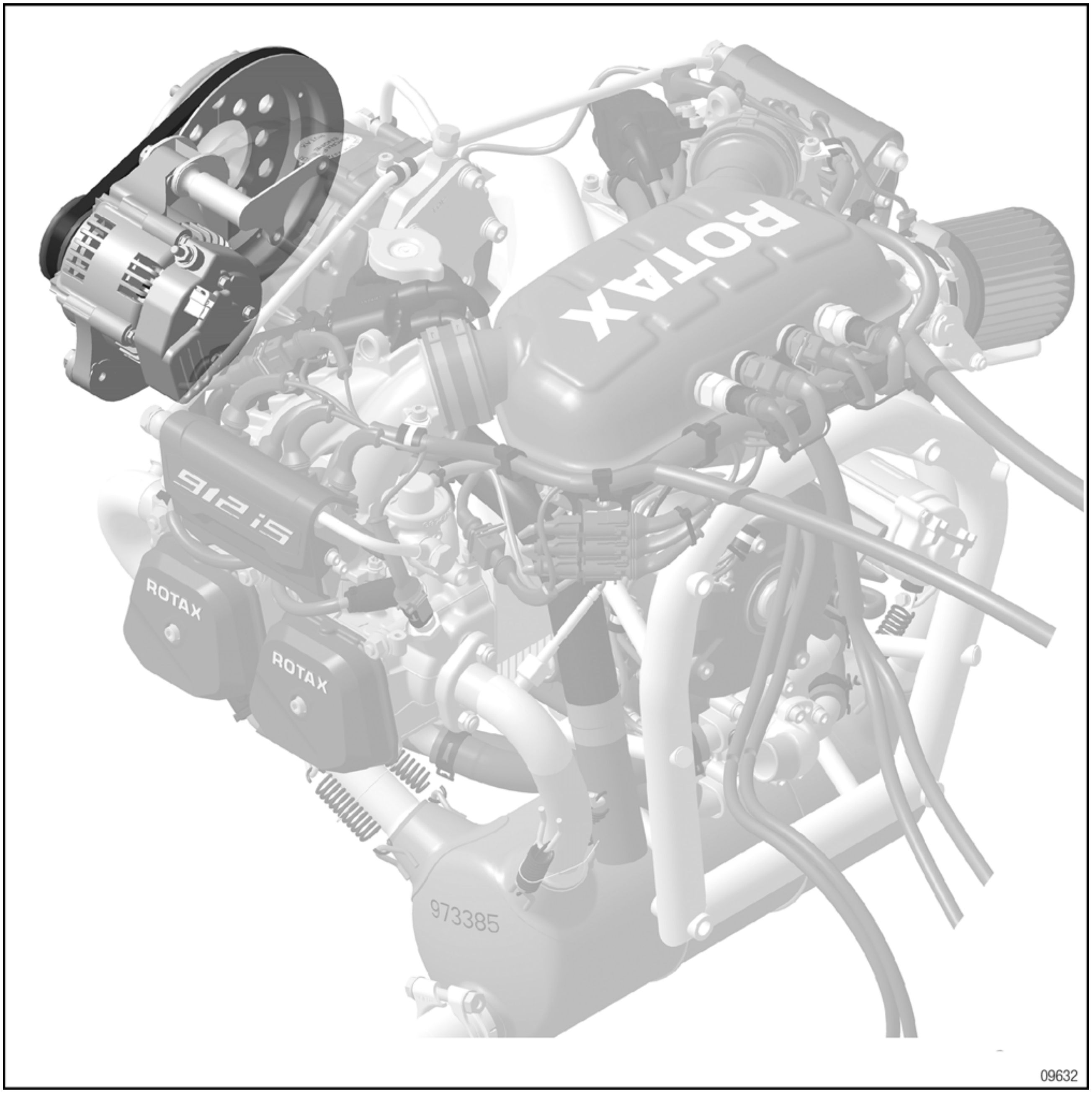

Figure 3.1: Location on the engine

TIGHTENING TORQUE

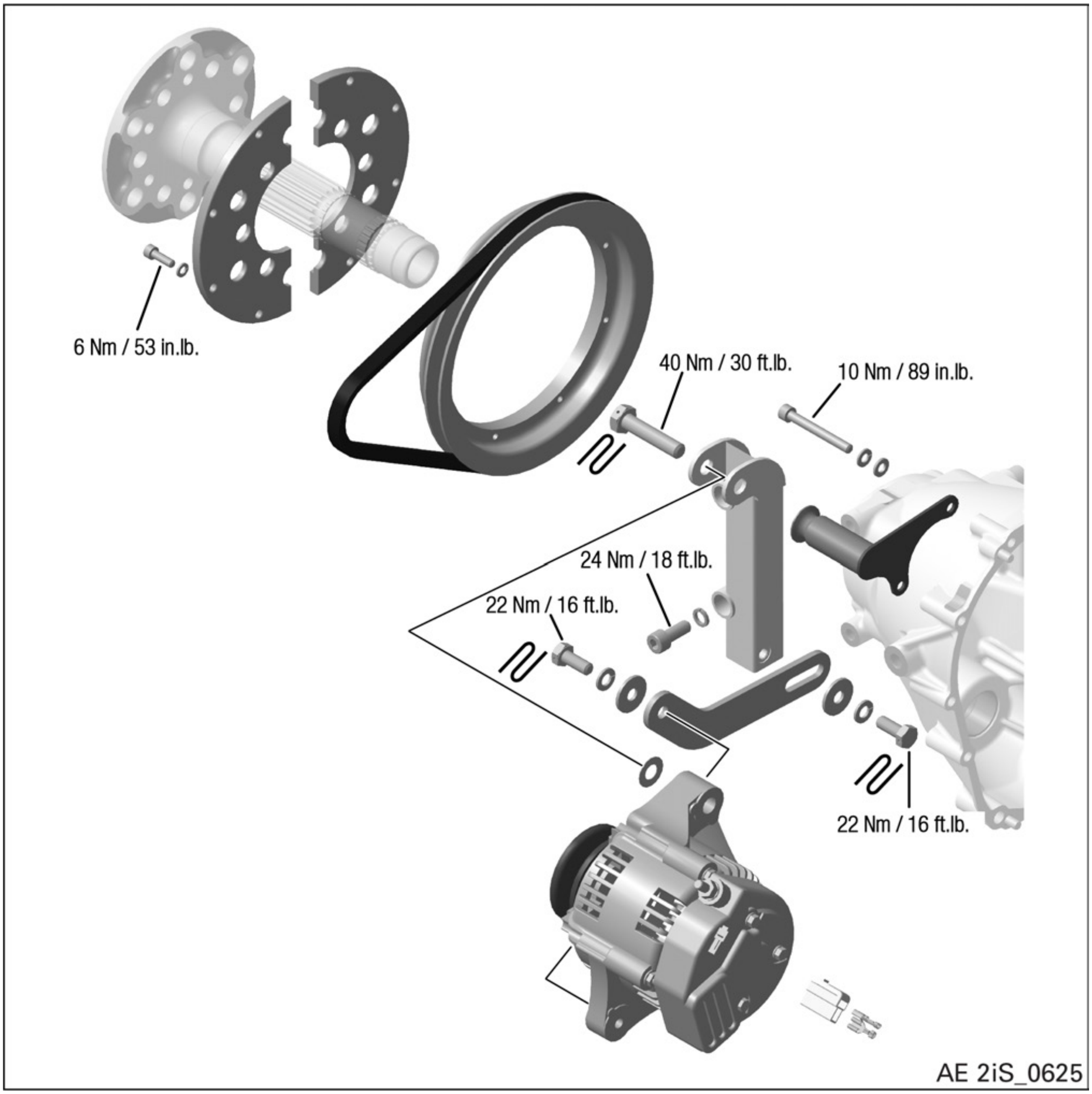

Figure 3.2

SYSTEM DESCRIPTION

The ROTAX® 912 i Series can optionally be equipped with an external alternator. This is a state-of-the-art, electromechanical three-phase generator (compact generator) with small outer dimensions. It has the task of supplying the electric consumers with energy and charging the starter battery with the least possible fuel consumption and low noise levels during operation of the aircraft.

DRIVE

Drive is provided by the engine by means of a V-belt.

SAFETY INSTRUCTION

⚠ WARNING

Danger of damage to engine! There is a risk of short circuits and cable fires during work on the electric system.
All installation work on the electric system should be carried out with the engine switched off and the battery (negative terminal) disconnected. Ignition, main and LANE selector switches must be "OFF"!

MAINTENANCE

As well as the maintenance and special checks, see current Maintenance Manual Line (MML) for the respective engine type.

BEFORE THE EXTERNAL ALTERNATOR IS REMOVED:

NOTICE

If these checks are omitted, it may be necessary to dismantle the product again to rectify any faults after repair work.

General visual inspection. See current Maintenance Manual Line (MML) for the respective engine type.

Carry out a generator inspection during an engine test run. See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12–20–00 section Planned maintenance.

Output voltage check. See “Documentation of aircraft manufacturer”.

REMOVAL

Preparation

Loosen pulley tension. See current Maintenance Manual Line (MML) for the respective engine type.

Remove the propeller. See "Documentation of aircraft manufacturer".

V-BELT PULLEY — REMOVAL

Step	Procedure
1	Loosen 8 Allen screws with lock washers.
2	Remove pulley carriers, V-belt pulley and V-belt.

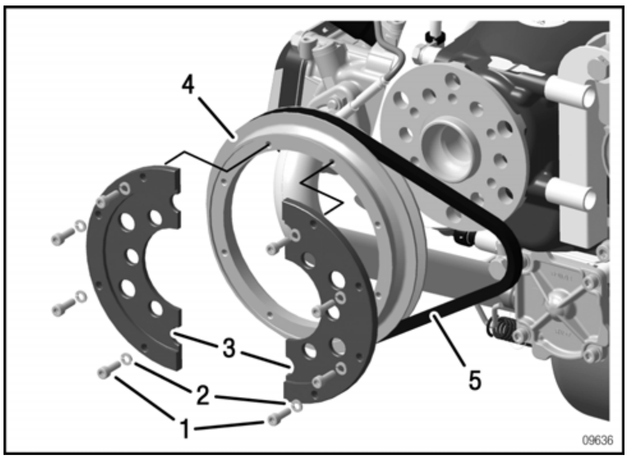

Figure 3.3: Typical

1 Allen screws *2 Lock washers*
3 Pulley carrier *4 V-belt pulley*
5 V-belt

ALTERNATOR — REMOVAL

Step	Procedure
1	Loosen 2 hex. screws along with lock washers and washers.
2	Remove the tension bar underneath the external generator.

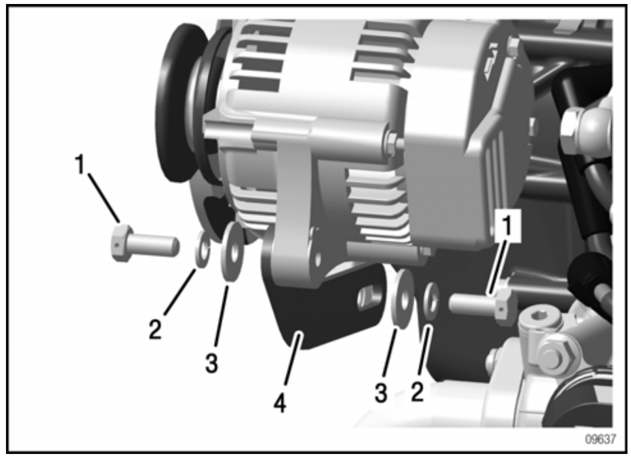

Figure 3.4: Typical

1 Hex. screws *2 Lock washers*
3 Washers *4 Tension bar*

Step	Procedure
3	Loosen hex. screw and remove the alternator and thrust washer.

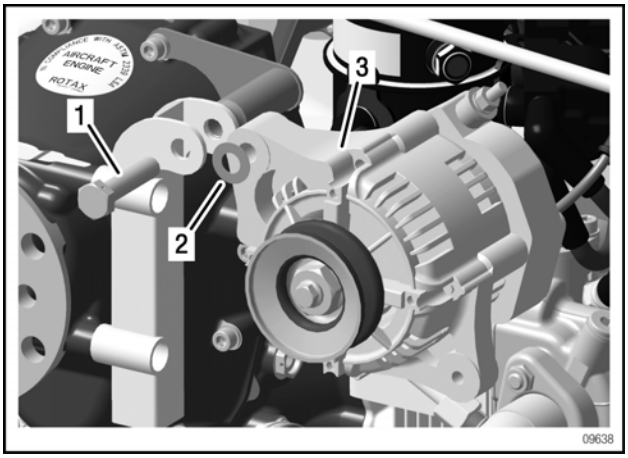

Figure 3.5: Typical

1	*Hex. screw*	2	*Thrust washer*
3	*External alternator*		

Step	Procedure
4	Loosen 2 Allen screws along with lock washers and remove the alternator bracket.

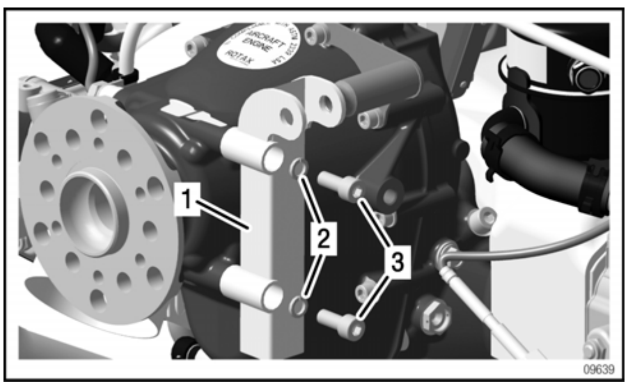

Figure 3.6: Typical

1	*Alternator bracket*	2	*Lock washer*
3	*Allen screws*		

Step	Procedure
5	Remove 2 Allen screws along with lock washers and washers from the gearbox housing and alternator support.

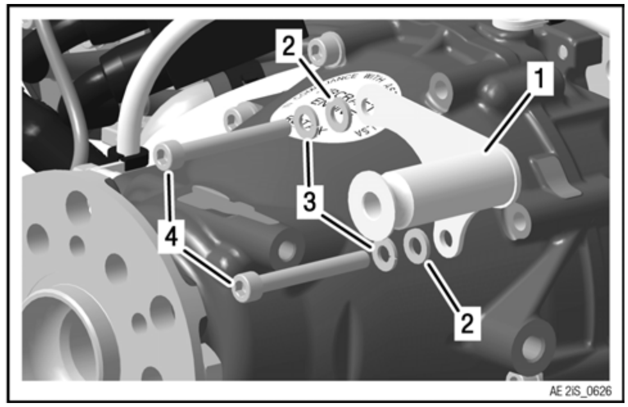

Figure 3.7: Typical

1	*Alternator support assy.*	2	*Washers*
3	*Lock washers*	4	*Allen screws*

INSTALLATION

V-BELT PULLEY — INSTALLATION

Step	Procedure
1	Push the V-belt pulley completely over the propeller flange and insert the V-belt 9.5x675 loosely into the V-belt pulley.

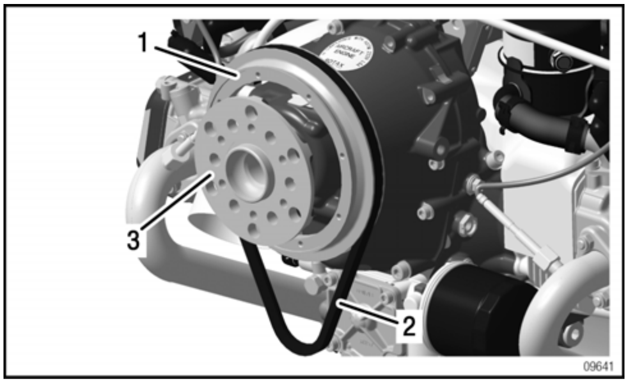

Figure 3.8: Typical

1 V-belt pulley *2 V-belt 9.5x675*
3 Propeller flange

NOTICE

The two pulley carriers must sit with the centring exactly on the inner side of the propeller flange.

Step	Procedure
2	Insert both pulley carriers with the centring towards the inner side of the propeller flange.
3	Push the V-belt pulley onto the two pulley carriers and tighten with 8 Allen screws M5x16 and lock washers A5. Tightening torque 6 Nm (53 in. lb.)

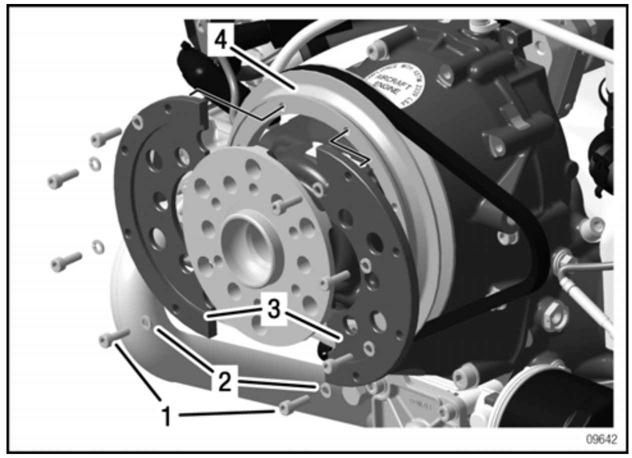

Figure 3.9: Typical

1 Allen screws M5x16 *2 Lock washers A5*
3 Pulley carrier *4 V-belt pulley*

ALTERNATOR — INSTALLATION

Step	Procedure
1	Fix the alternator support finger-tight by means of 2 Allen screws M6x50, lock washers A6 and washers 6.4.

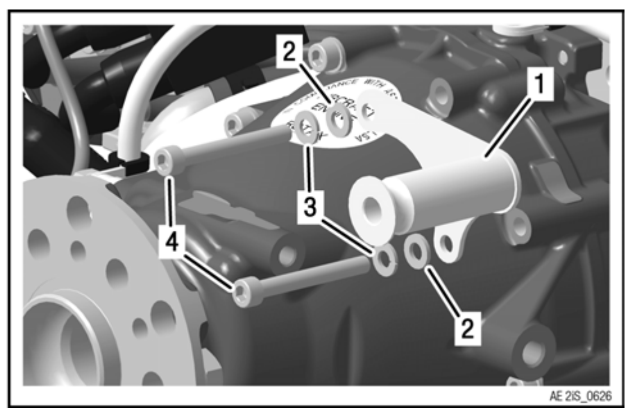

Figure 3.10: Typical

1 Generator support *2 Washer 6.4*
3 Lock washers A6 *4 Allen screws M6x50*

Step	Procedure
2	Attach the alternator bracket finger-tight to the gearbox housing using the 2 Allen screws M8x20 and lock washers VHZ8.

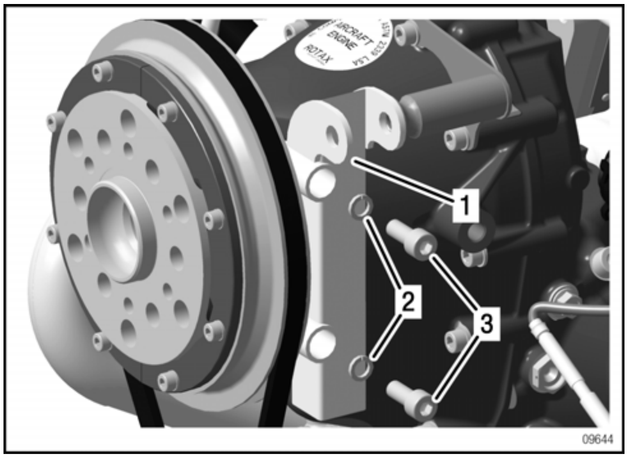

Figure 3.11: Typical

1 Alternator bracket	*2 Lock washers VHZ 8*
3 Allen screw M8x20	

Step	Procedure
3	Push the alternator into the lug of the alternator bracket and fix initially finger-tight with hex. screw M10x45 and thrust washer 10.1/20/0.5 (inside the lug).

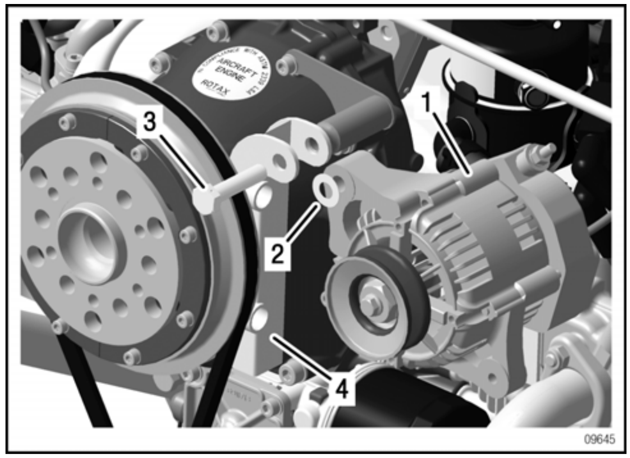

Figure 3.12: Typical

1 Alternator	*2 Thrust washer 10.1/20/0.5*
3 Hex. screw M10x45	*4 Alternator bracket*

Step	Procedure
4	Tighten the pre-mounted Allen screws M6 and M8. Tightening torque Allen screw M6 10 Nm (89 in. lb.). Tightening torque Allen screw M8 24 Nm (18 ft. lb).
5	Place the V-belt in the V-belt pulley of the alternator.

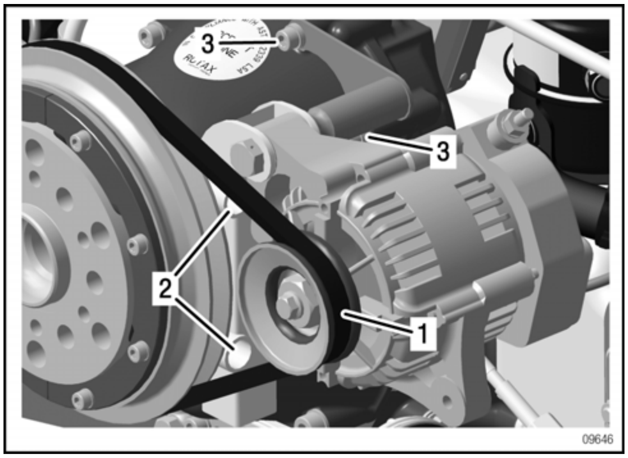

Figure 3.13: Typical

1 *V-belt*	2 *Allen screw M8x20*
3 *Allen screw M6x50*	

Step	Procedure
6	Attach the tension bar finger-tight to the alternator bracket using 2 hex. screws M8x20 with a lock washer A8 and a washer 8.4.

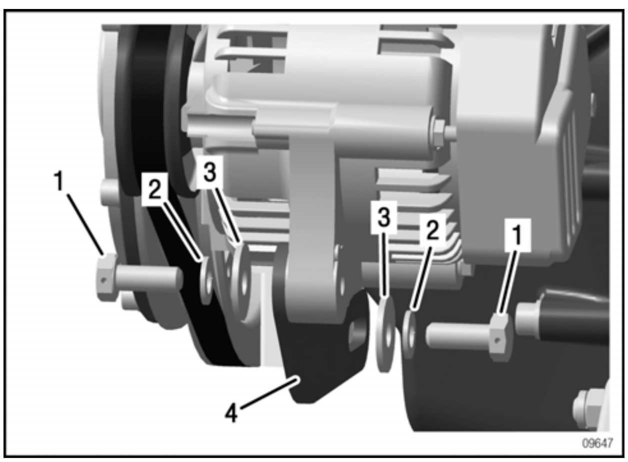

Figure 3.14: Typical

1 *Hex. screws M8x20*	2 *Lock washer A8*
3 *Washer 8.4*	

Step	Procedure
7	Adjust the pulley tension and tighten hex. screws M10 and M8. Tightening torque hex. screws M10: 40 Nm (30 ft. lb.) Tightening torque hex. screws M8: 22 Nm (16 ft. lb.). See relevant Maintenance Manual Line (MML) for the respective engine type.
8	Attach the safety wires.

V-BELT TENSION

See current Maintenance Manual Line (MML) for the respective engine type.

FINISHING WORK

Install the propeller. See "Documentation of aircraft manufacturer".

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Chapter: 37–10–00
VACUUM PUMP

TOPICS IN THIS CHAPTER

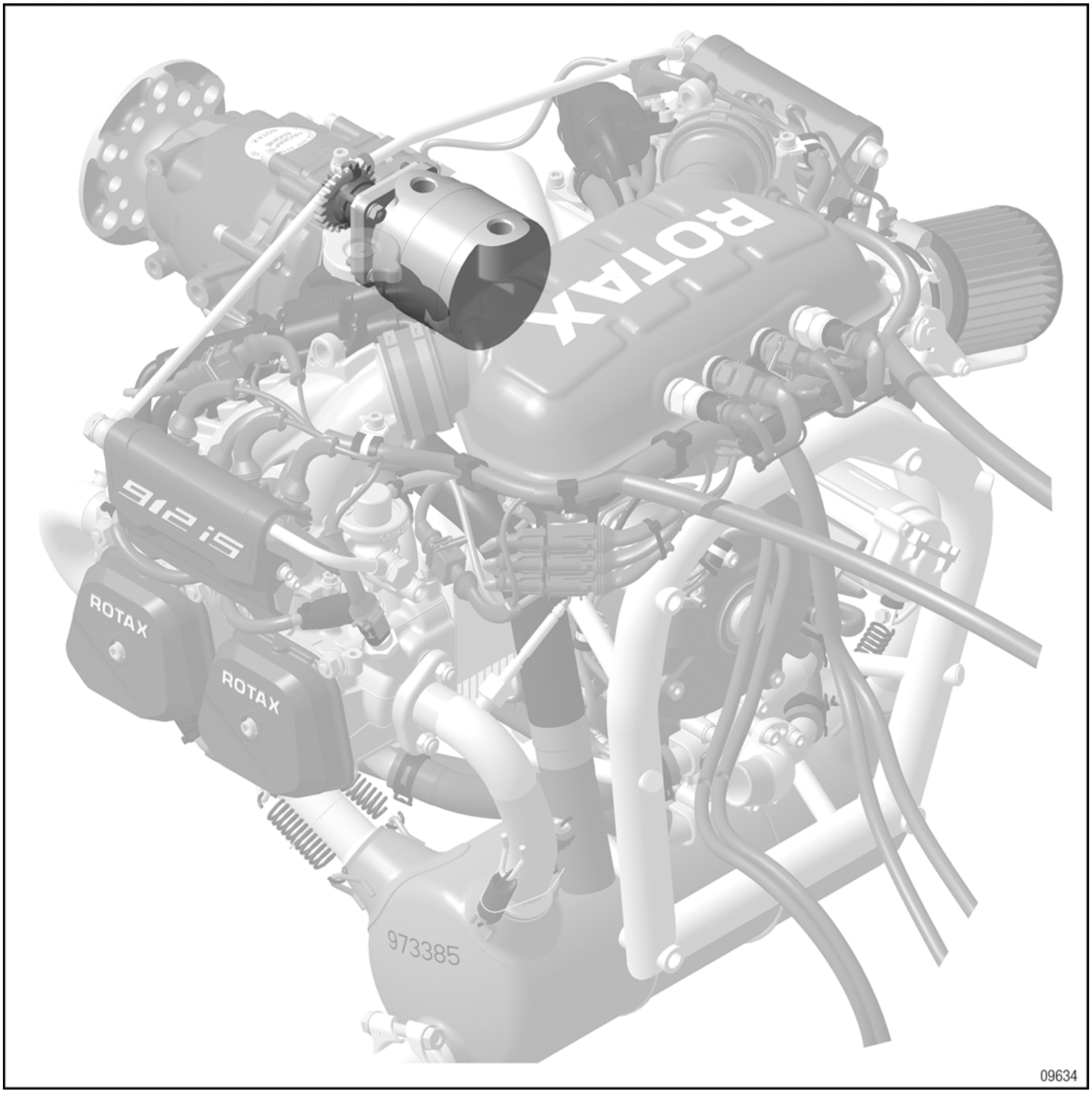

Figure 4.1: Location on the engine

SPECIAL TOOLS

Description	Part number
Insertion jig assy.	276332
Retaining tool	242661
Ring spanner a/f 10/13	876470
Puller assy.	876489
Press-in mushroom	877597
Press-in mushroom	877595
Insertion jig assy.	877276

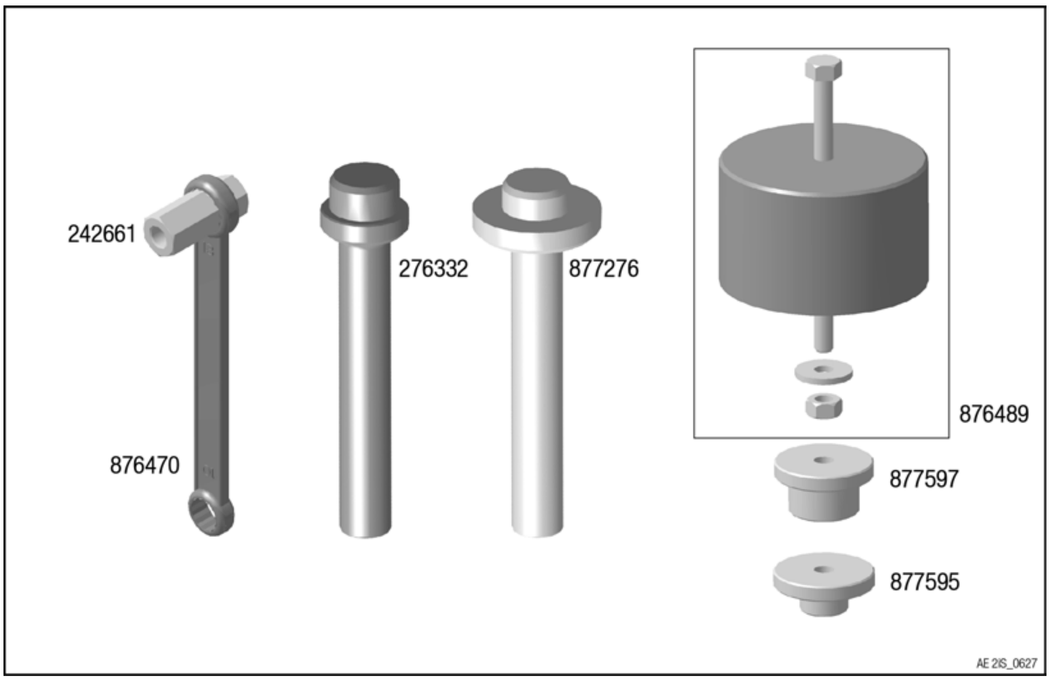

Figure 4.2: Special tools

SERVICE PRODUCTS

Description	Part number
Engine oil	n.a.
LOCTITE 243	897651
LOCTITE 648	899788

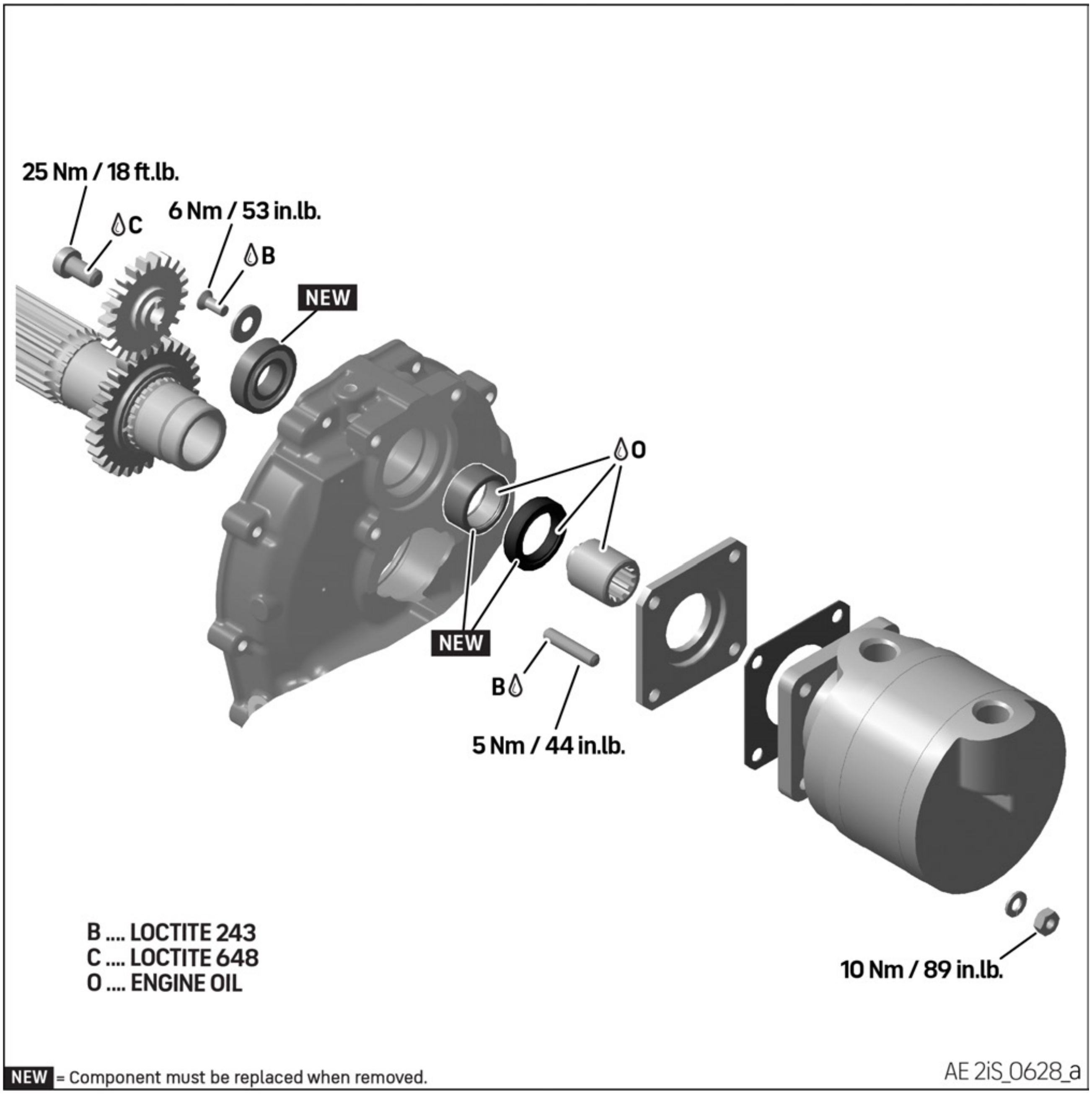

Figure 4.3: Vacuum pump

SYSTEM DESCRIPTION

There is the option of installing a vacuum pump. To do this, the drive for the vacuum pump must be retrofitted in the propeller gearbox.

NOTE

Simultaneous use of the vacuum pump and governor is not possible.

Gear ratio
The vacuum pump and the governor have the same drive and therefore an equal gear ratio, see Chapter 61-20-00 Governor.

SAFETY INSTRUCTION

⚠ WARNING
Follow the general safety instructions during all work on the engine and the assemblies around it.

MAINTENANCE

As well as the maintenance and special checks, see current Maintenance Manual Line (MML) for the respective engine type.

REMOVAL

VACUUM PUMP — REMOVAL

Preparation

General visual inspection. See current Maintenance Manual Line (MML) for the respective engine type.

Carry out a functional test run to identify any damage. See "Documentation of aircraft manufacturer".

Remove the propeller gearbox so that the governor drive can be removed. See current Maintenance Manual Line (MML) for the respective engine type

Step	Procedure
1	Loosen the 4 hex. nuts with lock washers (or washers).

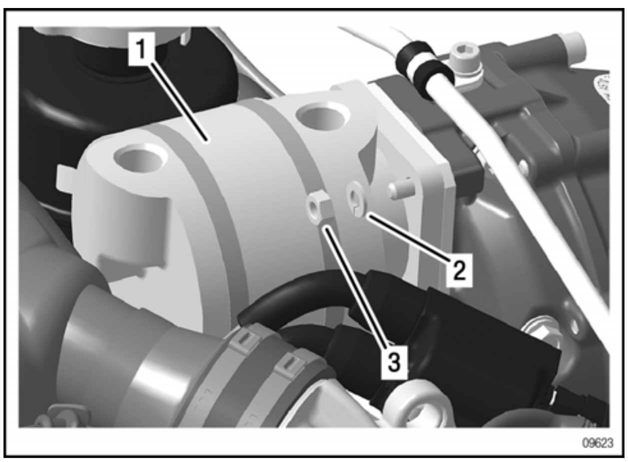

Figure 4.4

1 Vacuum pump *2 Lock washer*
3 Hex. nut

Step	Procedure
2	Remove the vacuum pump including the gasket and the attachment flange from the crankcase.

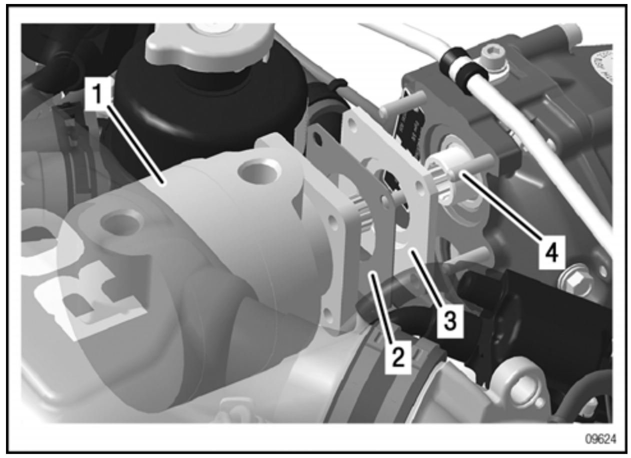

Figure 4.5

1 Vacuum pump *2 Gasket*
3 Attachment flange *4 Studs*

NOTE

Various screws or studs with nuts are required, depending on the manufacturer of the vacuum pump.

Step	Procedure
3	Fix the drive sleeve with retaining tool part no. 242661 and 876470.
4	Loosen the Allen screw and remove the vacuum pump gear with the drive sleeve.

NOTICE
The M8 fastening screw for the vacuum pump gear is 14 mm (0.55 in.) long with a normal screw head in the vacuum pump drive.

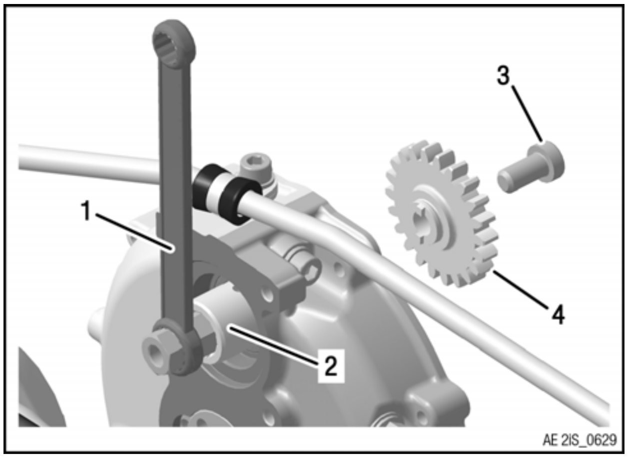

Figure 4.6: Typical

1	*Retaining tool 242660 and 876470*	2	*Drive sleeve*
3	*Allen screw M8x14*	4	*Vacuum pump gear 22T*

Step	Procedure
5	Loosen the countersunk screw with retaining washer for the ball bearing fastening.

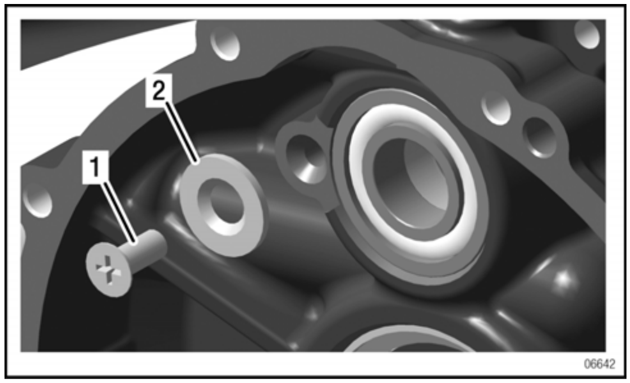

Figure 4.7

1	*Countersunk screw*	2	*Retaining washer*

Step	Procedure
6	Lift out the oil seal and press the needle sleeve along with the ball bearing towards the gearbox with a suitable insertion jig part no. 276332.

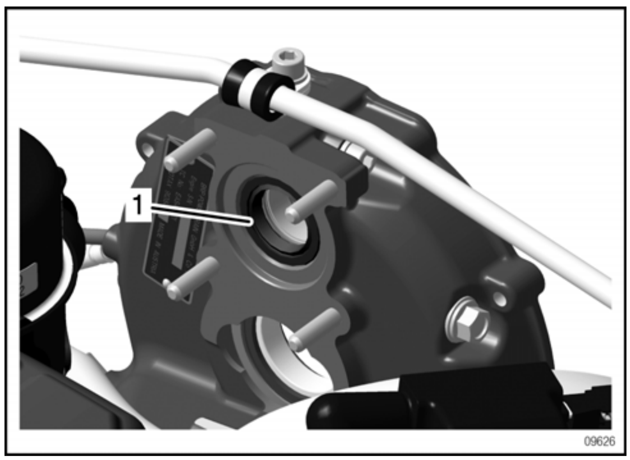

Figure 4.8

1 *Oil seal*

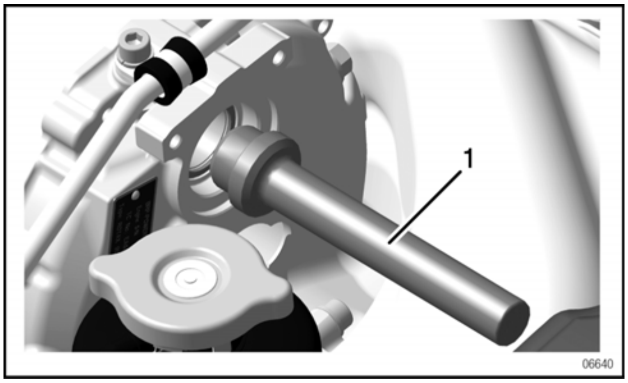

Figure 4.9

1 *Insertion jig 276332*

NOTE

The needle sleeve, oil seal and ball bearing are damaged by this and must be replaced.

INSPECTION

Preparation

Clean all parts carefully. See current Maintenance Manual Line (MML) for the respective engine type.

General visual inspection. See current Maintenance Manual Line (MML) for the respective engine type.

DRIVE SLEEVE — INSPECTION

Step	Procedure
1	Check the gear-tooth system of the drive sleeve.

NOTE

Wear usually appears as a flattened area on the journal.

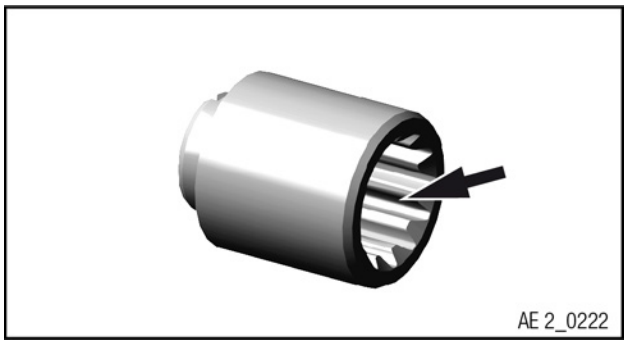

Figure 4.10

VACUUM PUMP GEAR - INSPECTION

Step	Procedure
1	Check the gear-tooth system of the drive gear and vacuum pump gear.

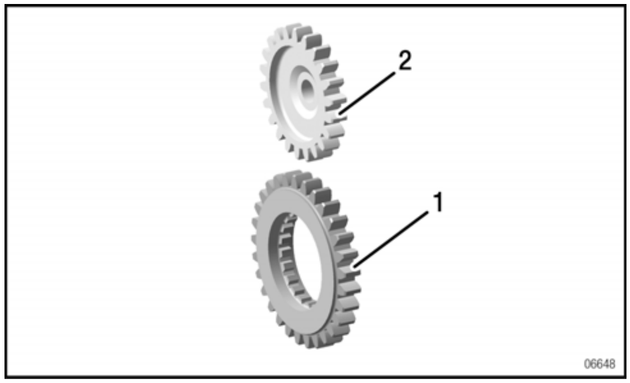

Figure 4.11

1 Drive gear   *2 Vacuum pump gear*

VACUUM PUMP — INSPECTION

NOTICE

Follow the vacuum pump manufacturer's instructions for maintenance, inspection and repair.

INSTALLATION

For installation of needle sleeve and ball bearing see Chapter 61–20–00.

OIL SEAL — INSTALLATION

Step	Procedure
1	Press in a new oil seal AS 22x32x7 with insertion jig part no. 877276 and lubricate with engine oil.

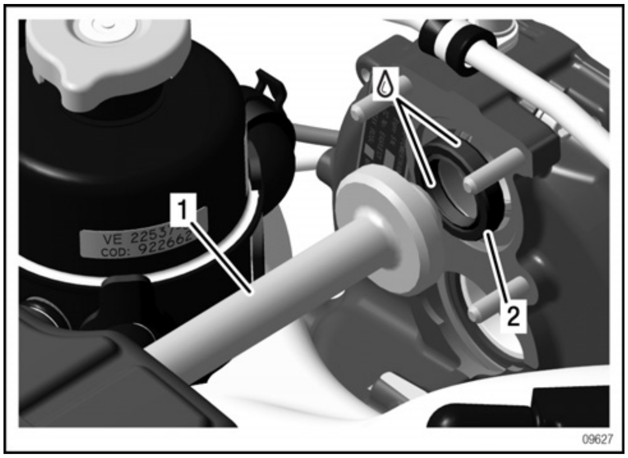

Figure 4.12: TYPICAL

1	*Insertion jig 877276*	2	*Oil seal AS 22x32x7*

VACUUM PUMP GEAR – INSTALLATION

Step	Procedure
1	Insert the lubricated drive sleeve. Hold with the retaining tool part no. 242661 and 876470. Then align slots of drive sleeve with gear.
2	Secure Allen screw M8x14 with LOCTITE 648 and tighten it. Tightening torque 25 Nm (18 ft.lb.)

NOTICE

The M8 fastening screw for the vacuum pump gear is 14 mm (0.55 in.) long with a normal screw head in the vacuum pump drive.

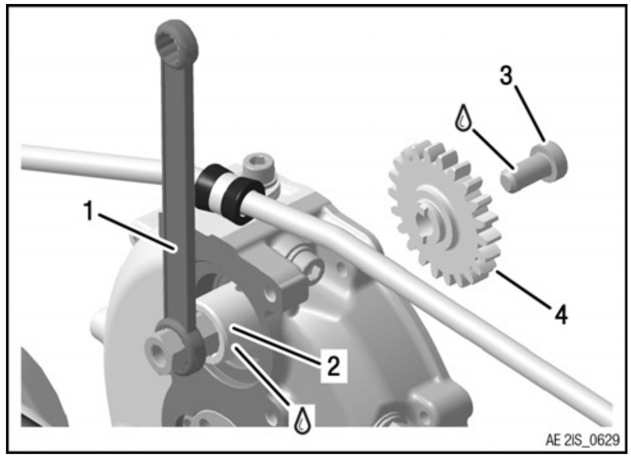

Figure 4.13: Typical

1	*Retaining tool 242661 and 876470*	2	*Drive sleeve*
3	*Allen screw M8x14*	4	*Vacuum pump gear*

VACUUM PUMP — INSTALLATION

Follow the instructions of the aircraft manufacturer.

Step	Procedure
1	Check that the studs are firmly in place. If necessary, apply LOCTITE 243 and tighten. Tightening torque 5 Nm (44 in.lb.).

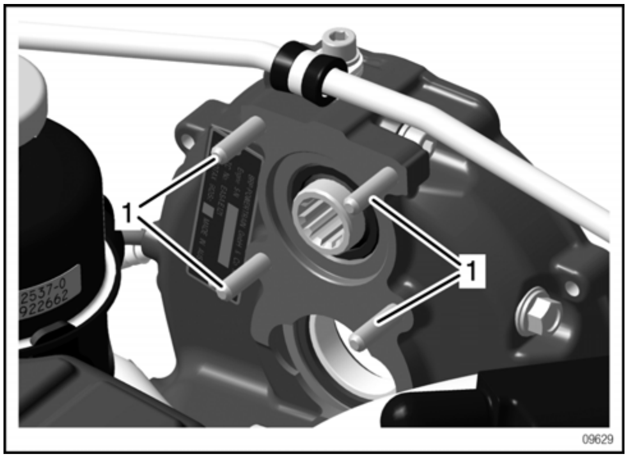

Figure 4.14

1 Studs M6

NOTICE
The gear-tooth system of the governor must match when installed!

NOTICE
No hammering or pressing! The drive gear must only be pushed on by hand.

NOTE

Make sure that the toothing is engaged and the drive gear of the vacuum pump move easily into the drive sleeve.

Step	Procedure
2	Position the vacuum pump including the gasket and the attachment flange on the crankcase.
3	Screw 4 hex. nuts M6 including lock washers onto studs M6 and tighten them. Tightening torque 10 Nm (89 in.lb.).

NOTE

Various screws or studs and nuts are required, depending on the manufacturer of the vacuum pump.

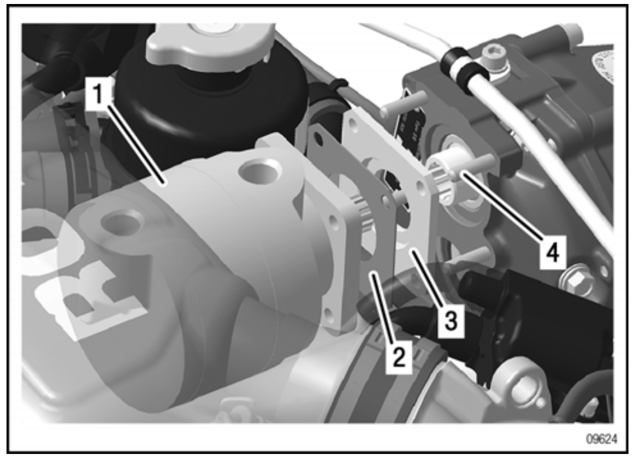

Figure 4.15

1 Vacuum pump *2 Gasket*
3 Attachment flange *4 Studs M6*

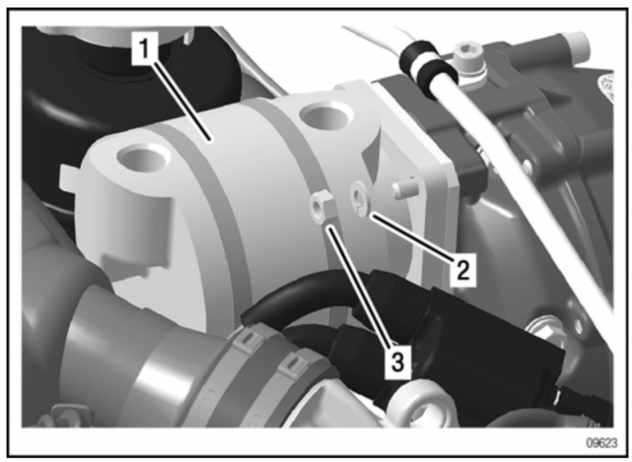

Figure 4.16

1 Vacuum pump *2 Lock washer A6*
3 Hex. nut M6

FINISHING WORK

Install the propeller gearbox.
See current Maintenance Manual Line (MML) for the respective engine type.

Fill with operating fluids or check filling levels.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-10-00 section Adding operating fluids.

Carry out an engine test run.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Planned maintenance..

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Chapter: 61–20–00
GOVERNOR

TOPICS IN THIS CHAPTER

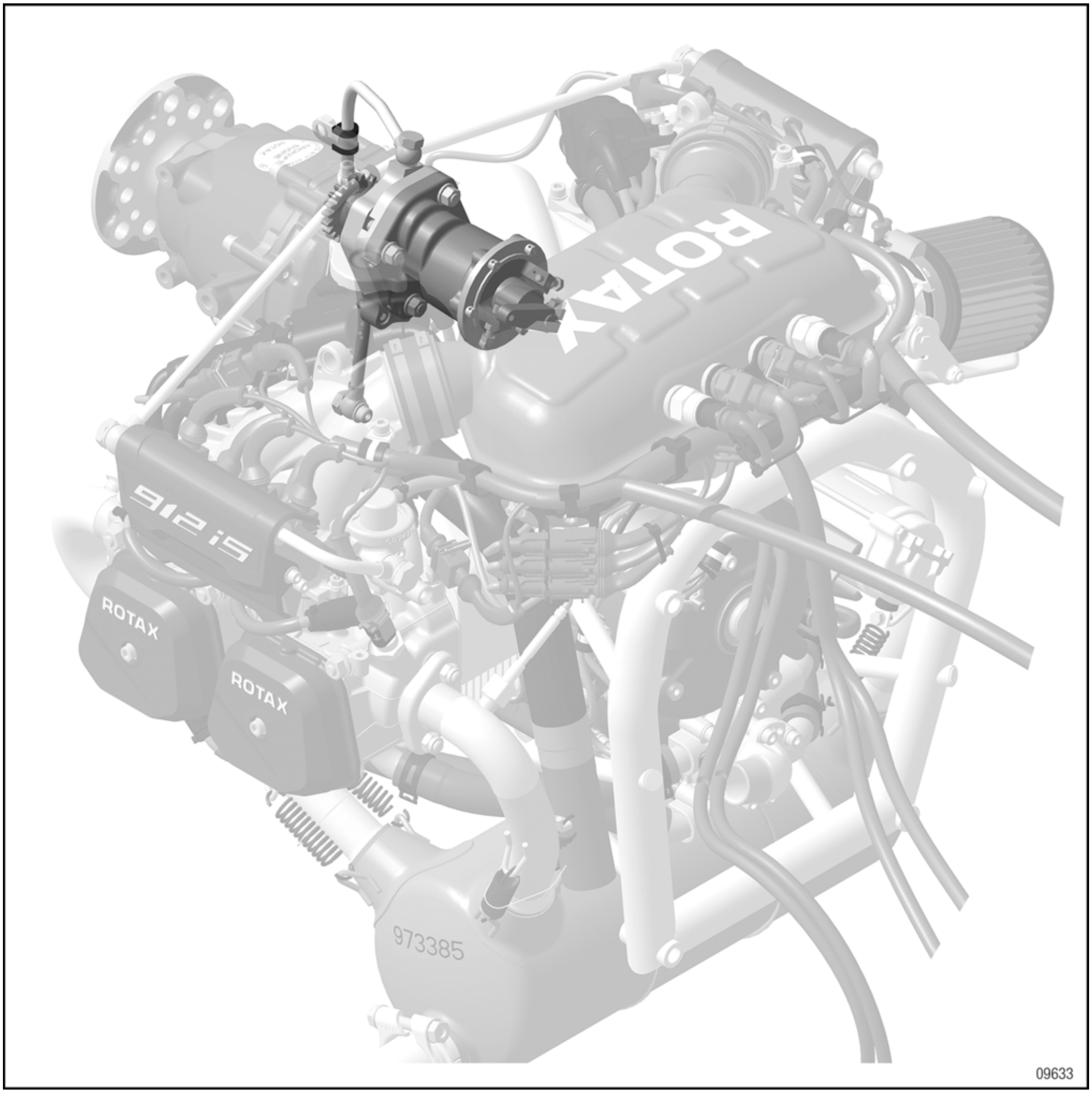

Figure 5.1: Location on the engine

SPECIAL TOOLS

Description	Part number
Extractor assy.	877615
Puller	876489
Insertion jig assy.	276332
Retaining device	242661
Ring spanner a/f 10/13	876470
Press-in mushroom	877595
Press-in mushroom	877597
Press-in mushroom	877590

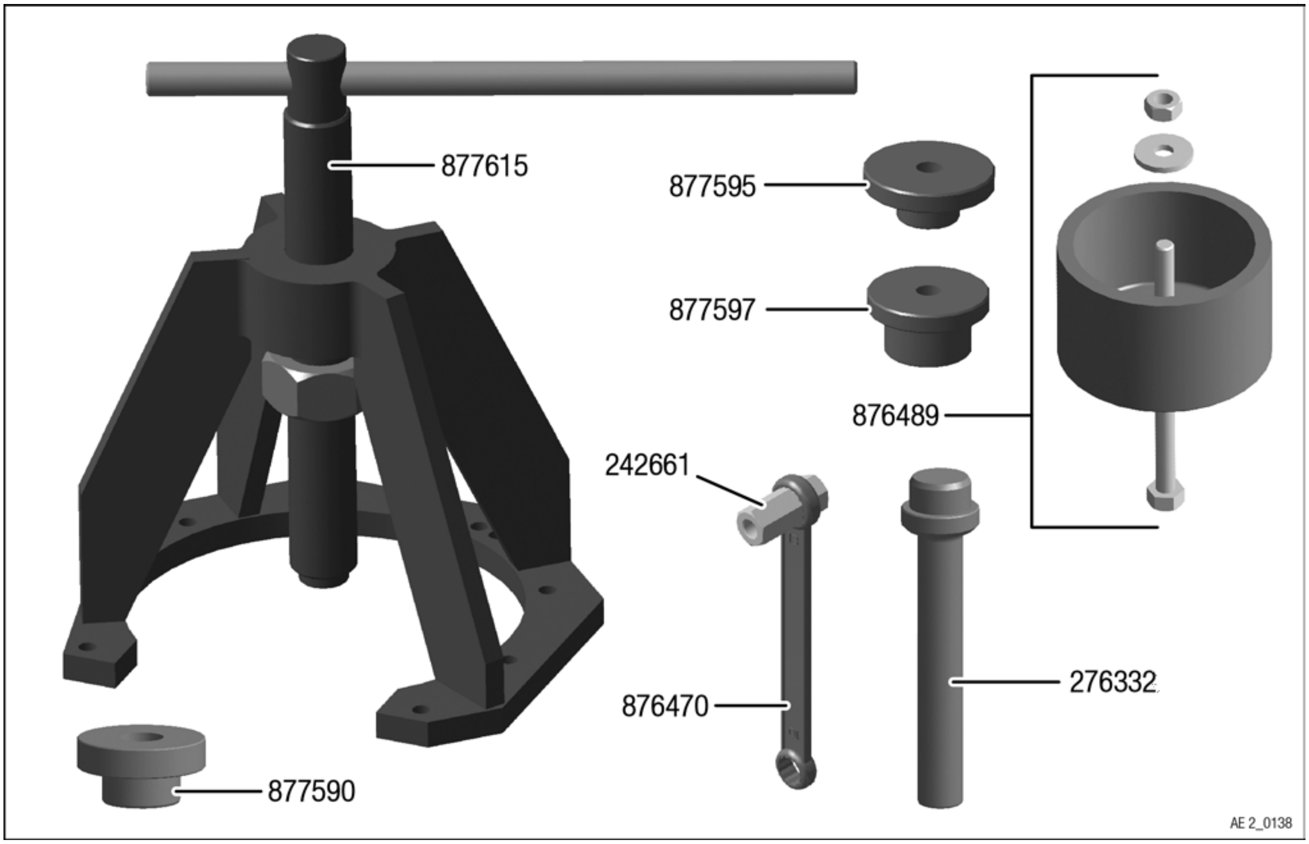

Figure 5.2: Special tools

SERVICE PRODUCTS

Description	Part number
LOCTITE 243	897651
LOCTITE 648	899788
LOCTITE ANTI SEIZE	297434
Engine oil	n.a.

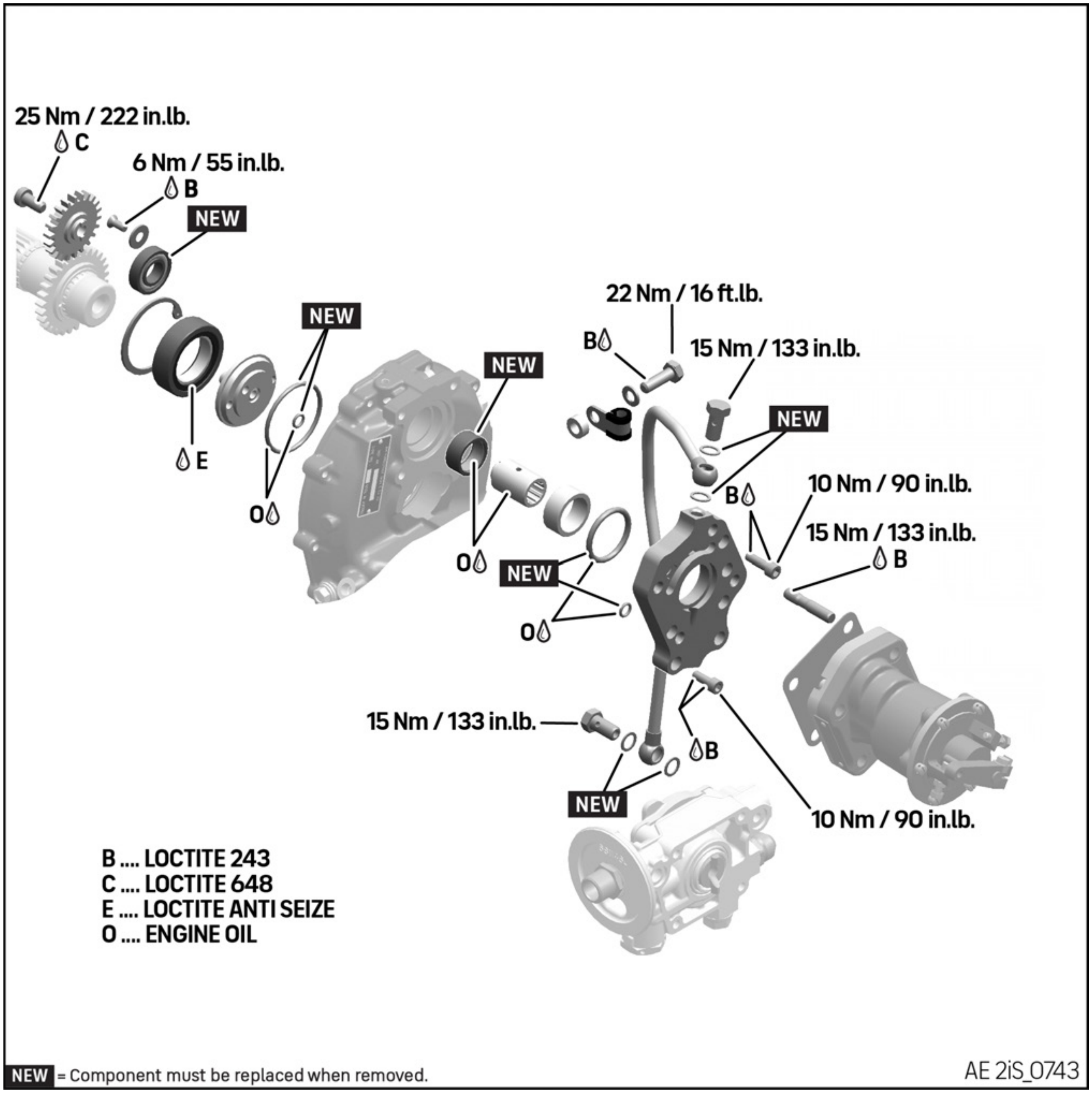
25 Nm / 222 in.lb.
C
6 Nm / 55 in.lb.
B
NEW
E
NEW
O
NEW
O
22 Nm / 16 ft.lb.
B
15 Nm / 133 in.lb.
NEW
B
10 Nm / 90 in.lb.
15 Nm / 133 in.lb.
B
NEW
O
15 Nm / 133 in.lb.
B
NEW
10 Nm / 90 in.lb.
B .... LOCTITE 243
C .... LOCTITE 648
E .... LOCTITE ANTI SEIZE
O .... ENGINE OIL
NEW = Component must be replaced when removed.
AE 2iS_0743

Figure 5.3

SYSTEM DESCRIPTION

For operation with a hydraulic constant-speed propeller on configuration 3 of the engine type 912 i Series, a hydraulic governor can be attached to control the propeller.
Configuration 2 can be retrofitted for this purpose, i.e. the drive for the governor in the propeller gearbox, the oil feed line to the propeller shaft and the propeller shaft must be retrofitted.

NOTE

For configuration 2, the hollow propeller shaft must be replaced.

Gear ratio (i)		
Crankshaft: Propeller shaft	51: 21	2.429
Propeller shaft: Governor	22: 29	0.759
Total	1.842	

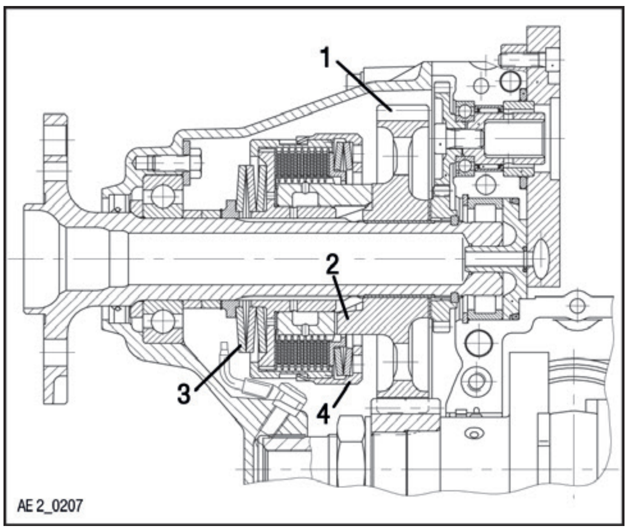

Figure 5.4: Configuration 3, with overload clutch

1	*Straight toothed spur gear*	*2*	*Dogs*
3	*Disc springs*	*4*	*Overload clutch*

SAFETY INSTRUCTION

⚠ WARNING

Follow the general safety instructions during all work on the engine and the assemblies around it.

MAINTENANCE

As well as the maintenance and special checks, see current Maintenance Manual Line (MML) for the respective engine type.

REMOVAL

GOVERNOR – REMOVAL

Preparation

General visual inspection. See current Maintenance Manual Line (MML) for the respective engine type.

Carry out engine test run to check proper functioning of the governor. See current Maintenance Manual Line (MML) for the respective engine type.

Drain oil. See current Maintenance Manual Line (MML) for the respective engine type.

NOTICE

If these checks are omitted, it may be necessary to dismantle the governor again to rectify any faults after it has been repaired.

Step	Procedure
1	Remove the governor along with the gasket. See aircraft manufacturer documentation.

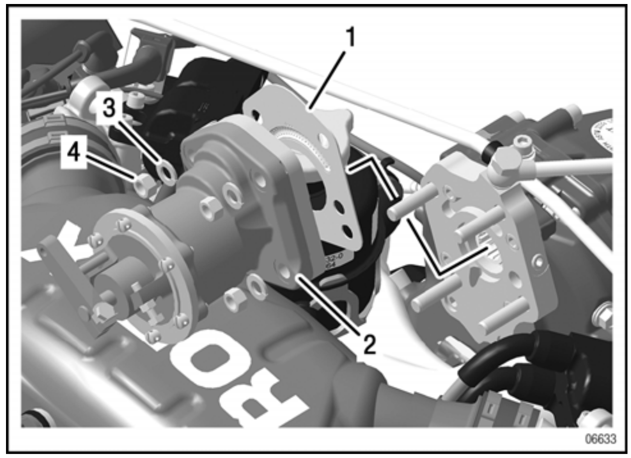

Figure 5.5: TYPICAL

1	*Gasket*	*2*	*Governor*
3	*Lock washer*	*4*	*Hex. nut*

Various screws, studs and nuts are required, depending on the manufacturer of the governor. See the current edition of SB-912-052 "Installation/use of governors”.

GOVERNOR FLANGE — REMOVAL

CONFIGURATION 3

Step	Procedure
1	Loosen the hex. screw with the washer and remove the cable clamp and distance sleeve.
2	Loosen banjo bolts with gasket rings on both sides of the governor flange and oil pump housing and remove the governor pressure oil line assy.
3	Loosen 4 Allen screws M6x20 and 2 Allen screws M6x16 from the governor flange.
4	Remove the governor flange with the O-ring and spacer behind it.

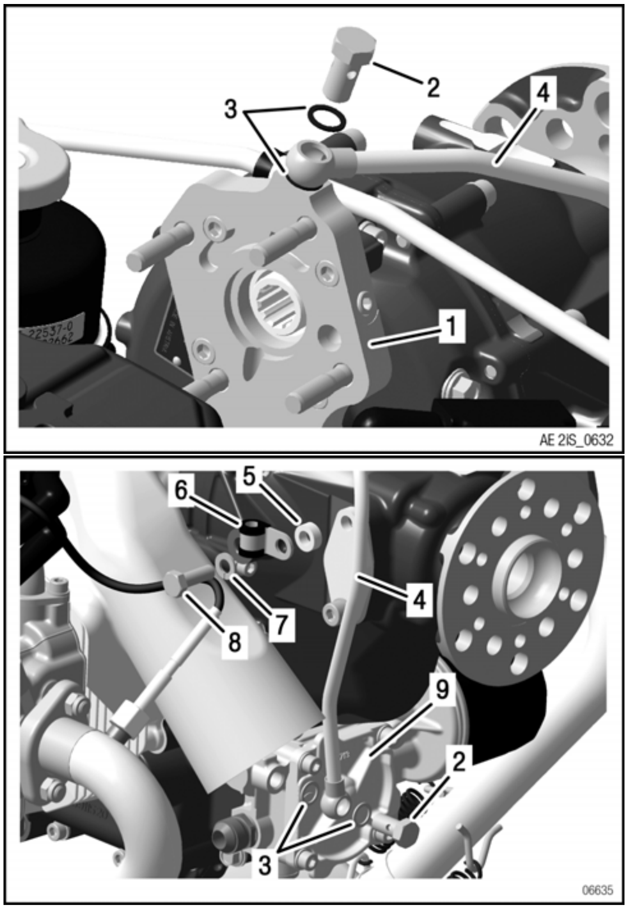

Figure 5.6

1	*Governor flange*	2	*Banjo bolt*
3	*Sealing rings*	4	*Governor pressure oil line assy.*
5	*Distance sleeve*	6	*Cable clamp*
7	*Lock washer*	8	*Hex. screw*
9	*Oil pump housing*		

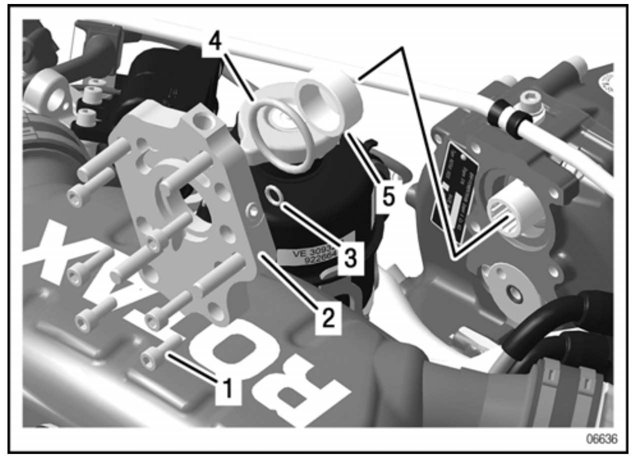

Figure 5.7

1	*Allen screws*	2	*Governor flange*
3	*O-ring*	4	*O-ring*
5	*Spacer*		

GOVERNOR DRIVE — REMOVAL

CONFIGURATION 3

Preparation

- The propeller gearbox must be removed so that the governor drive can be removed. See current Maintenance Manual Line (MML) of the respective engine type.

Step	Procedure
1	Fix the drive sleeve with retaining tool part no. 242661 and 876470.
2	Loosen the Allen screw and remove the vacuum pump gear with the drive sleeve.

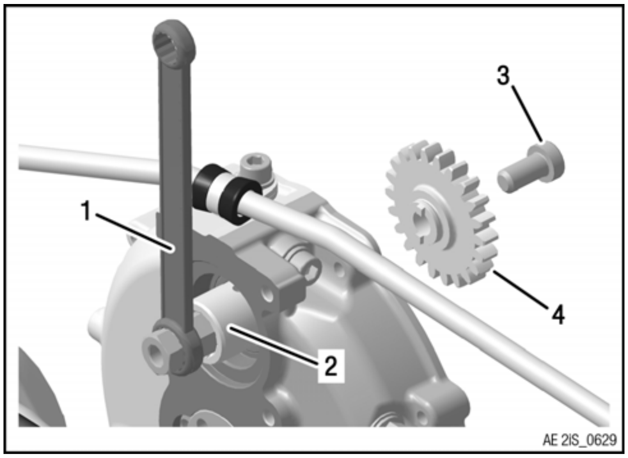

Figure 5.8

1	*Retaining tool 242661 and 876470*	*2*	*Drive sleeve*
3	*Allen screw*	*4*	*Vacuum pump gear*

Step	Procedure
3	Loosen the countersunk screw with thrust washer for the ball bearing fastening.
4	Press the needle sleeve along with the ball bearing out towards the gearbox with a suitable insertion jig part no. 276332.

NOTE

The needle sleeve and ball bearing are damaged by this and must be replaced.

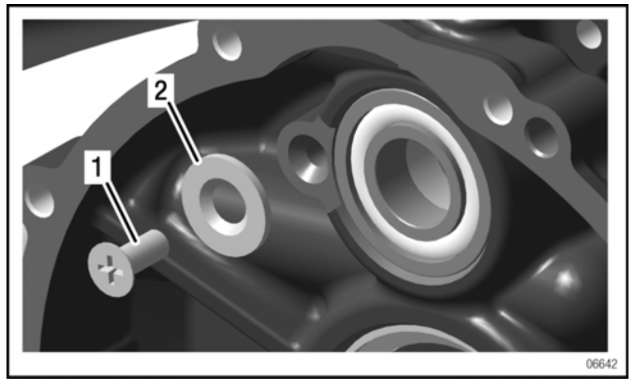

Figure 5.9

1	*Countersunk screw*	*2*	*Thrust washer*

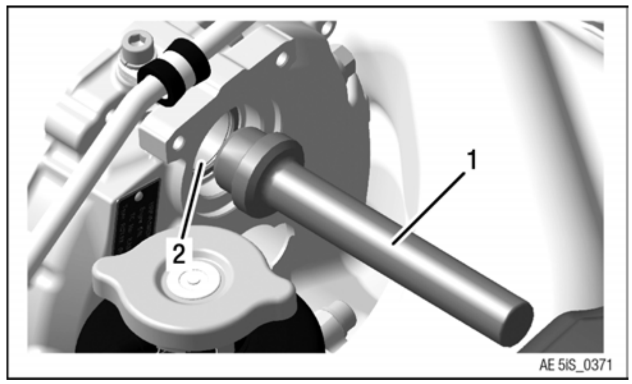

Figure 5.10

1 *Insertion jig 276332*

ROLLER BEARING CONFIGURATION 3 — REMOVAL

See Chapter 72–10–00 section Propeller gearbox.

INSPECTION

GOVERNOR - INSPECTION

NOTICE
Follow the governor manufacturer's instructions for maintenance, inspection and repair.

GOVERNOR DRIVE - INSPECTION

Preparation

Clean all parts carefully. See current Maintenance Manual Line (MML) for the respective engine type.

General visual inspection.
See current Maintenance Manual Line (MML) for the respective engine type.

Step	Procedure
1	Measure the inner diameter of the propeller shaft. See section Wear limits (GB05).
2	Measure the journal of the oil inlet flange. See section Wear limits (GB06).

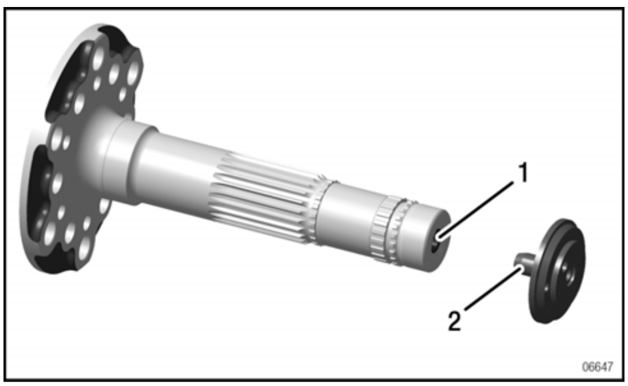

Figure 5.11

1 Propeller shaft inner diameter *2 Oil inlet flange journal*

NOTE

Wear usually appears as a flattened area on the journal.

Step	Procedure
3	Check the gear-tooth system of the drive gear and vacuum pump gear.

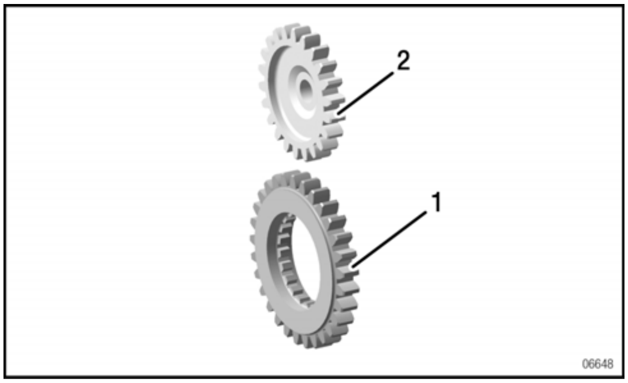

Figure 5.12

1 Drive gear *2 Vacuum pump gear*

Step	Procedure
4	Check that all the oil bores in the governor flange are clear.

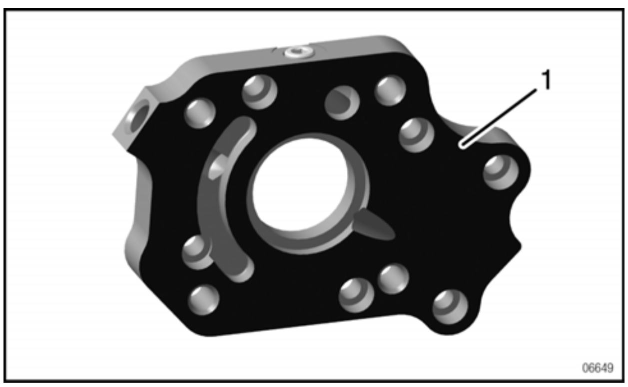

Figure 5.13

1 Governor flange

Step	Procedure
5	Check the toothing of the drive sleeve for damage..

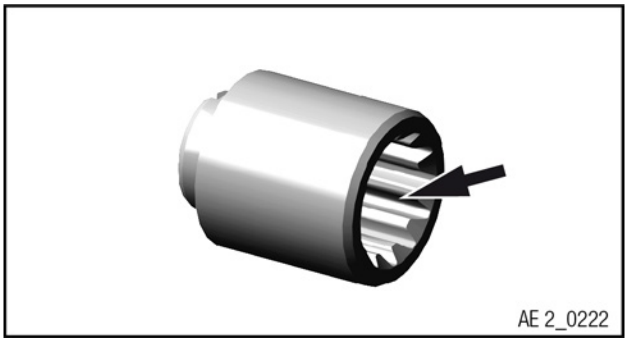

Figure 5.14

WEAR LIMITS

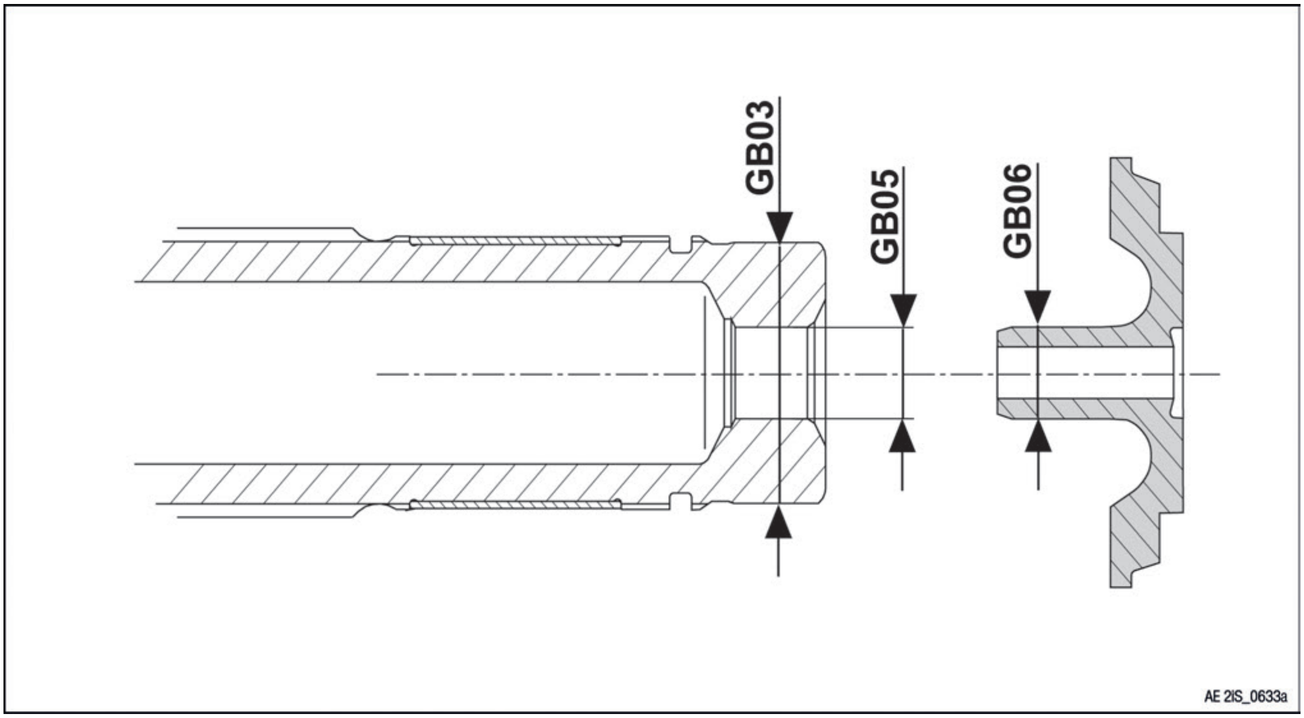

Figure 5.15: Propeller gearbox

For detailed information and measurements, see Chapter 72-10-00 section Wear limits (Gearbox).

INSTALLATION

NOTICE
All gaskets, O-rings and oil seals must be replaced!

NEEDLE SLEEVE – INSTALLATION

Step	Procedure
1	Lubricate the new needle sleeve.
2	Apply puller part no. 876489 on the governor side.
3	Place the press-in mushroom part no. 877597 on the needle sleeve and fix it with the hex. nut and washer.

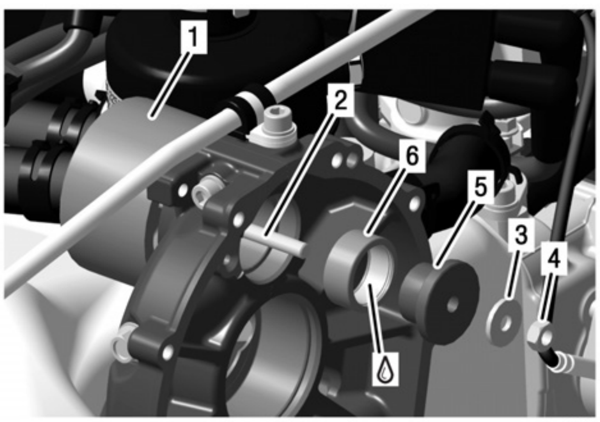

Figure 5.16

1	*Puller 876489*	2	*Hex. screw*
3	*Washer*	4	*Hex. nut*
5	*Press-in mushroom part 877597*	6	*Needle sleeve 22x18x12*

Step	Procedure
4	The needle sleeve is pressed in as far until seated by turning the hex. screw clockwise.

BALL BEARING — INSTALLATION

Step	Procedure
1	Apply puller part no. 876489 on the governor side.
2	Insert the press-in mushroom part no. 877595 into the roller bearing and fix it with the hex. nut and washer.
3	The new ball bearing is pressed in until seated by turning the hex. screw clockwise.

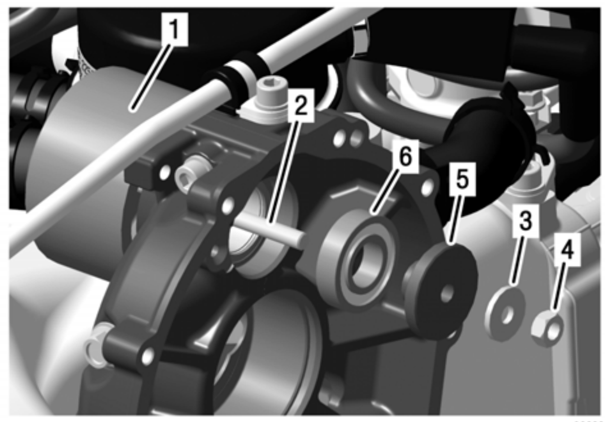

Figure 5.17

1	*Puller 876489*	2	*Hex. screw*
3	*Washer*	4	*Hex. nut*
5	*Press-in mushroom 877595*	6	*Ball bearing*

Step	Procedure
4	Secure countersunk screw M5x12 including the thrust washer with LOCTITE 243 and tighten it. Tightening torque 6 Nm (53 in.lb.)

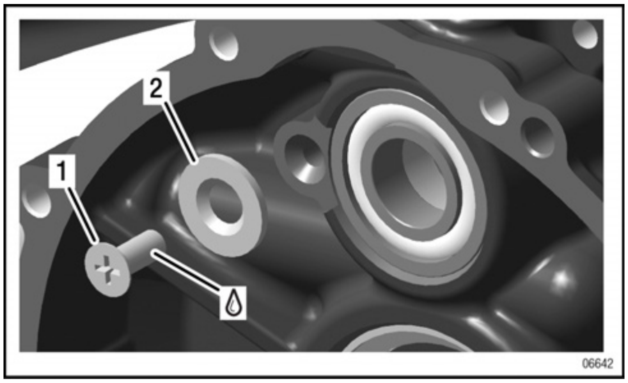

Figure 5.18

1	*Countersunk screw M5x12*	2	*Thrust washer*

ROLLER BEARING CONFIGURATION 3 — INSTALLATION

See Chapter 72-10-00 section Propeller gearbox.

GOVERNOR DRIVE — INSTALLATION

CONFIGURATION 3

Step	Procedure
1	Insert the lubricated drive sleeve. Hold with the retaining tool part no. 242661 and 876470. Then align slots of drive sleeve with gear.
2	Secure Allen screw M8x16 with LOCTITE 648 and tighten it. Tightening torque 25 Nm (18 ft.lb.)

NOTICE

The M8 fastening screw for the vacuum pump gear is 16 mm (0.63 in.) long and has a low profile screw head in the vacuum pump drive.

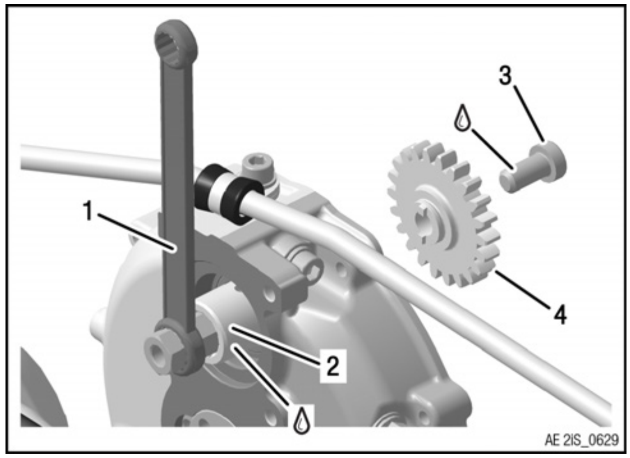

Figure 5.19: Typical

1	*Retaining tool 242660 and 876470*	2	*Drive sleeve*
3	*Allen screw M8x16*	4	*Vacuum pump gear*

GOVERNOR FLANGE — INSTALLATION

CONFIGURATION 3

Step	Procedure
1	Install distance sleeve with new O-ring 32x4 to the crankcase.
2	Place one new O-ring 7x2 each in the oil inlet flange and governor flange and hold them in position with a little bit of grease.

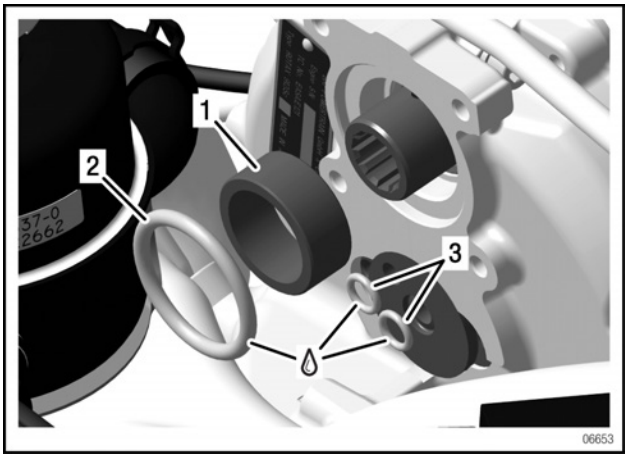

Figure 5.20: TYPICAL

1 *Distance sleeve*
2 *O-ring 32x4*
3 *O-ring 7x2*

NOTICE
Leakage may occur, if LOCTITE 243 sticks the small O-rings. Avoid too much LOCTITE 243!

Step	Procedure
3	Place on the governor flange, secure it using LOCTITE 243 with 4 Allen screws M6x20 on the crankcase and with 2 Allen screws M6x16 on the oil inlet flange, and tighten the screws. Tightening torque 10 Nm (89 in. lb.). **NOTE** *LOCTITE 5910 can be used on the sealing surfaces of the governor flange* **NOTE** *Put LOCTITE 243 onto the thread and the head of the Allen screws.*

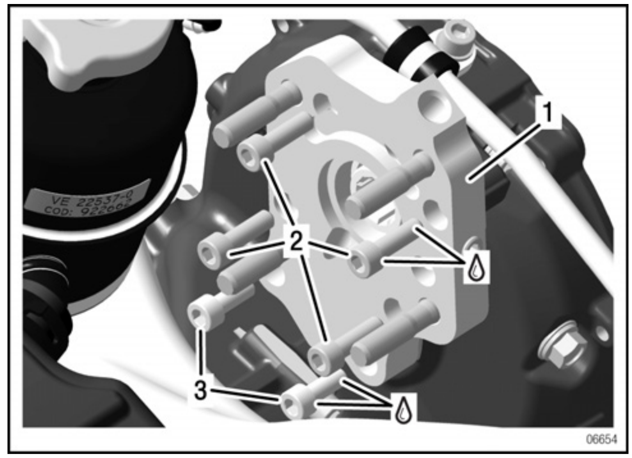

Figure 5.21

1 *Governor flange*
2 *Allen screw M6x20*
3 *Allen screw M6x16*

NOTICE
Longer screws may destroy the oil inlet flange and bearings. Observe the length of the screws.

Step	Procedure
4	Install the propeller gearbox. See current Maintenance Manual Line (MML) of the respective engine type.
5	Install the governor pressure oil line on the governor flange and on the oil pump housing using banjo bolt M10x1x23 with sealing rings A10x14. Tightening torque 15 Nm (133 in.lb.)
6	Fasten governor pressure oil line with the cable clamp and the distance sleeve using lock washer A8, hex. screw M8x25 and LOCTITE 243. Tightening torque 22 Nm (16 ft.lb.).

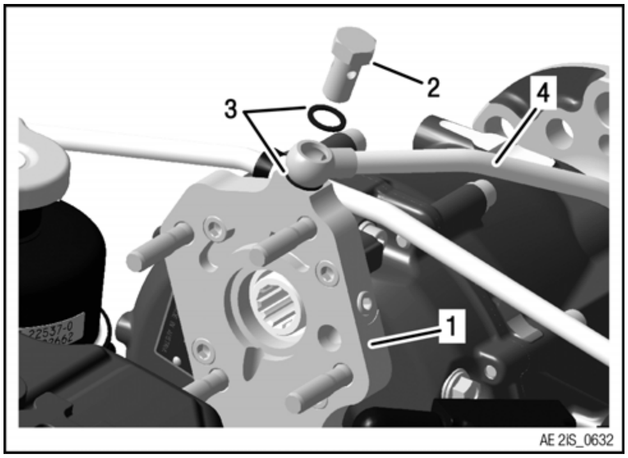

Figure 5.22

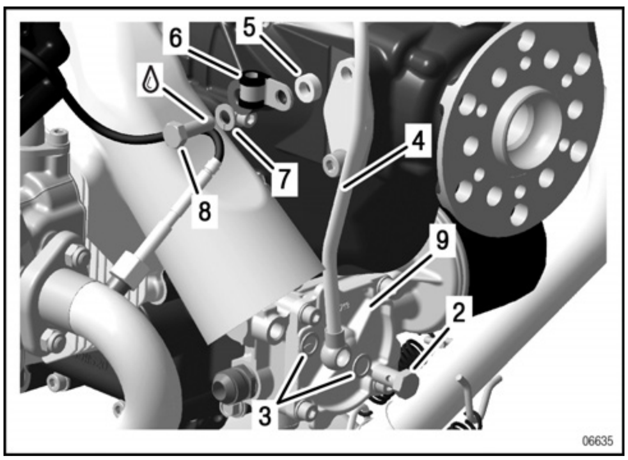

Figure 5.23

1	*Governor flange*	2	*Banjo bolt M10x1x23*
3	*Sealing ring A10x14*	4	*Governor pressure oil line assy.*
5	*Distance sleeve 8.4/15/6*	6	*Cable clamp 8/M8*
7	*Lock washer A8*	8	*Hex. screw M8x25*
9	*Oil pump*		

NOTE

The plug screws usually remain installed. If necessary, a manometer can be connected to check the governor pressure.

Step	Procedure
7	Secure the 2 plug screw M8x1 with LOCTITE 243. Tightening torque 10 Nm (89 in.lb.)

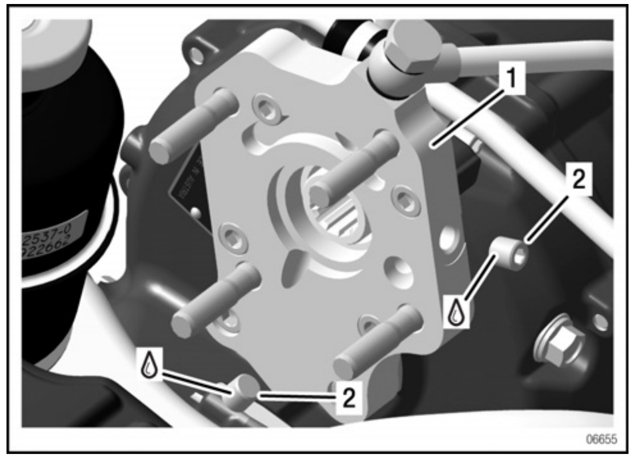

Figure 5.24

1	*Governor flange*	2	*Plug screws M8x1*

Step	Procedure
8	Check that the studs are firmly in place. If necessary, apply LOCTITE 243 and tighten. Tightening torque 15 Nm (133 in.lb.).

GOVERNOR INSTALLATION

Various screws and nuts are required, depending on the manufacturer of the governor. See the current edition of SB-912 i-001 "Installation/use of governors".

NOTE

*Governors manufactured by McCAULEY and WOODWARD **cannot** be installed in the 912 i Series engine type due to their length.*

NOTICE
The gear-tooth system of the governor must match when installed!

NOTE

Make sure that the gearing is engaged and the geared shaft of the governor move easily into the drive sleeve.

NOTICE
No hammering or pressing! The drive gear must only be pushed on by hand.

FINISHING WORK

Fill with operating fluids or check filling levels.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-10-00 section Adding operating fluids.

Purge the oil system.
See current Installation Manual (IM) for the respective engine type, Chapter 79-00-00 section Purging the lubrication system.

Carry out an engine test run.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Planned maintenance

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Chapter: 71–00–00
POWER PLANT

TOPICS IN THIS CHAPTER

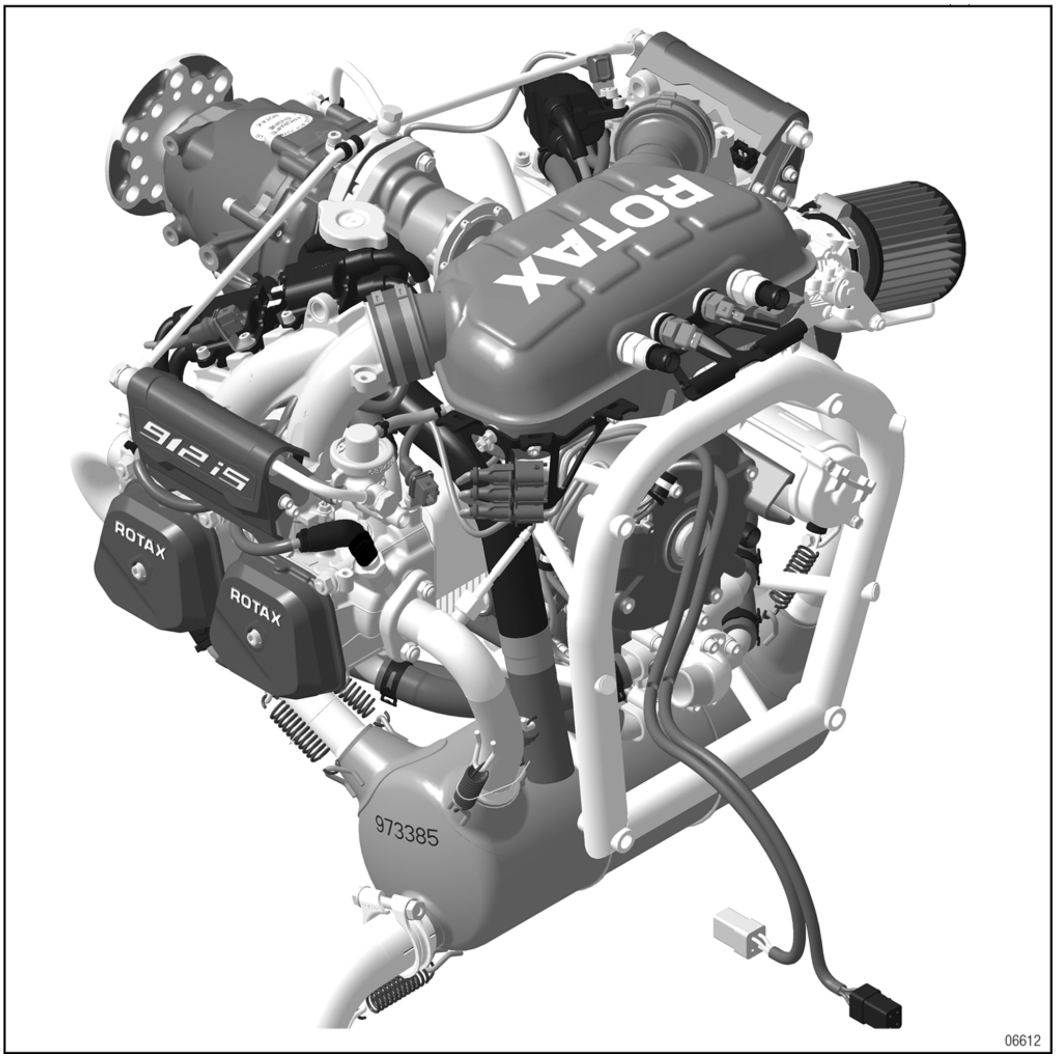

Figure 6.1: Power plant

SPECIAL TOOLS

Description	Part number
Engine lifting kit assy.	876040
Trestle support	877930
Trestle adapter assy.	876050
Socket driver hex. 8 ball head	876240

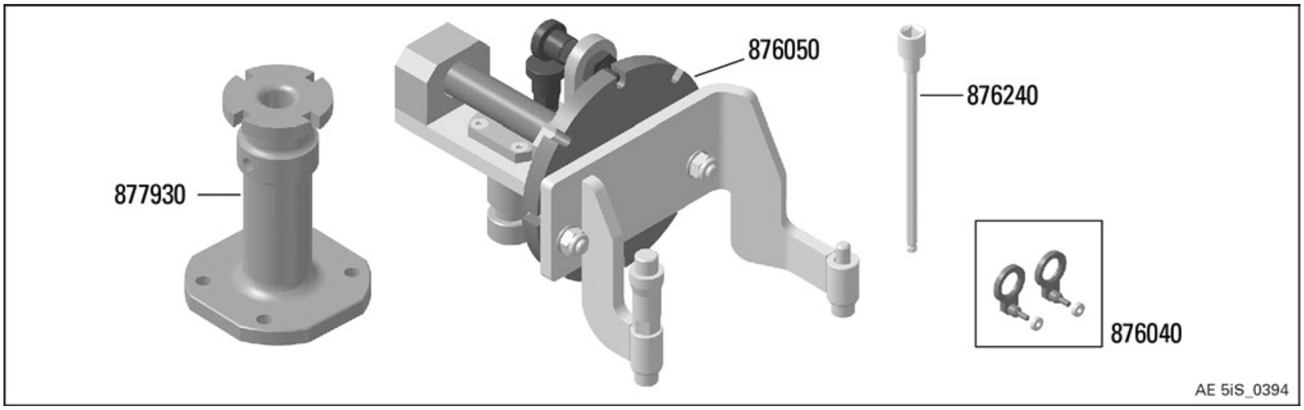

Figure 6.2: Special tools

SERVICE PRODUCTS

Description	Part number
LOCTITE 243	897651
LOCTITE 648	899788

INSTALLATION CHECKLIST

The following installation checklist must be copied and filed in during power plant/engine installation.

Installation checklist for power plant assy.	
Aircraft	
Type	
Serial number	
Registration number	
Manufacturer	
Engine	
Type	
Serial number	
FUSE BOX serial number	
ECU part no. (S/N)	
Manufacturer	BRP-Rotax GmbH&Co KG, 4623 Gunskirchen, Austria
Specifications/version	
Miscellaneous data	
Installation date	
Mechanic (surname and forename)	

Installation-related point	OK	Remark
Control unit (ECU) checked for damage and corrosion. Insulated construction checked.		
Fuse unit (FUSE BOX) checked for damage and corrosion. Fuses checked.		
Fuse unit (FUSE BOX) connections checked for secure connection. See also Chapter 76-10-00 Fuse box – installation.		
Protective coverings removed.		
Fuel filters/prefilters on the aircraft frame side cleaned.		

Installation-related point	OK	Remark
All fuel tanks and fuel lines cleaned. See “Documentation of aircraft manufacturer”. See relevant Maintenance Manual Line (MML) Chapter 12–20–00 Planned maintenance.		
Checking the engine for contamination and damage. See relevant Maintenance Manual Line (MML) Chapter 05–00–00 Maintenance.		
Installation of the engine and its components. See also Chapter Chapter 71–00–00 Power plant.		
Control unit (ECU) connections checked for secure connection. Connector lock in position! See also Chapter 76-10-00 section ECU — installation.		
Routing of wiring harness checked. See 76-50-00 Wiring harness.		
Grounding cable checked according to aircraft manufacturer’s specifications. Allocation checked. See documentation of aircraft manufacturer.		
Fuel pump connection checked. See documentation of aircraft manufacturer. See also Chapter 73-00-00 Fuel system.		
Fuel system checked for leaks. See relevant Maintenance Manual Line (MML) Chapter 12–20–00		
Fuel filter checked for blockages. See relevant Maintenance Manual Line (MML) Chapter 12–20–00.		
Propeller installed according to the aircraft manufacturer’s and propeller manufacturer’s specifications. See “Documentation of aircraft manufacturer”.		
Lubrication system filled and purged. To do this, see relevant Maintenance Manual Line (MML) Chapter 12–10–00 section Adding operating fluids + Chapter 12-20-00 section Purging of oil system.		

Installation-related point	OK	Remark
Cooling system flushed and filled. To do this see relevant Maintenance Manual Line (MML) Chapter 12–10–00 section Adding operating fluids + Chapter 12-20-00 section Flushing the engine cooling system.		
Engine test run/functional test. See relevant Maintenance Manual Line (MML) Chapter 12–20–00.		

General notes/remarks:
(Please fill in using block capitals!)

Location:________________________________**Date:** ____________________________
Signature: __________________________**Print name:** __________________________

GENERAL NOTE

DELIVERY OF THE ENGINE

Delivery and handling of the engine and assemblies

- When the engine is delivered, check that the original ROTAX® packaging is not damaged.
- If the packaging is damaged, contact the authorised sales and service partner for ROTAX® aircraft engines.

Unpacking the engine

To unpack a new engine, proceed as follows:

Step	Procedure
1	Remove the wooden lid.
2	Remove the protective packaging.

NOTICE

Use the engine lifting kit part no. 876040 to lift the engine out.

Checking the state of delivery

NOTICE

Danger of consequent damage to the engine and aircraft due to corrosion and damage.
In the event of any kind of negative diagnosis of the engine after the packaging has been removed, immediately contact an authorised sales or service partner for ROTAX® aircraft engines.A corroded or damaged engine must never be installed in an aircraft!

After the engine has been unpacked, carry out the following steps to check the state of delivery:

Step	Procedure
1	Check that the serial number and engine type description on the type plate match the data on the delivery note.
2	Check the engine for damage or corrosion. If everything is found “OK”, the engine can be accepted.

Removal of protective coverings and preservation

Step	Procedure
1	Remove protective coverings, waxed paper or something similar.
2	The protective coverings attached for transport or preservation must be removed.

ENGINE PRESERVATION

If limit is exceeded or preservation was not performed annually - this section is valid for:
Storage and preservation requirements for a new engine or an engine which has been in operation.
Following steps need to be checked before return to operation:

- Removal of the gearbox and one cylinder.
- Visual inspection for possible corrosion on gear set, propeller shaft, clutch, crankshaft, camshaft, con rod, piston rings and valves.

NOTE

If there is any corrosion of the components, the engine must be overhauled according to the current Overhaul Manual (OHM) for the respective engine type.

NOTICE

The preservation is in the responsibility of the engine owner or any other service contracted partner of him or her. The relevant documentation to approve that the preservation was done correctly also is in the responsibility of the previous named parties. BRP-Rotax can not approve, if a preservation was done correctly or not.If no documentation of preservation is available, BRP-Rotax recommends to perform the checks according to part “Following steps need to be checked before return to operation”.

⚠ WARNING

Non-compliance can result in serious injuries or death!
The engine must not be put into operation.

NOTE

The maximum possible storage period of the engine is limited to 24 months.

Finishing work:

- Install cylinder and cylinder head. See Chapter 72–30–10 section Cylinder - installation and Chapter 72-30-00 section Cylinder head - installation.

Install propeller gearbox assy.
See current Maintenance Manual Line (MML) for the respective engine type.

- Install the gearbox oil line assy. (configuration 2) or pressure oil line (configuration 3). See Chapter 61–20–00 Governor .

Fill with operating fluids or check filling levels.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-10-00 section Adding operating fluids.

Purge the oil system.
See current Installation Manual (IM) for the respective engine type, Chapter 79-00-00 section Purging the lubrication system.

Flush the engine cooling system.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Flushing the engine cooling system.

Carry out an engine test run.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Planned maintenance

Storage and preservation of an engine which has been in operation
Thanks to the special cylinder wall coating, the ROTAX® aircraft engine does not generally need any special anti-corrosion measures.

NOTICE

Storage is possible up to 12 months if the following steps are observed.

NOTE

In the event of longer out of service periods repeat the whole preservation procedure annually.

Carry out oil change.
See current Maintenance Manual Line (MML) for the respective engine type.

- Seal all openings, exhaust pipe and air filters on the cold engine to prevent contamination and humidity.
- Spray steel parts on the outside with preservation oil.
- Replace or function test injectors at Rotax authorized overhaul shop.
- If the engine is out of service for longer periods, the whole preservation process must be repeated annually.

See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00, section “Planned maintenance”.

RETURN TO SERVICE

See current Maintenance Manual Line (MML) for the respective engine type.

⚠ WARNING

Non-compliance can result in serious injuries or death!
Work on the engine must be carried out by authorised personnel and certified.

Step	Procedure
1	Remove all plugs.
2	Clean the spark plugs with solvent and a plastic brush.
3	If preservation has been carried out less than a year ago, it is not necessary to change the oil again.
4	If the engine has been out of service for more than a year, the 100–hour inspection must be carried out.

TREATING RUST AND SURFACE DAMAGE

CORROSION

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 manufacturers 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.

During longer out-of-service periods, flash rust can form on various metal parts. In the event of considerable corrosion or severely rusted screws, nuts, washers, bearings, bushings etc. replacement is absolutely necessary.

- Propeller shaft — To prevent surface rust, the flange should be lightly greased, see Chapter 72-00-00.
- For the electric system, see Chapter 74-00-00.

SYSTEM DESCRIPTION

DESCRIPTION OF DESIGN

A ROTAX® 912 i Series engine consists basically of several main components and add-on assemblies, which are described in more detail in the Operators Manual (OM) (Chapter 1).

TECHNICAL DATA

NOTICE
Observe detailed technical data relevant for operation. See the latest Operators Manual (OM).

OPERATING LIMITS

See current Operators Manual (OM) of the respective engine type, section “Operating instructions”.

OPERATING FLUIDS/CAPACITIES

See current Operators Manual (OM) of the respective engine type, section “Operating media”.

WEIGHTS

See current Operators Manual (OM) of the respective engine type, section “Technical data”.

SERIAL AND PART NO.

The parts are labelled with serial and part numbers. The following description explains the main two versions of serial and part numbers.

NOTE

If additional parts are purchased, part of the serial and part numbering of the aeronautical equipment manufacturer is included.

SERIAL NUMBER

The number system for the serial number consists of a two-digit number block and a four-digit number block with a point separating them.

The first number block of the serial number indicates the year of manufacture, the second is a consecutive number.

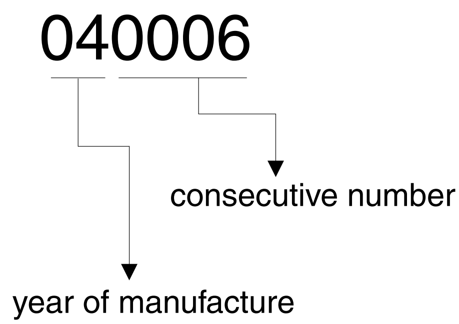

Figure 6.3: e.g. serial number

PART NO.

The part number consists of a simple six-digit number block.

This number block is a consecutive number.

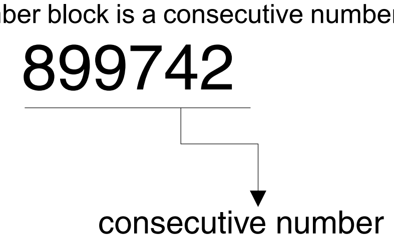

Figure 6.4: e.g. part no.

ENGINE/COMPONENTS, GENERAL

Design	4–cylinder normal aspirated engine
Bore	84 mm (3.31 in.)
Stroke	61.0 mm (2.40 in.)
Displace-ment	1352 cm³ (82.5 in³)
Cylinders	Light alloy cylinder with Nicasil plating
Pistons	Light alloy piston with 3 piston rings
Cylinder head	4 single cylinder heads
Compres-sion	10.8:1
Intake valve	38 mm (1.5 in.), valve seat plated
Exhaust valve	32 mm (1.26 in.) NIMONIC, valve seat stellite-plated
Valve clearance	Automatic valve clearance compen-sation by means of hydraulic valve tappet
Valve drive	OHV, hydraulic valve tappet, push-rods and rocker arms
Camshaft	Steel, heat- and surface-treated
Crankshaft	Mounted in 5 places on plain bear-ings, carburised
Cooling system	Liquid-cooled cylinder heads, ram air cooled cylinders
Lubrication	Main oil pump circuit: Dry sump forced lubrication system, trochoid pump driven by the cam-shaft, oil return by blow-by
Oil pressure	See current Operators Manual (OM) of the respective engine type.
Firing order	1–4–2–3
Spark plugs	12 mm (0.474 in.). See current Main-tenance Manual Line (MML), Chap-ter 12-20-00.
Electrode gap	See current Maintenance Manual Line (MML), Chapter 12-20-00.
Integrated generator	2 permanent magnet 3-phase gener-ators. 200 and 400 W.
Regulator	12 V 20 A DC
External generator (optional)	Full-wave rectifier with 12 V 40 A DC serial regulator
Fuel pumps	2 electric fuel pumps
Starter	Electric starter, 12 V
Propeller gearbox	Integrated gearbox with mechanical vibration damping and overload clutch
Gear trans-mission	2.43
Direction of rotation	Counterclockwise, seen from the front in the direction of the propeller flange
Overload clutch	Multi-disc clutch
Vacuum pump (optional)	Drive via the gearbox
Propeller pitch gover-nor (optional)	Drive via the gearbox

ENGINE COMPONENTS, ENGINE VIEWS, CYLINDER DESIGNATION AND DEFINITION OF MAIN AXIS

PTO	Power take off side
MS	Magneto side
A	Attachment points (for engine transport)
◕, Z	Center of gravity
P	Zero reference point (starting point for all dimensions)
	NOTE
	Allow ± 1 mm on all stated dimensions as manufacturing tolerance
x, y, z	Coordinate system axis
Cyl. 1	Cylinder 1
Cyl. 2	Cylinder 2
Cyl. 3	Cylinder 3
Cyl. 4	Cylinder 4

Components, engine views

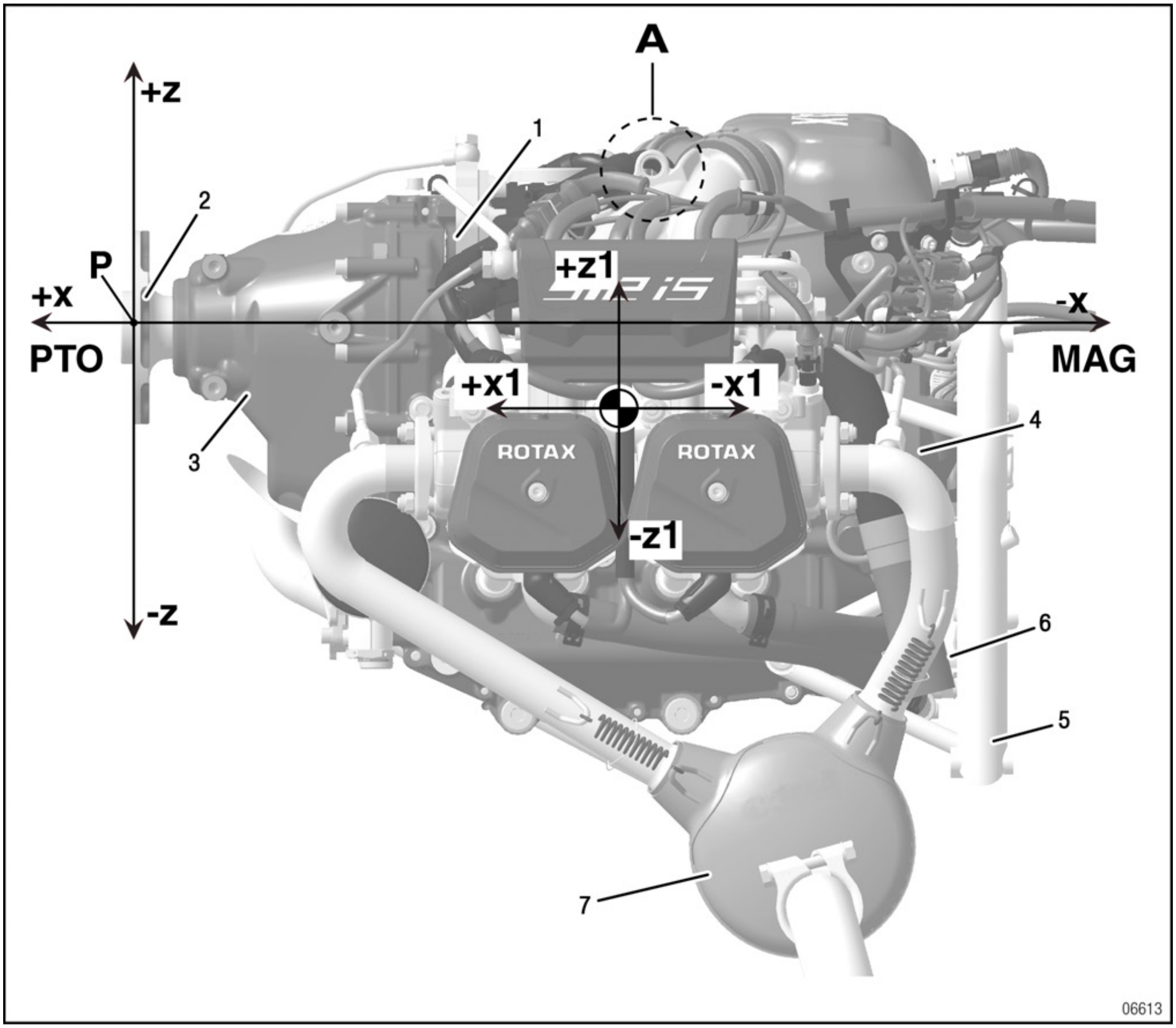

Figure 6.5: Side view

1	*Engine serial number*	2	*Propeller flange*
3	*Propeller gearbox*	4	*Ignition housing*
5	*Engine suspension frame (optional)*	6	*Water pump housing*
7	*Muffler assy.*		

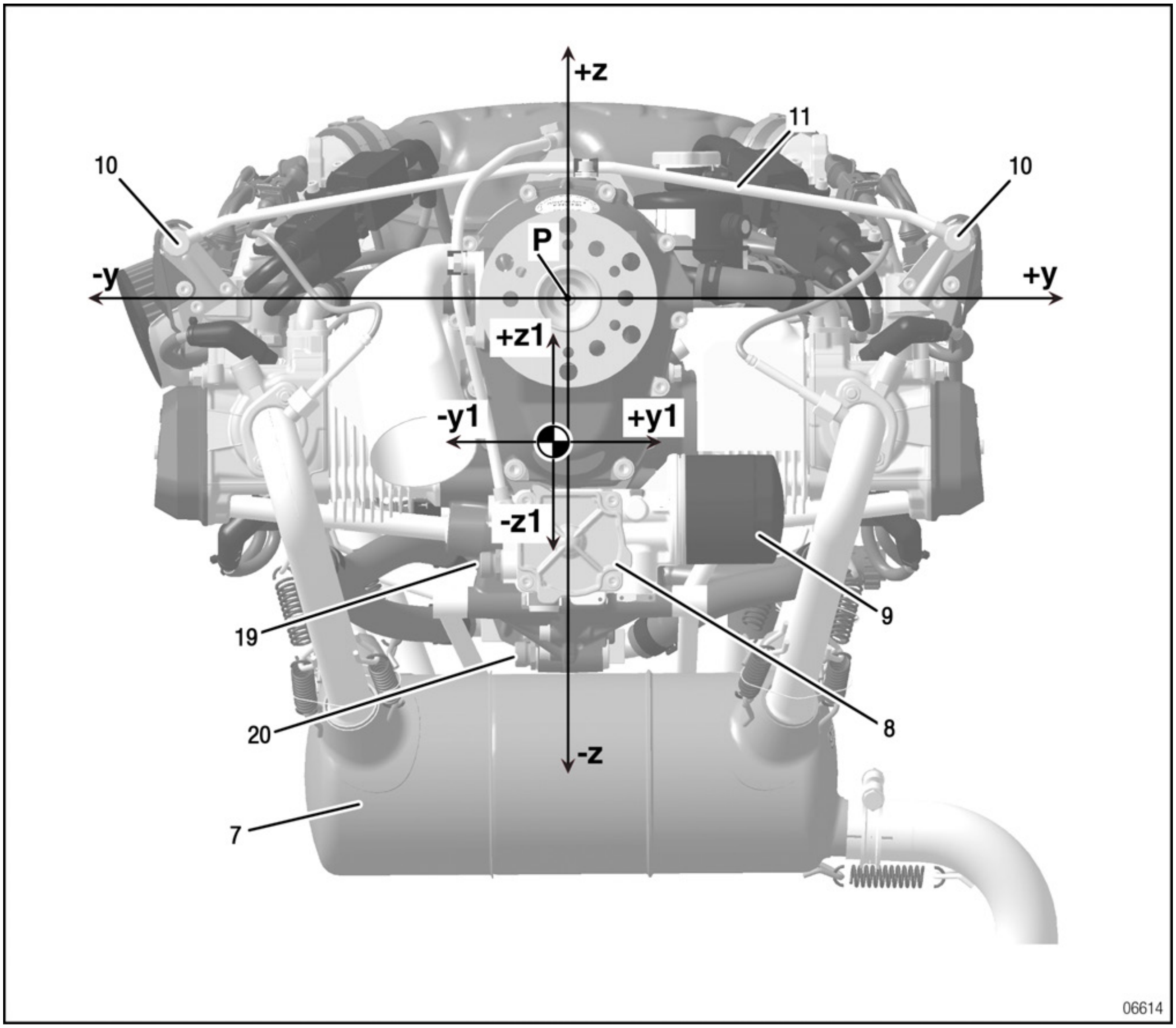

Figure 6.6: front view

8	*Oil pump housing*	9	*Oil filter*
10	*Fuel rail left/right*	11	*Fuel hose assy.*
19	*Connection for oil feed line*	20	*Connection for oil return line*

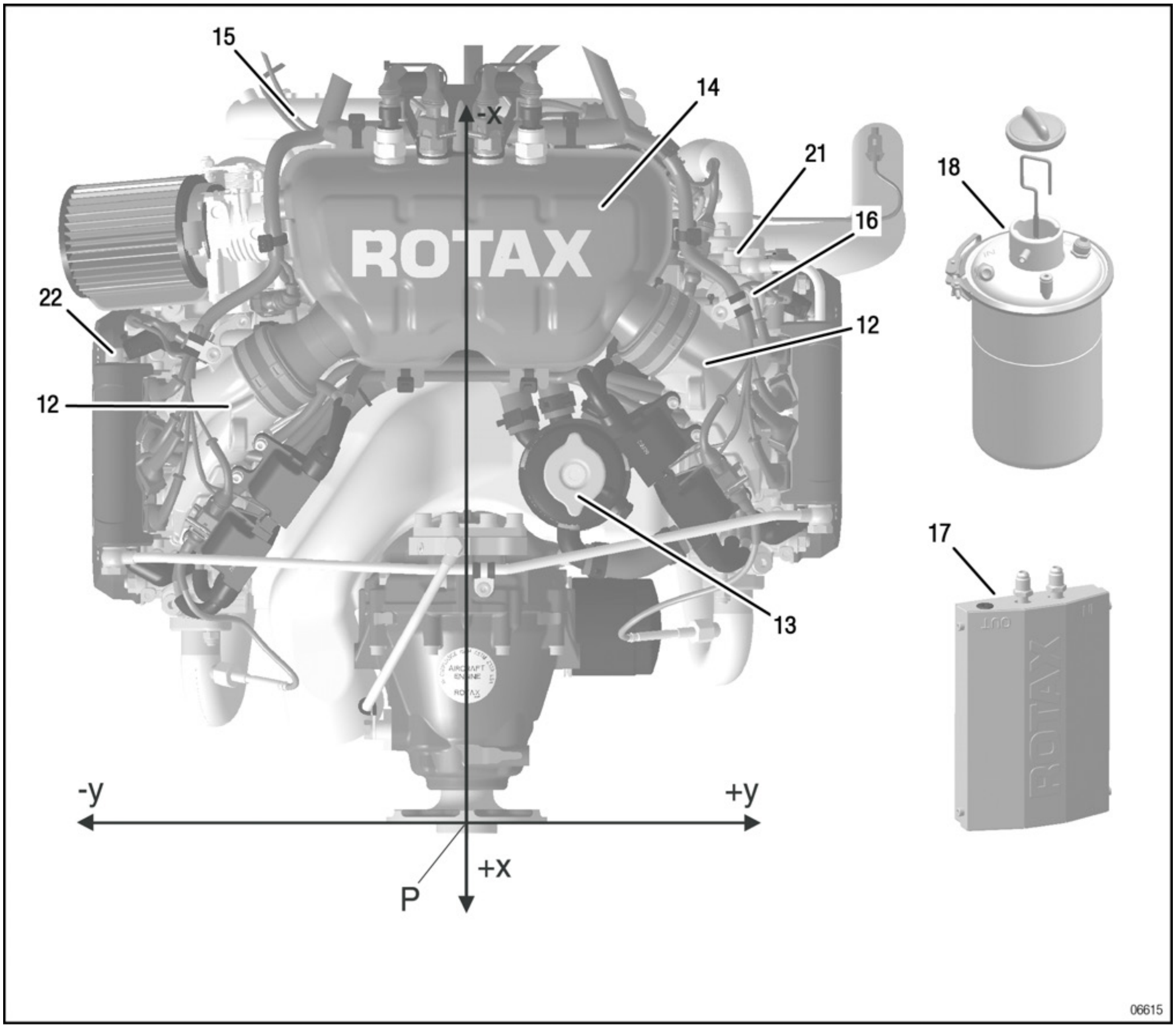

Figure 6.7: top view

12	*Intake manifold, left (cyl. 1/3), right (cyl. 2/4)*	13	*Expansion tank assy.*
14	*Airbox*	15	*Electric starter assy.*
16	*Fuel pressure regulator*	17	*Fuel pump module assy.*
18	*Oil tank assy.*	21	*Connection for fuel return line*
22	*Connection for fuel feed line*		

MAINTENANCE

For maintenance and special checks, see Maintenance Manual Line (MML) for the respective engine type.

POWER PLANT

SAFETY INSTRUCTION

⚠ WARNING

Danger of severe burns and scalds! Always allow the engine to cool down to ambient temperature before starting any work.

⚠ WARNING

Danger of serious injury! During work on the lubrication system there is a risk of injury due to pressure!

ENVIRONMENTAL NOTE

Please observe the disposal regulations applicable in your area.

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.

NOTE

Ensure that the lubrication system is no longer pressurized!

POWER PLANT — REMOVAL

Preparation Engine

- Switch the ignition key OFF

Drain the oil. See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Planned maintenance.

Drain the coolant. See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Planned maintenance.

Drain the fuel. See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Planned maintenance.

Remove the feed line of fuel rail 1/3 and return line of fuel rail 2/4 and fuel pressure regulator. Follow the instructions of the aircraft manufacturer.

Remove the oil hoses from oil feed line, return line and turbo return line. Follow the instructions of the aircraft manufacturer.

Remove the coolant hoses (inlet, outlet and overflow bottle). Follow the instructions of the aircraft manufacturer.

For disconnection of the ground cables follow the instructions of the aircraft manufacturer.

For disconnection of the fuel pump follow the instructions of the aircraft manufacturer.

Disconnect the connector HIC_A / HIC_B. Follow the instructions of the aircraft manufacturer.

For disconnection of the starter relay, follow the instructions of the aircraft manufacturer.

- Disconnect the positive pole on the electric starter. See 80-00-00 Electric starter.
- Disconnect Ambient Air Pressure and Temperature Sensor (AAPTS), fusebox and ECU see 76-50-00 Wiring harness.
- Install the lifting kit part no. 876040.

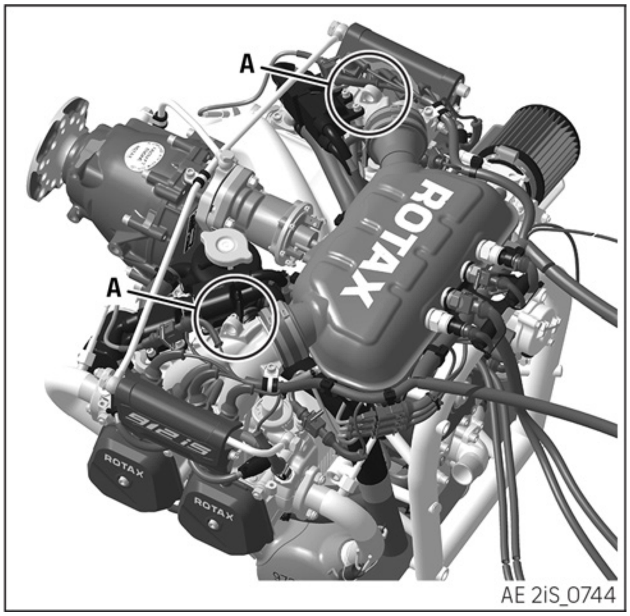

Figure 6.8

A *Attachment points (for engine lifting)*

REMOVAL OF THE POWER PLANT FROM THE AIRCRAFT

⚠ WARNING

Danger of injury due to falling parts!When the engine is removed there is a risk of injury due to the engine or its assemblies falling!
Use ROTAX lift set, no other lifting points allowed. Note center of gravity! Do not walk under the lifted engine!Wear protective footwear!

NOTICE

Danger of damage to the engine and aircraft!
Before the engine is removed, ensure that all detachable connections between the engine and the aircraft, i.e. hoses, lines, cables, cable ties and clamps have been disconnected and moved out of position so that they do not obstruct removal!

NOTICE

For removal and installation of the power plant proceed according to the aircraft manufacturer's instructions.

POWER PLANT – INSTALLATION

Install the feed line of fuel rail 1/3 and return line of fuel rail 2/4 and fuel pressure regulator. Follow the instructions of the aircraft manufacturer.

Install the oil hoses for oil feed line, return line and turbo return line. Follow the instructions of the aircraft manufacturer.

Install the coolant hoses (inlet, outlet and overflow bottle). Follow the instructions of the aircraft manufacturer.

For connection of the ground cables follow the instructions of the aircraft manufacturer.

For connection of the fuel pump follow the instructions of the aircraft manufacturer.

Connect the connector HIC_A / HIC_B. Follow the instructions of the aircraft manufacturer.

For connection of the starter relay, follow the instructions of the aircraft manufacturer.

- Connect the positive pole on the electric starter. See 80-00-00 Electric starter
- Connect Ambient Air Pressure and Temperature Sensor (AAPTS), fusebox and ECU see 76-50-00 Wiring harness.
- Remove the lifting kit.

Fill with operating fluids or check filling levels. See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12–10–00 section Adding operating fluids.

Purge the oil system. See current Installation Manual (IM) for the respective engine type, Chapter 79-00-00 section Purging the lubrication system.

Flush the engine cooling system.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Flushing the engine cooling system.

Carry out an engine test, see current Maintenance Manual Line (MML) for the respective engine type, Chapter 12–20–00 section Planned maintenance.

TRESTLE ADAPTER ASSY. – INSTALLATION AND REMOVAL

⚠ WARNING

Danger of injury due to falling parts!When the engine is removed there is a risk of injury due to the engine or its assemblies falling!
Use ROTAX lift set, no other lifting points allowed. Note center of gravity! Do not walk under the lifted engine!Wear protective footwear!

Preparation

- Remove exhaust assy. See Chapter 78-10-00 section Exhaust assy. — removal.

NOTE

The assemblies and lines are only to be removed if necessary.

NOTICE

Make sure that no foreign bodies get into connected lines and connections.

Step	Procedure
1	Remove plug screw or adapter (metric or UNF) with sealing ring (cylinder 1/3).
2	Install bolt of tool part no. 876050 into the crankcase tightening torque 35 Nm (26 ft. lb.).

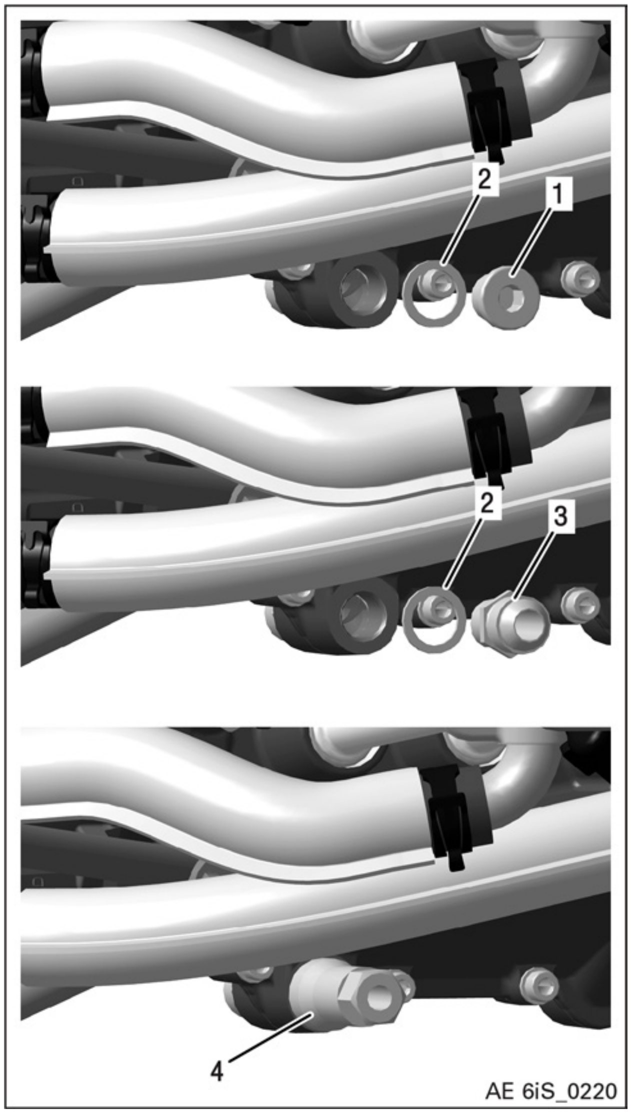

Figure 6.9: TYPICAL

1	*Plug screw*	*2*	*Sealing ring*
3	*Adapter*	*4*	*Bolt*

Step	Procedure
3	Install trestle adapter assy. part no. 876050 onto the crankcase with two Allen screws M10x50 tightening torque 35 Nm (26 ft. lb.).
4	Install engine including trestle adapter assy. part no. 876050 into the trestle support part no. 877930.

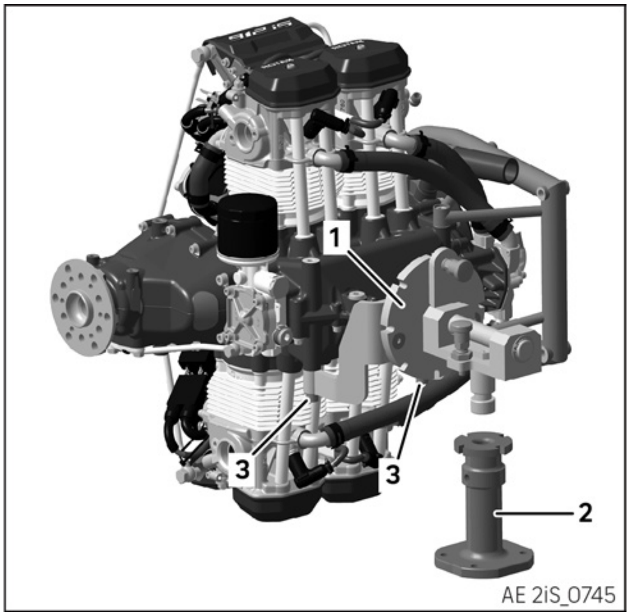

Figure 6.10: TYPICAL

1	*Trestle adapter assy. part no. 876050*	2	*Trestle support part no. 877930*
3	*Allen screws M10x50*		

TRESTLE ADAPTER ASSY. – REMOVAL

Step	Procedure
1	Remove engine including trestle adapter assy. part no. 876050 from the trestle support part no. 877930.
2	Loosen 2 Allen screws M10x50 and remove with trestle adapter assy. part no. 876050 from the engine.
3	Remove bolt of tool part no. 876050 from the crankcase.

NOTICE

Make sure that no foreign bodies get into connected lines and connections.

Step	Procedure
4	Install plug screw M16x1.5 with a new sealing ring 16x22 and LOCTITE 243 or adapter (metric or UNF) with a new sealing ring 16x22 and LOCTITE 648. Tightening torque 35 Nm (26 ft. lb.) .

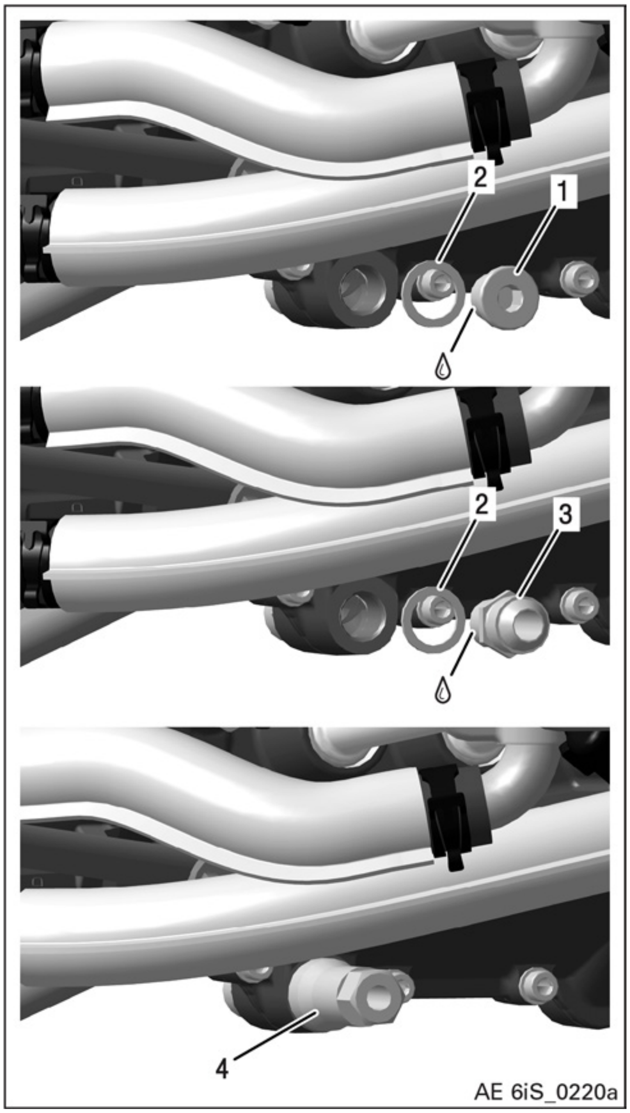

Figure 6.11: TYPICAL

1	*Plug screw M16x1.5*	2	*Sealing ring 16x22*
3	*Adapter (metric or UNF)*	4	*Bolt*

FINISHING WORK

- Install exhaust assy. See Chapter 78-10-00, section Finishing work.
- Install the power plant into the aircraft according to the aircraft manufacturer's instructions and see also section Power plant - Installation.

Install surrounding components according to the aircraft manufacturer's instructions.

Fill with operating fluids or check filling levels.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-10-00 section Adding operating fluids.

Flush the engine cooling system.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Flushing the engine cooling system.

Purge the oil system.
See current Installation Manual (IM) for the respective engine type, Chapter 79-00-00 section Purging the lubrication system.

Carry out an engine test run.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Planned maintenance

REMOVAL

ENGINE SUSPENSION FRAME — REMOVAL

⚠ WARNING
Danger of severe burns and scalds! Always allow the engine to cool down to ambient temperature before starting any work.

Drain the coolant.
See current Maintenance Manual Line (MML) for the respective engine type.

Remove the coolant hoses (feed and return) according to the aircraft manufacturer's instructions.

Preparation

- Remove the water pump housing with lower form hoses. See Chapter 75-00-00, section .
- Remove exhaust assy. if necessary. See Chapter 78-10-00, section Exhaust assy. — removal.

Step	Procedure
1	Remove the Allen screws (1x M10x110 and 3x M10x35) with lock washers.
2	Remove the engine suspension frame including the thrust washers.

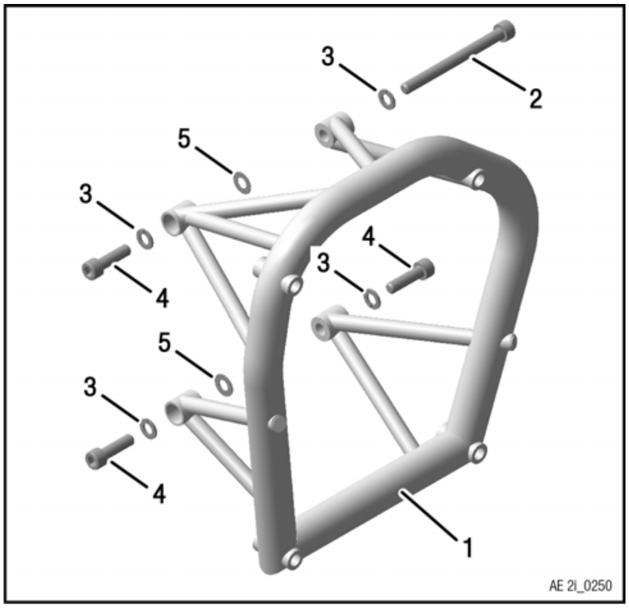

Figure 6.12

1	*Engine suspension frame*	2	*Allen screw M10x110*
3	*Lock washer*	4	*Allen screw M10x35*
5	*Thrust washer*		

NOTICE
On the left-hand side (cylinders 2/4), thrust washers can be installed for tension-free assembly. Use as required. Do not lose them!

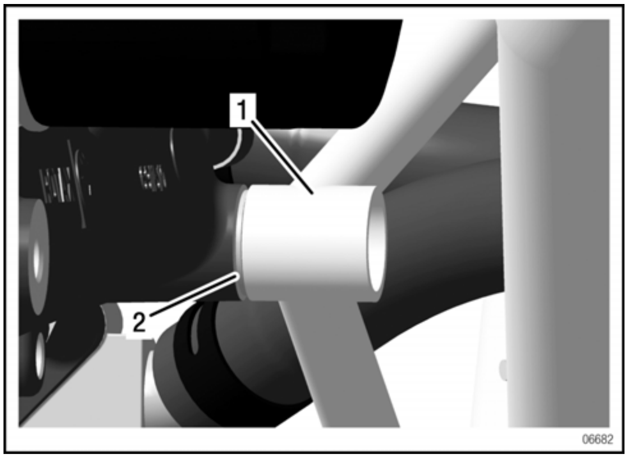

Figure 6.13

1	*Engine suspension frame*	2	*Thrust washer*

NOTICE

Do not damage the Coolant Temperature Sensor (CTS) and Exhaust Temperature Sensor (EGT) on cylinder 4!

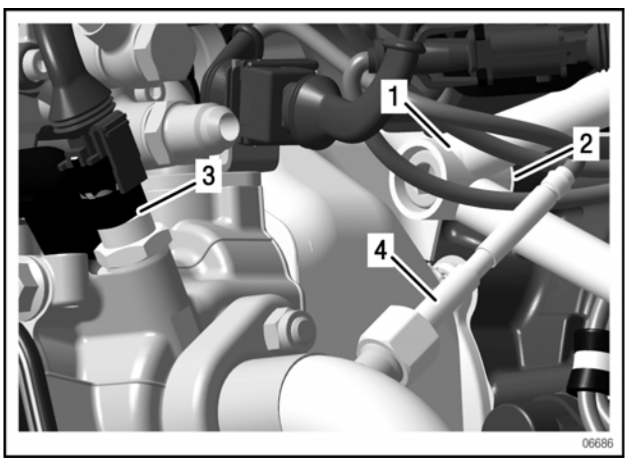

Figure 6.14

1	*Engine suspension frame*	2	*Thrust washer*
3	*Coolant temperature sensor (CTS)*	4	*Exhaust gas temperature sensor (EGT)*

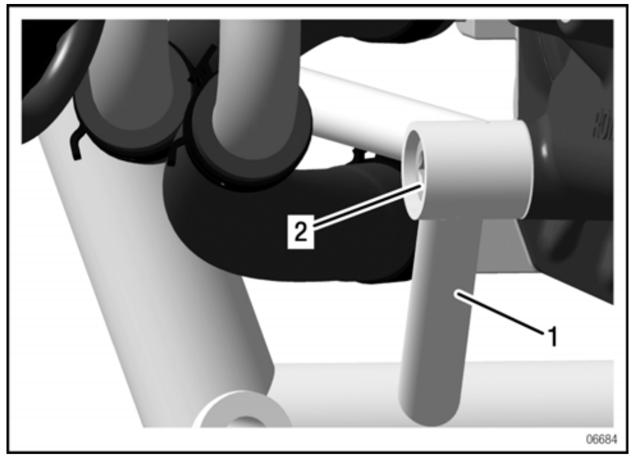

Figure 6.15

1	*Engine suspension frame*	2	*Allen screw M10x35 with lock washer*

NOTE

Remove the air filter including the heat shield according to the aircraft manufacturer's instructions.

NOTICE

Do not damage the Exhaust Gas Temperature sensor (EGT) on cylinder 3!

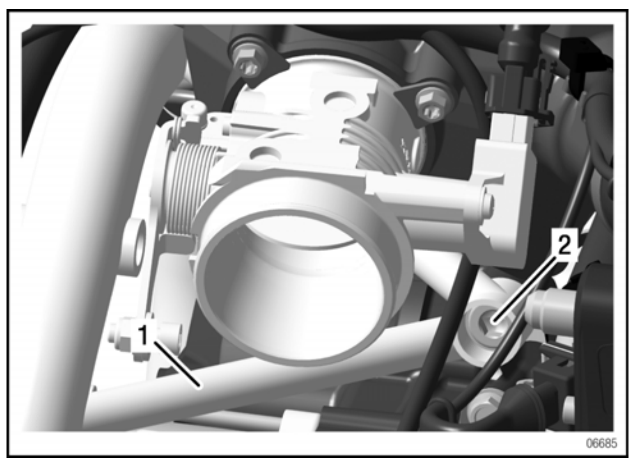

Figure 6.16

1	*Engine suspension frame*	2	*Allen screw M10x110 with lock washer*

INSPECTION

ENGINE SUSPENSION FRAME — INSPECTION

Step	Procedure
1	All components must be visually inspected.

NOTE

Detailed visual inspection of the engine suspension frame in the vicinity of all welded connections between the tube and the struts.

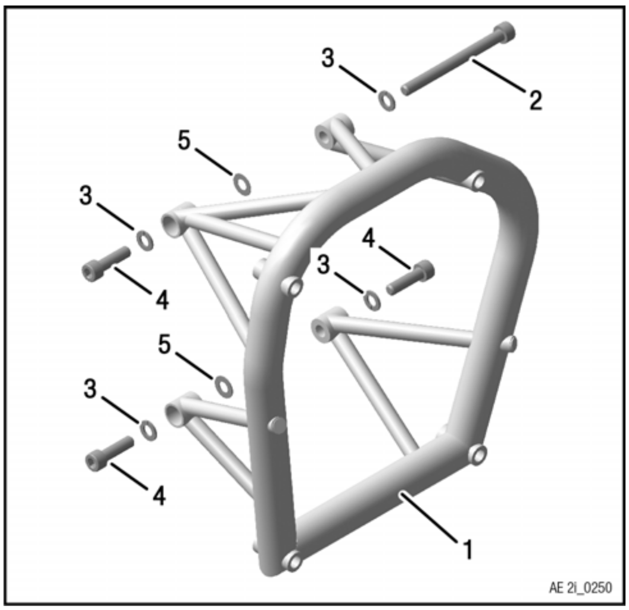

Figure 6.17

1	*Engine suspension frame*	*2*	*Allen screw M10x110*
3	*Lock washer*	*4*	*Allen screw M10x35*
5	*Thrust washer*		

NOTE

If necessary, a transfer flight to a repair company is permissible, as long as not more than one tube or strut is not more than 50% detached. If it is completely detached, immediate replacement is necessary.

INSTALLATION

ENGINE SUSPENSION FRAME — INSTALLATION

NOTICE

The engine suspension frame must be installed in a tension-free manner. Space out the engine suspension frame with thrust washers, as necessary to fill any gap.

NOTE

The Allen screws M10x110 must conform to strength class 10.9.

NOTICE

Do not damage the Exhaust Gas Temperature sensor (EGT) on cylinders 3 and/or 4 and Coolant Temperature sensor (CTS) on cylinder 4!

Step	Procedure
1	Tighten the engine suspension frame (cylinder 3) with Allen screws M10x35 and M10x110 including lock washers A10 with 60 Nm (44 ft.lb.) and secure with LOCTITE 243.
2	Now install thrust washers 10.1/20/0.5 between the crankcase and the engine suspension frame (cylinder 4). **NOTE** *Maximum allowed shimming distance is 2 mm (0.08 in.)*
3	Tighten second side of the engine suspension frame with Allen screws M10x35 including the lock washers A10 with 60 Nm (44 ft.lb.) and secure with LOCTITE 243.

FINISHING WORK

- Install the water pump housing with lower form hoses. See Chapter 75–00–00 section Water pump housing with lower form hoses — installation.
- Install muffler, if necessary. See Chapter 78-10-00 section Exhaust assy. — installation.
- Install the coolant hoses (feed and return) according to the aircraft manufacturer's instructions.

Fill with operating fluids or check filling levels.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-10-00 section Adding operating fluids.

Purge the oil system.
See current Installation Manual (IM) for the respective engine type, Chapter 79-00-00 section Purging the lubrication system.

Flush the engine cooling system.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Flushing the engine cooling system.

Carry out an engine test.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Planned maintenance.

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Chapter: 72–00–00
ENGINE

TOPICS IN THIS CHAPTER

This section describes the maintenance of the ROTAX® 912 i Series engine. The description is divided into subsections and explanations of system functions.

Subject	Section
Engine	Chapter 72-00-00
Propeller gearbox	Chapter 72-10-00
Engine block	Chapter 72-20-00
Cylinder head	Chapter 72-30-00

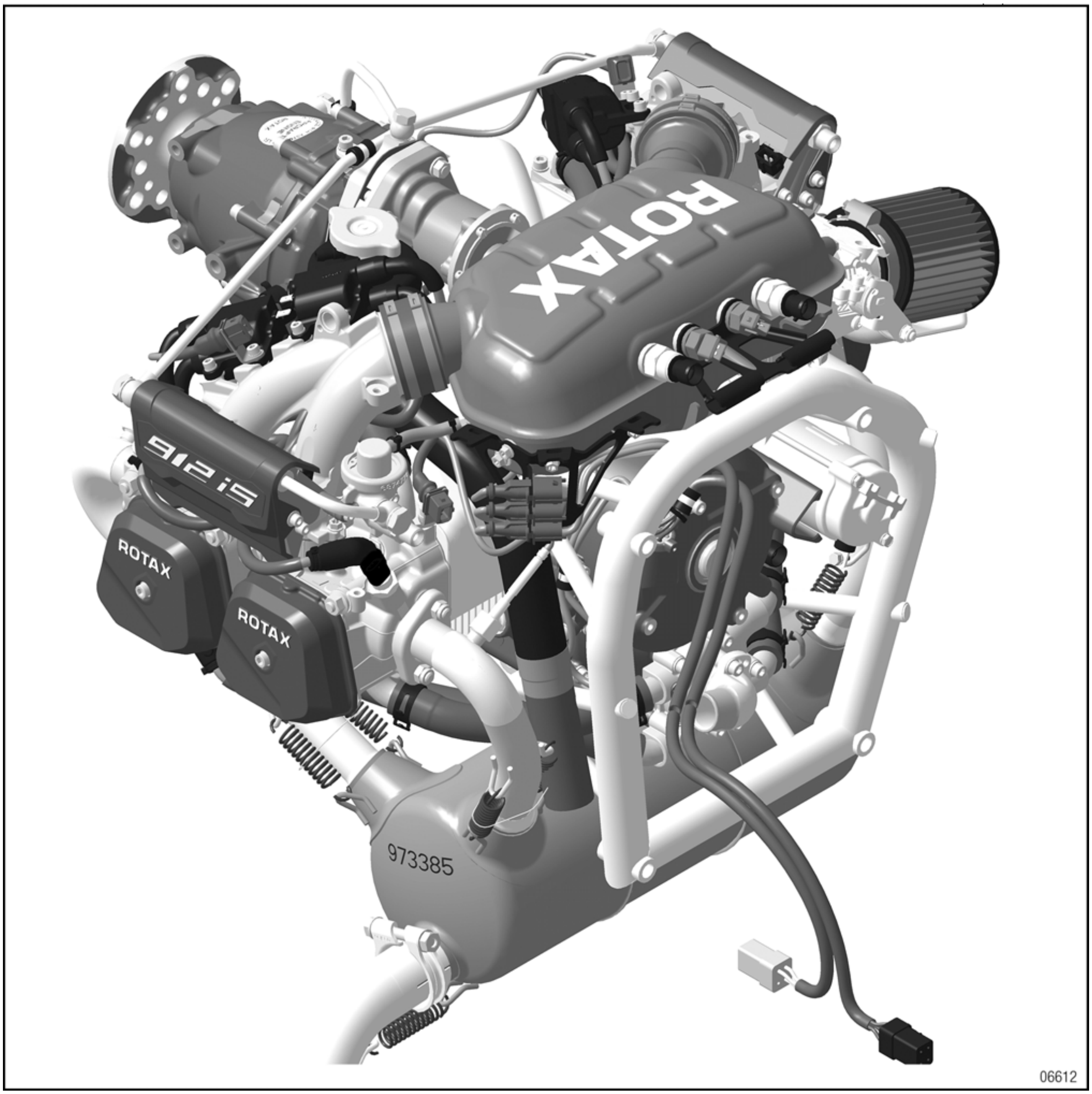

Figure 7.1: Engine

SYSTEM DESCRIPTION

The 912 i Series engine is a 4-cylinder, four-stroke, horizontally opposed engine with manifold injection. This engine has liquid cooled cylinder heads and ram air cooled cylinders; this engine also has a fully redundant, electronic engine management system (EMS) including fuel injection, map-controlled ignition etc. Dry sump forced lubrication ensures constant oil pressure.

SAFETY INSTRUCTION

⚠ WARNING

Danger of severe burns and scalds!
Always allow the engine to cool down to ambient temperature before starting any work.

⚠ WARNING

Risk of injury due to spring-loaded parts!

NOTICE

Ensure that the ignition is switched off!
Disconnect the battery! Prevent the engine from being unintentionally switched on!

NOTE

Precautions for escaping oil must be taken at the installation site.

CRANKSHAFT DISTORTION — INSPECTION

Preparation

Drain oil. See current Maintenance Manual Line (MML) for the respective engine type.

Remove the propeller gearbox. See current Maintenance Manual Line (MML) for the respective engine type.

NOTE

The inspection of the crankshaft only makes sense if the shaft runout of the crankshaft AS or MS is more than 0.080 mm (0.0031 inch).

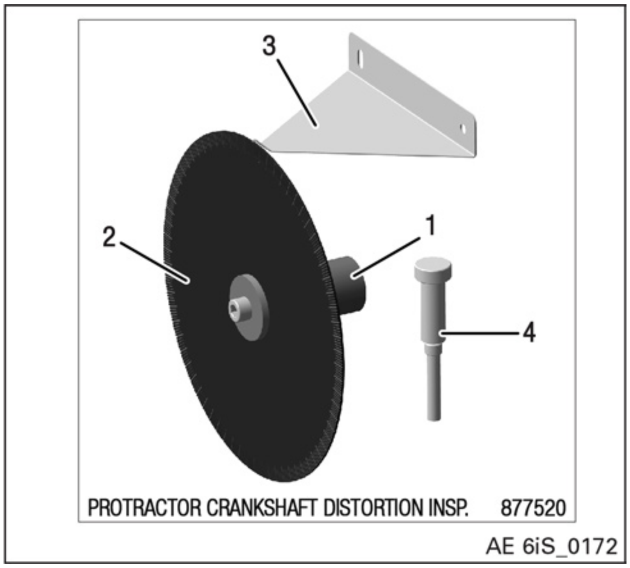

Figure 7.2

1	*Bushing*	2	*Gauge block*
3	*Indicator*	4	*Piston stopper*

NOTICE

Do not damage the crankshaft

Step	Procedure
1	Carefully mount bushing for gauge block onto the crankshaft.
2	Install the indicator between the ball bearing and the roller bearing with Allen screws M6x20.

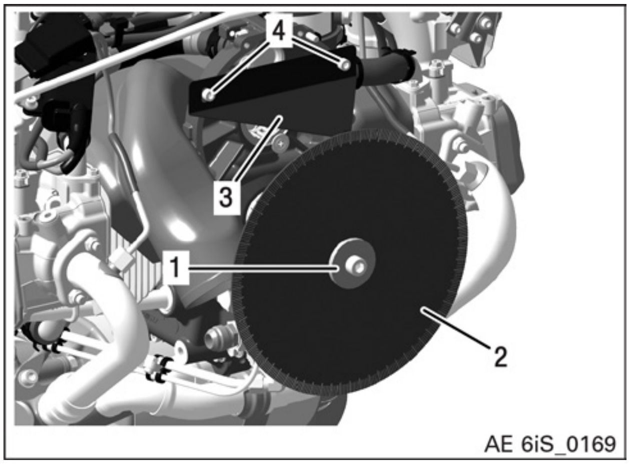

Figure 7.3: TYPICAL

1	*Bushing*	2	*Gauge block*
3	*Indicator*	4	*Allen screw M6x20*

NOTICE

Make sure that no foreign bodies get into open spark plug hole.

Step	Procedure
3	Remove the upper spark plugs. See current Maintenance Manual Line (MML) of the respective engine type, Chapter 12-20-00.
4	Install the piston stopper into cylinder 1 completely.

NOTE

On all 4 cylinders the piston stopper has to be installed in the upper spark plug thread.

NOTE

Make sure that the piston stopper has been screwed in completely – so there is no space between the spark plug hole and the tooling surface.

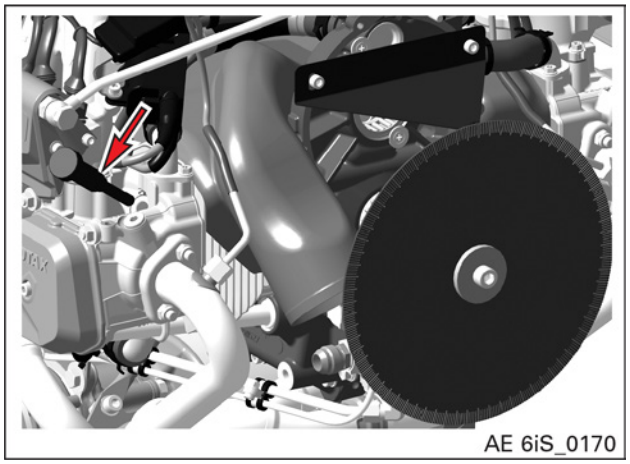

Figure 7.4: TYPICAL – Piston stopper

Step	Procedure
5	Turn the crankshaft carefully in direction of engine rotation until the piston touches the piston stoppers.

NOTE

Always turn the crankshaft in direction of engine rotation, to move the piston towards the piston stopper.

NOTE

The force applied should be strong enough to break-through possible accumulations on the piston's surface.

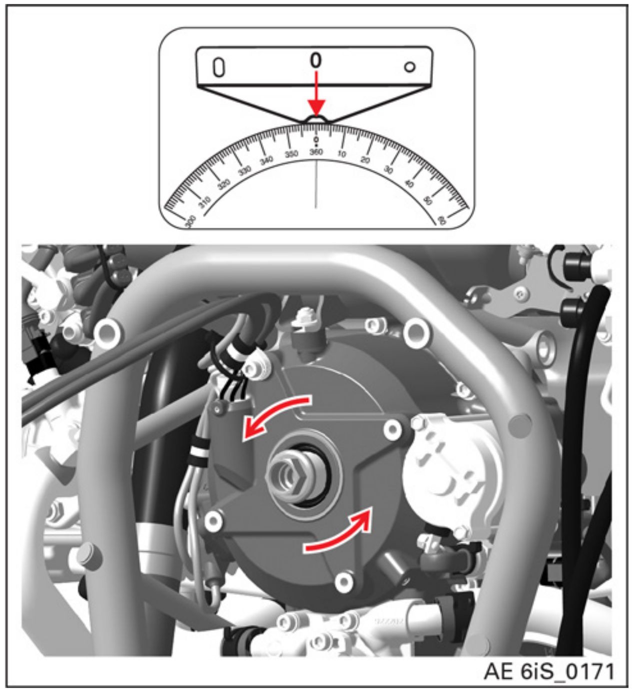

Figure 7.5: TYPICAL — Direction of engine rotation

Step	Procedure
6	Turn the gauge block itself until the arrow of the indicator points to 0°. Then tighten the Allen screw of the gauge block holder.

NOTE

From this point onwards until the measurement procedure has ended the protractor must not be turned on the metal sheet.

NOTE

In this position the piston of cylinder 1 touches the piston stopper.

NOTICE

Values can always be positive or negative, which is very important for the whole measurement.

Step	Procedure
7	Turn the piston slightly away from the piston stopper so it is easier to remove it.
8	Install the piston stopper at cylinder 2 and proceed like at cylinder 1.
9	Note the difference to 0° from the protractor.
10	Turn the piston slightly away from the piston stopper so it is easier to remove it. Repeat this procedure for cylinder 3 and 4. The piston will be stopped at 180°. Note the difference to 180° from the protractor for cylinder 3 and 4.

NOTICE

If a value exceeds the GB20 limit, then the engine has to be repaired or overhauled according to the current Overhaul Manual (OHM) for the respective engine type. Overhaul Manual (OHM) and its appendix is available for any appropriately rated person or entity on request and by following the standards of the original manufacturer.

NOTICE

The deviation of the crank pin (as a whole) must not exceed the GB20 value. For GB20 see “wear limits”.

Example showing the results from measuring a crankshaft, where the GB20 threshold is not exceeded.

Cylinder	Deviation – good
1	0°
2	+2°
3	0°
4	+1°

Example showing the results from measuring a crankshaft, where the GB20 threshold is exceeded.

Cylinder	Deviation – bad
1	0°
2	+2°
3	0°
4	-1°

FINISHING WORK

- Install the upper spark plug. See current Maintenance Manual Line (MML) of the respective engine type, Chapter 12-20-00 Installation of the spark plug.

Install propeller gearbox assy.
See current Maintenance Manual Line (MML) for the respective engine type.

Fill with operating fluids or check filling levels.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-10-00 section Adding operating fluids.

Purge the oil system.
See current Installation Manual (IM) for the respective engine type, Chapter 79-00-00 section Purging the lubrication system. It must be carried out in accordance with SI-916 i-003, “Purging the lubrication system”, latest issue.

Carry out an engine test run.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Planned maintenance.

WEAR LIMITS

Descrip-tion	Code	**Reading new**		**Wear limit**			Readings			
		min.	max.	100 %	50 %					
CRANKSHAFT							**Cyl. 1**	**Cyl. 2**	**Cyl. 3**	**Cyl. 4**
Crank-shaft angle of twist	GB20	0 (degrees)	2 (degrees)			actual				
						renewed				

Chapter: 72–10–00
PROPELLER GEARBOX

TOPICS IN THIS CHAPTER

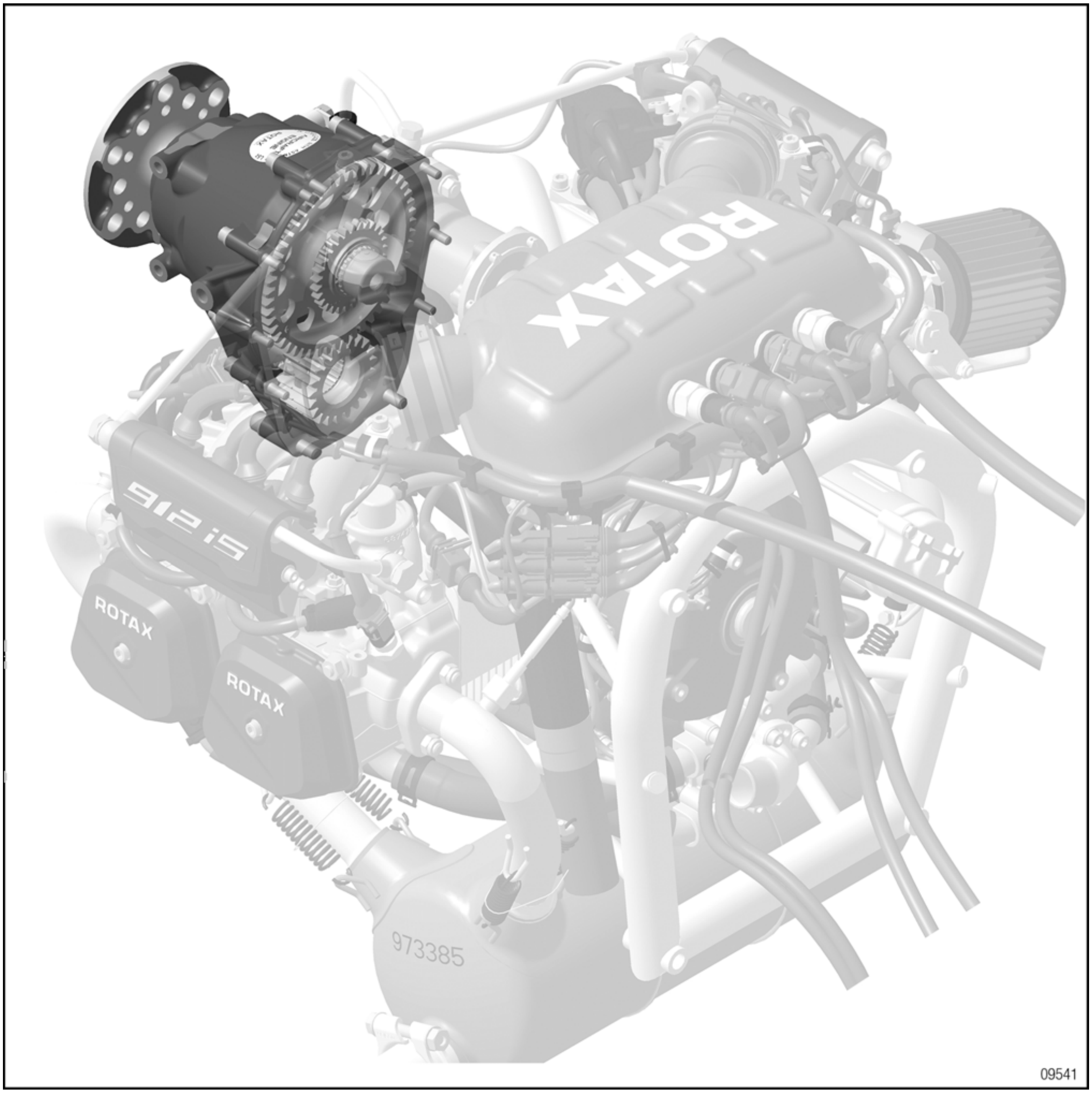

Figure 8.1: Location on the engine

SPECIAL TOOLS

Description	Part number
Hot air gun	n.a.
Socket wrench assy. 41x12.5	877445
Mounting yoke to compress dog gear	876885
Circlip pliers	n.a.
Extractor	877615
Press-out mushroom (configuration 2)	877605
Press-out mushroom (configuration 3)	877600
Insertion jig	876518
Stud M10x45/20 (configuration 2)	941180
Pull-out-plate (configuration 2)	877561
Hex. nut M10 (configuration 2)	242092
Puller assy. (configuration 3)	876489
Press-in jig (configuration 2)	877594
Press-in mushroom	877590

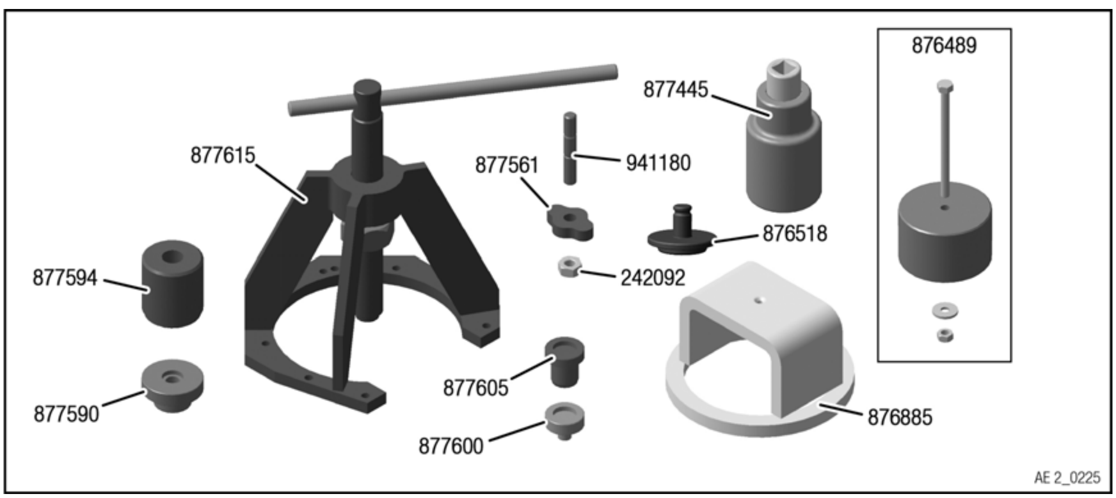

Figure 8.2: Special tools

SERVICE PRODUCTS

Description	Part number
Engine oil	n.a.
LOCTITE 243	897651
LOCTITE 648	899788
LOCTITE 5910	899791
LOCTITE 7063	n.a
LITHIUM-BASE GREASE	897330
LOCTITE ANTI SEIZE	297434
Abrasive pad	n.a.

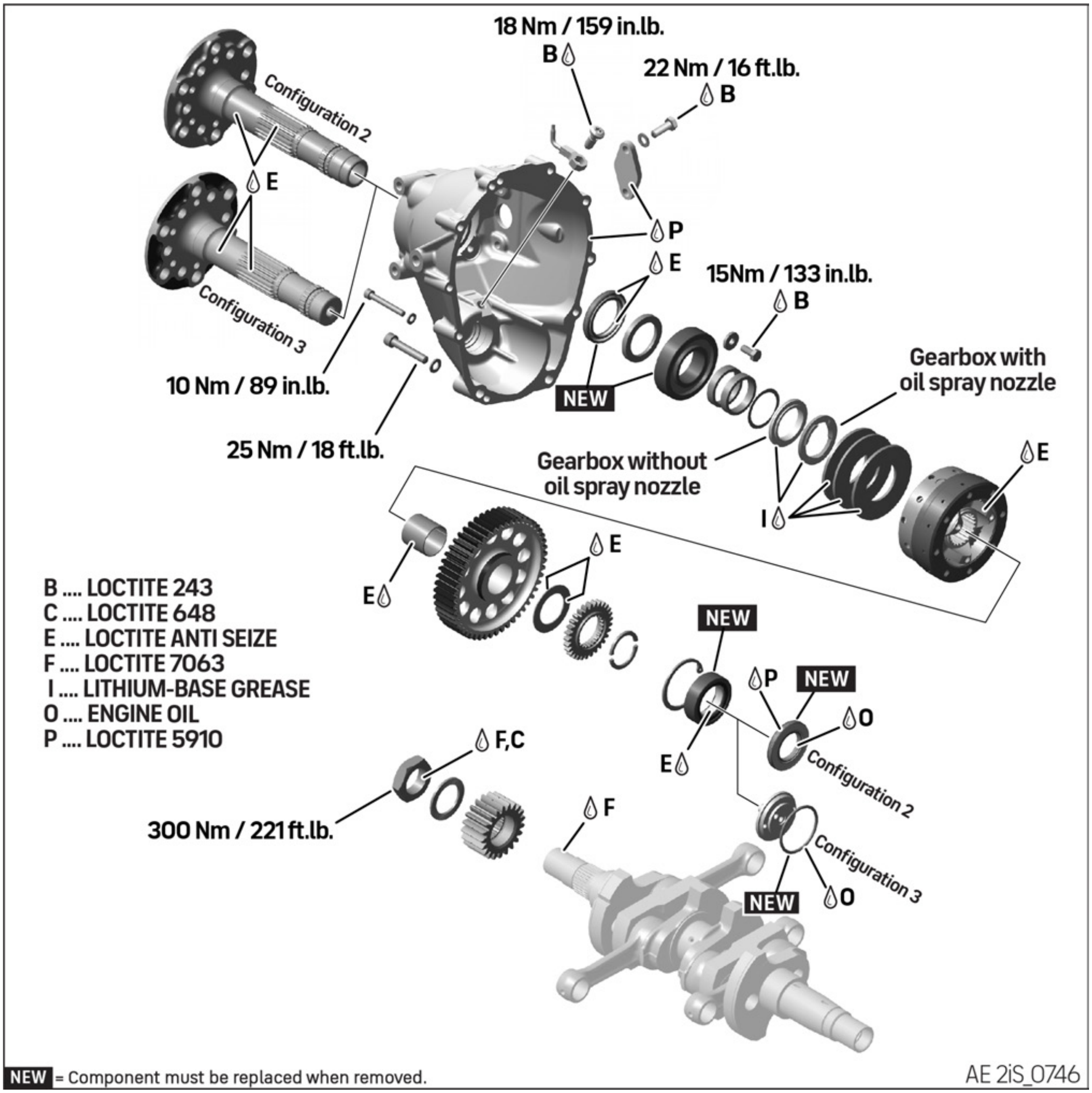
18 Nm / 159 in.lb.
B
22 Nm / 16 ft.lb.
B
Configuration 2
E
P
E
15Nm / 133 in.lb.
B
Gearbox with
oil spray nozzle
Configuration 3
10 Nm / 89 in.lb.
NEW
25 Nm / 18 ft.lb.
Gearbox without
oil spray nozzle
I
E
E
E
B .... LOCTITE 243
C .... LOCTITE 648
E .... LOCTITE ANTI SEIZE
F .... LOCTITE 7063
I .... LITHIUM-BASE GREASE
O .... ENGINE OIL
P .... LOCTITE 5910
NEW
P
NEW
O
F,C
E
Configuration 2
F
300 Nm / 221 ft.lb.
Configuration 3
NEW
O
NEW = Component must be replaced when removed.
AE 2iS_0746

Figure 8.3

SYSTEM DESCRIPTION

The propeller shaft is driven by the crankshaft by means of a linear helical gear unit. Gear ratio crankshaft : propeller shaft 2.43 : 1.
The propeller gearbox has a damping means to counteract torsional vibrations. This consists of torsional shock absorption by means of contoured dogs with axial spring loading by disc springs.

The design also includes a friction damped free rotation at the dogs to ensure smooth engine idling. Due to this free rotation, a distinct torsional impact arises at engine start and stop and in the event of sudden load changes, but due to the integrated overload clutch it will remain harmless.

NOTE

This overload clutch also protects the crankshaft from overloading if the propeller comes into contact with the ground.

NOTE

The overload clutch is fitted in serial production on both certified aircraft and uncertified aircraft engines of configuration 3.

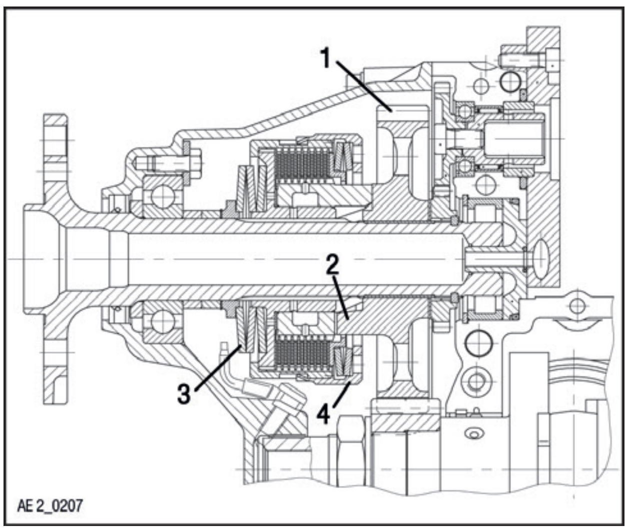

Figure 8.4: Configuration 3 with overload clutch

1	*Straight toothed spur gear*	2	*Dogs*
3	*Disc springs*	4	*Overload clutch*

SAFETY INSTRUCTIONS

⚠ WARNING

Danger of severe burns and scalds!
Always allow the engine to cool down to ambient temperature before starting any work.

⚠ WARNING

During work on the engine there is a risk of life-threatening injuries from the propeller and rotating parts in the engine!
Ensure that the ignition is switched off!
Disconnect the battery
Prevent the engine from being unintentionally switched on!

MAINTENANCE

As well as the maintenance and special checks, see current Maintenance Manual Line (MML) for the respective engine type.

REMOVAL

For removal of the propeller gearbox, see current Maintenance Manual Line (MML) for the respective engine type.

For removal of the drive gear, see current Maintenance Manual Line (MML) for the respective engine type.

Preparation
Before the propeller gearbox is removed, the gearbox oil line assy. must be removed.

DISASSEMBLY

DISASSEMBLY OF THE PROPELLER GEARBOX

NOTICE

Gearbox housing may be damaged.
Push the dog gear down only until the ring halves can be taken out. The gear cover must be freely rotatable!

Step	Procedure
1	Place the entire gearbox into a suitable fixture and press down the gear with the mounting yoke part no. 876885 until the ring halves can be taken out.

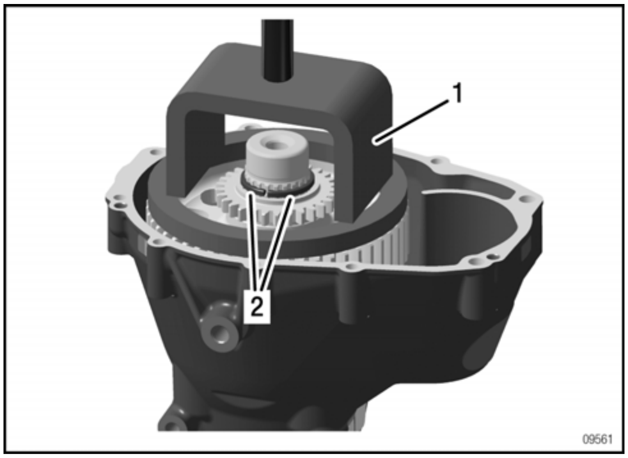

Figure 8.5

1 Mounting yoke 876885 *2 Ring halves*

NOTICE

Do not over-stretch the bearing bushing, otherwise it will become unusable.

Step	Procedure
2	Relieve the pressure on the gear.
3	Remove mounting yoke and the gearbox from the fixture.
4	Remove the drive gear, the thrust washer and the dog gear.
5	Force bearing bushing apart with circlip pliers and withdraw from propeller shaft.

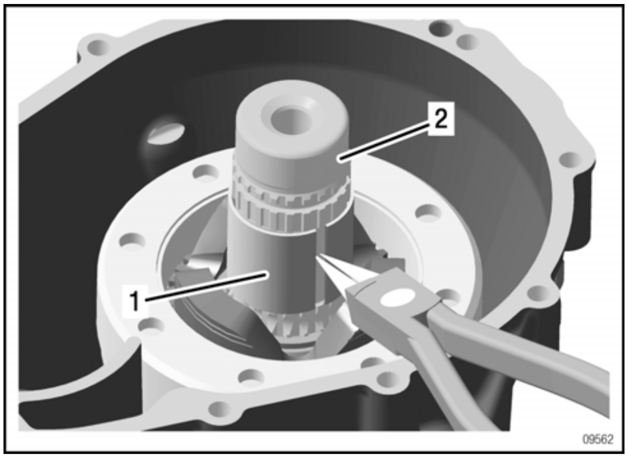

Figure 8.6

1 Bearing bushing *2 Propeller shaft*

Step	Procedure
6	Remove the clutch assy., 3 disc springs 80x35x3, step collar or step collar (for gearbox with oil spray nozzle) and 2 distance sleeves 8 mm (0.31 in)

NOTICE
The overload clutch is built in as standard in all certified and non-certified aircraft engines.

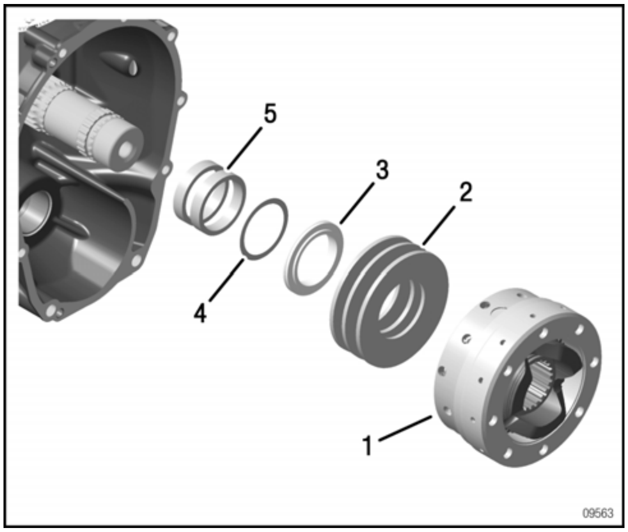

Figure 8.7: Propeller gearbox without oil spray nozzle

1	*Clutch assy.*	2	*Disc springs*
3	*Step collar*	4	*Compensating shim (as required)*
5	*Distance sleeves*		

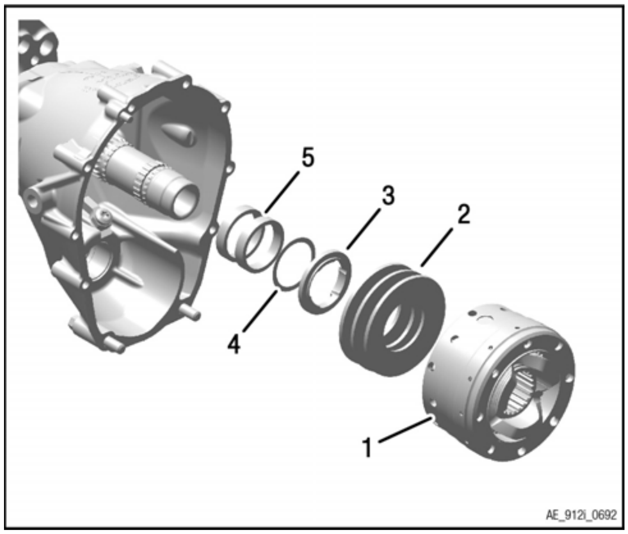

Figure 8.8: Propeller gearbox with oil spray nozzle

1	*Clutch assy.*	2	*Disc springs*
3	*Step collar*	4	*Compensating shim (as required)*
5	*Distance sleeves*		

REMOVAL OF THE PROPELLER SHAFT

NOTICE
If the propeller shaft is removed, the oil seal and ball bearing must be replaced!

Step	Procedure
1	Place the gearbox housing on a suitable support.

NOTICE
Damage to the machined inner diameter of the propeller shaft possible. The protection piece (press-out mushroom) must be used.

NOTE

Alternatively, the hand press can also be used to press out the propeller shaft.

Step	Procedure
2	Screw the extractor part no. 877615 onto the gearbox housing with six Allen screws M6x25 and place press-out mushroom part no. 877605 (for configuration 2) or press-out mushroom part no. 877600 (for configuration 3) onto the end of the propeller shaft as protection.
3	Place the pull-in spindle into the extractor support and screw the hex. nut M24x1.5 onto the spindle from the inside.
4	Held with the spanner, the propeller shaft is pushed out of the gearbox housing by turning the spindle clockwise.

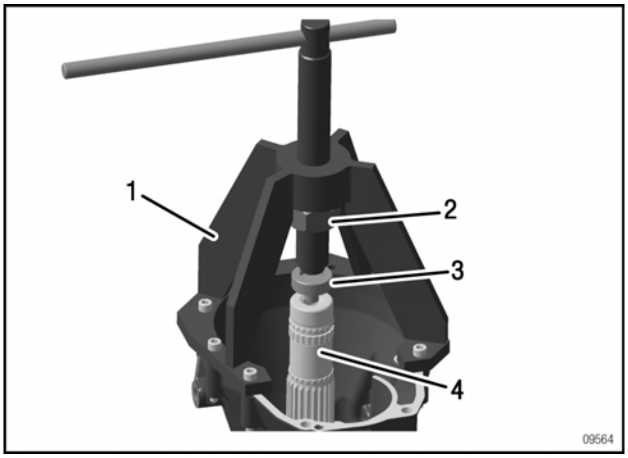

Figure 8.9

1 Extractor — *2 Hex. nut M24x1.5*
3 Press-out mushroom — *4 Propeller shaft*

REMOVAL OF THE BALL BEARING

After the propeller gearbox has been removed, the propeller shaft bearing on the crankcase side and the oil seal must be replaced.

NOTICE

The shaft seal will be damaged in this process and must therefore be replaced.

Step	Procedure
1	Loosen 4 hex. screws M7x16 with washers from the gearbox housing.
2	Heat the gearbox housing about 100 to 120 °C (176 to 212 °F) and press the ball bearing together with the oil seal and radius ring inwards with a suitable insertion jig.

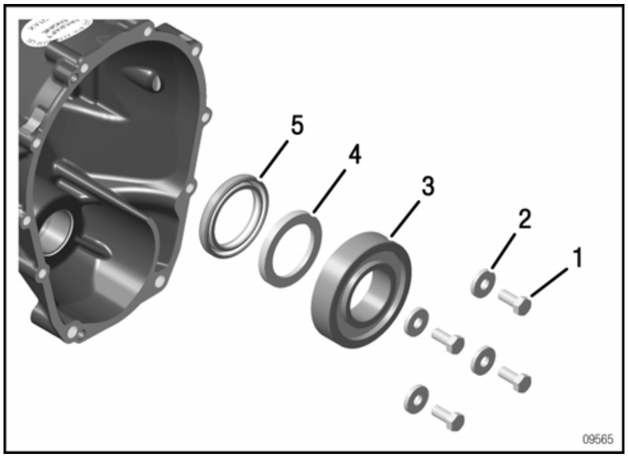

Figure 8.10: Propeller gearbox without oil spray nozzle

1 Hex. screw — *2 Washer*
3 Ball bearing — *4 Radius ring*
5 Oil seal

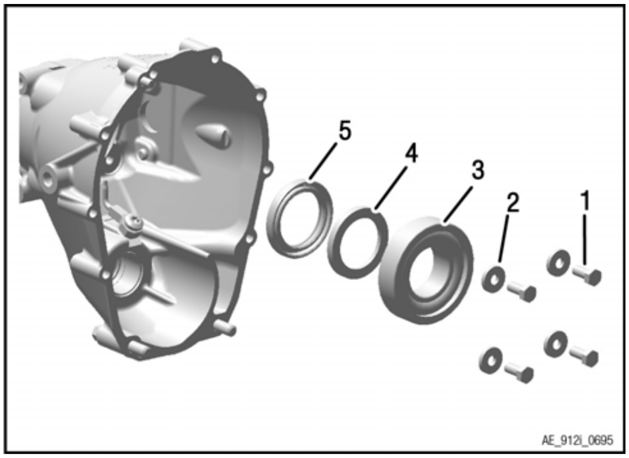

Figure 8.11: Propeller gearbox with oil spray nozzle

1	*Hex. screw*	2	*Washer*
3	*Ball bearing*	4	*Radius ring*
5	*Oil seal*		

Step	Procedure
3	If necessary, loosen the banjo bolt M8x1 and remove the oil spray nozzle.

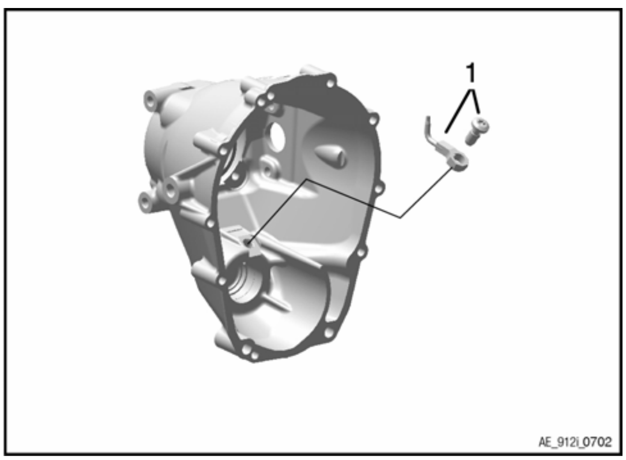

Figure 8.12

1 *Oil spray nozzle assy.*

BLINDING SHIM - REMOVAL

CONFIGURATION 2

Step	Procedure
1	Loosen the countersunk screw with thrust washer for the blinding shim fastening.
2	Press the blinding shim out towards the gearbox with the insertion jig part no. 276332.

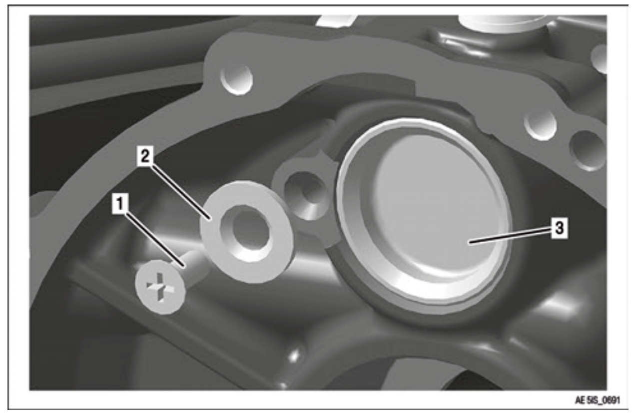

Figure 8.13

1	*Countersunk screw*	2	*Thrust washer*
3	*Blinding shim*		

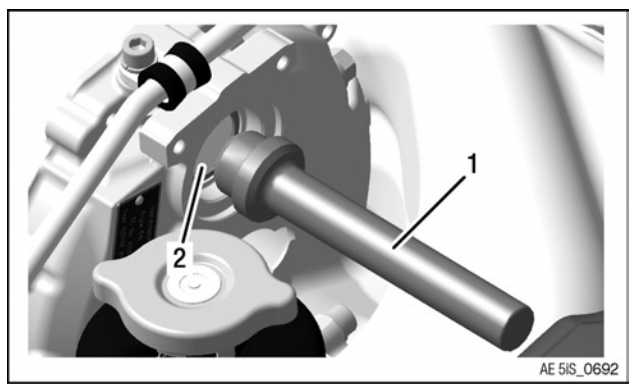

Figure 8.14: : TYPICAL

1	*Insertion jig part no. 276332*	2	*Blinding shim*

REMOVAL OF THE ROLLER BEARING — CONFIGURATION 2

Preparation

- If necessary remove the vacuum pump gear. See Chapter 37-10-00 section Vacuum pump — removal.

Remove propeller gearbox. See current Maintenance Manual Line (MML) for the respective engine type.

Step	Procedure
1	Remove retaining ring with circlip pliers.
2	Attach extractor part no. 877615 with six Allen screws M6x25 to the crankcase.
3	Install stud M10x45/20 part no. 941180 into the pull-in spindle and fix hex. nut M24x1.5 onto the pull-in spindle.
4	For better guidance, place the press-in mushroom part no. 877590 into the roller bearing.
5	Place the pull-in spindle into the extractor and through the crankcase.
6	On the rear side of the crankcase, push the pull-out plate part no. 877561 onto the stud and attach with the hex. nut M10 part no. 242091.

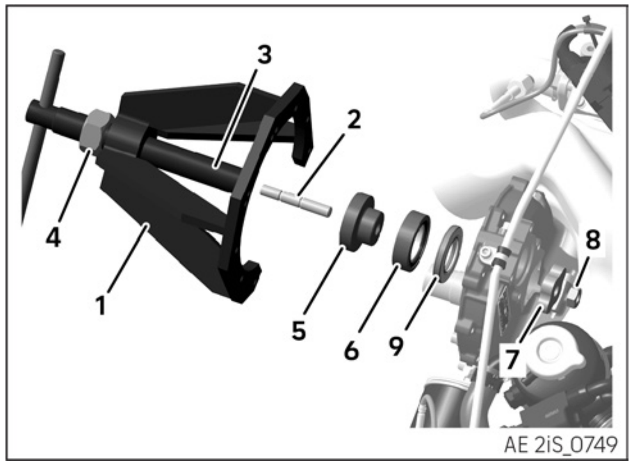

Figure 8.15

1	*Extractor 877615*	2	*Stud M10x45*
3	*Pull-in spindle*	4	*Stud M10x45/20*
5	*Press-in insert 877592*	6	*Roller bearing*
7	*Pullout plate 877561*	8	*Hex. nut M10*
9	*Oil seal*		

Step	Procedure
7	Keep pull-in spindle in position with the handle lever and turn the hex. nut clockwise until the roller bearing with oil seal is pulled out of housing.
8	Loosen hex. nut, remove pullout plate with roller bearing and oil seal and withdraw spindle. Unscrew extractor from housing.

NOTICE

The oil seal is damaged in the process and must therefore be replaced.

REMOVAL OF THE ROLLER BEARING — CONFIGURATION 3

Remove propeller gearbox. See current Maintenance Manual Line (MML) for the respective engine type.

Preparation

- Remove the governor flange. See Chapter 61-20-00.
- Remove the vacuum pump gear: See Chapter 37-10-00 section Vacuum pump gear.

NOTICE
The pressing out process for configuration 3 with the hydraulic governor is different from that for configurations 2. The roller bearing is pressed out together with the oil inlet flange.

Step	Procedure
1	Remove the retaining ring with the circlip pliers.
2	Put on puller part no. 876489 and push the hex. screw through the cap, roller bearing and oil inlet flange.

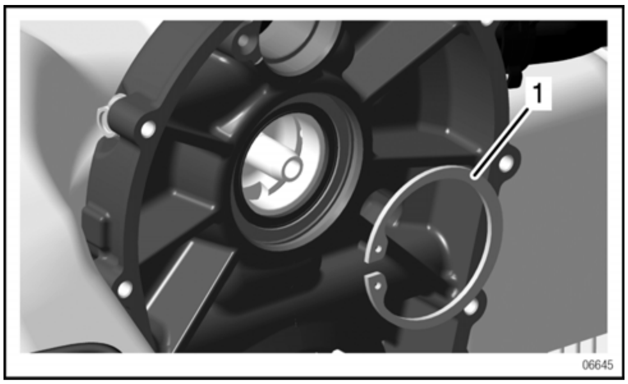

Figure 8.16

1 *Retaining ring*

Step	Procedure
3	Install the washer and nut on the rear.
4	The roller bearing is pressed out together with the oil inlet flange by turning the hex. screw clockwise.
5	Remove the O-rings.

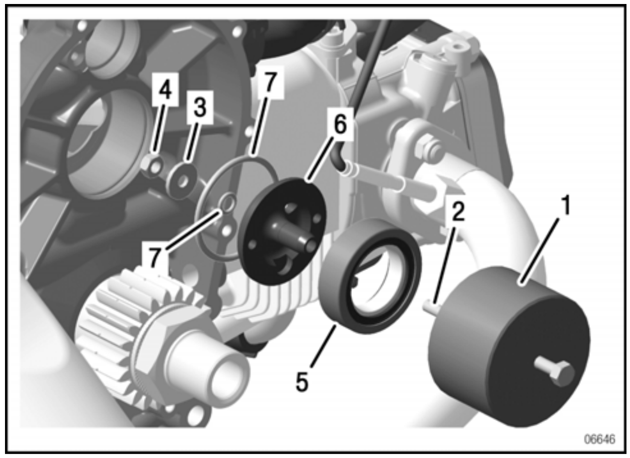

Figure 8.17

1 *Puller 876489*
2 *Hex. screw*
3 *Washer*
4 *Hex. nut*
5 *Roller bearing*
6 *Oil inlet flange*
7 *O-rings*

INSPECTION

PROPELLER GEARBOX SINGLE PARTS — INSPECTION

Preparation

Clean all parts carefully. See current Maintenance Manual Line (MML) for the respective engine type.

General visual inspection. See current Maintenance Manual Line (MML) for the respective engine type.

GEAR COVER ASSY. — INSPECTION

Step	Procedure
1	Inspect the gear cover for cracks.

NOTE

Only carry out in the case of ground contact!

Step	Procedure
2	Inspect gear cover for damage. • Depressions and scratches outside flat and sealing surfaces up to a maximum of 0.5 mm in depth and 2 mm in diameter are permissible. • Traces of corrosion and pitting outside sealing surfaces up to a maximum of 0.3 mm in depth and 2 mm in diameter are permissible.
3	Inspect contact surfaces for Allen screws. • Indentations up to a maximum of 0.2 mm are permissible. • Bumps up to a maximum of 0.2 mm are permissible.

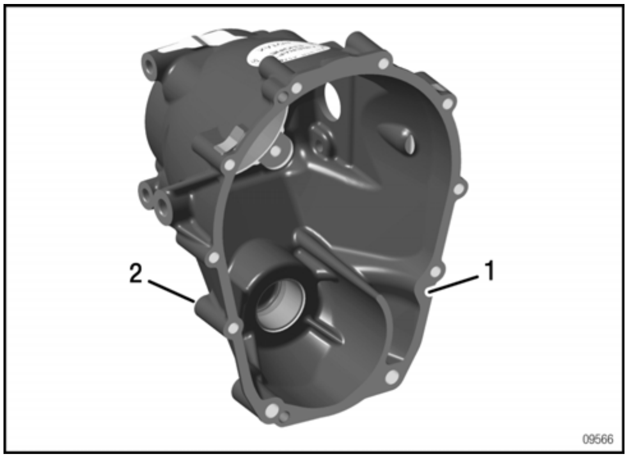

Figure 8.18: Propeller gearbox without oil spray nozzle

1 Flat sealing surfaces
2 Contact surfaces

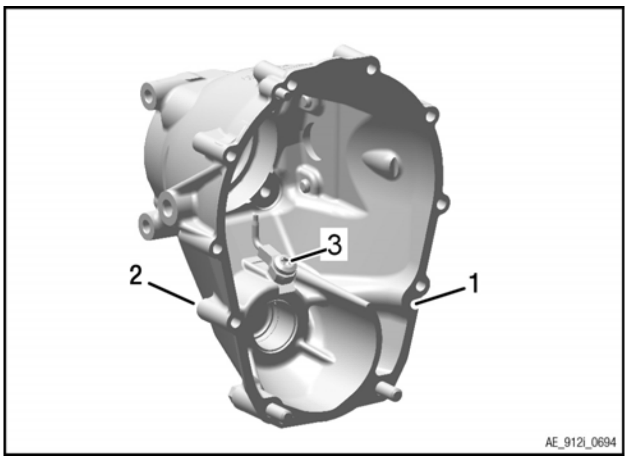

Figure 8.19: Propeller gearbox with oil spray nozzle

1 Flat sealing surfaces
2 Contact surfaces
3 Oil spray nozzle assy.

Step	Procedure
4	Inspect the oil spray nozzle for blockage and bending. Check the correct position of the jet.
5	Inspect that the bearing bushing for supporting the crankshaft in the gear cover is secure and measure dimension (GB01). See Chapter 72-10-00 section Wear limits.

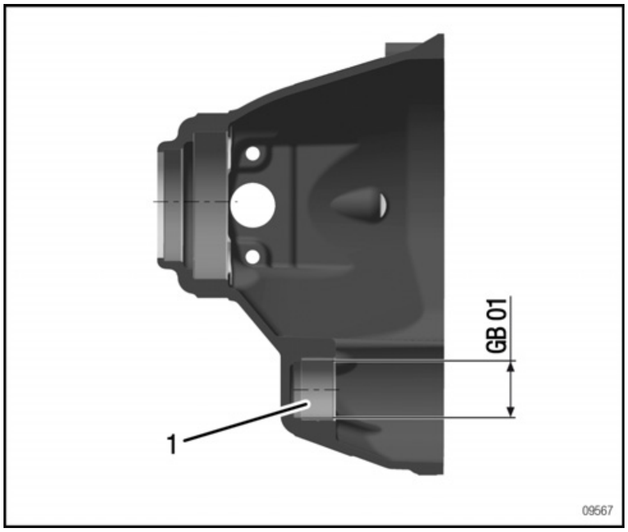

Figure 8.20

1 Bearing bushing

NOTE

Inside the oil spray nozzle there is a check ball with a spring, therefore it is necessary to use forced air to blow out the oil spray nozzle.

PROPELLER SHAFT — INSPECTION

NOTICE

The entire propeller shaft including fastening bores must be free from corrosion; there must be no fretting corrosion at the bearing points.

Step	Procedure
1	Measure both bearing seats. See Chapter 72–10–00 section Wear limits (GB02 and GB03).
2	Roll the propeller shaft and check for runout. Check the axial runout of the propeller flange. See Chapter 72–10–00 section Wear limits (GB04).
3	Check the oil seal running surface.

NOTE

The ball bearing must have an interference fit between the outer ring and the gearbox housing, and between the inner ring and the propeller shaft. See Chapter 72–10–00 section Wear limits.

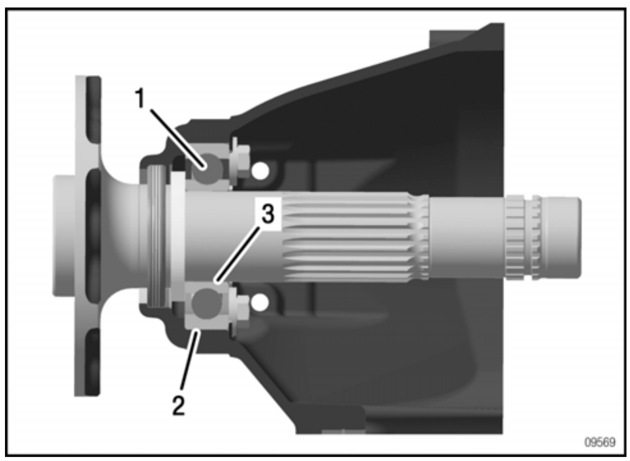

Figure 8.21

1 Ball bearing *2 Outer ring*
3 Inner ring

Step	Procedure
4	Check the groove for the retaining rings and gear-tooth system for wear and damage.

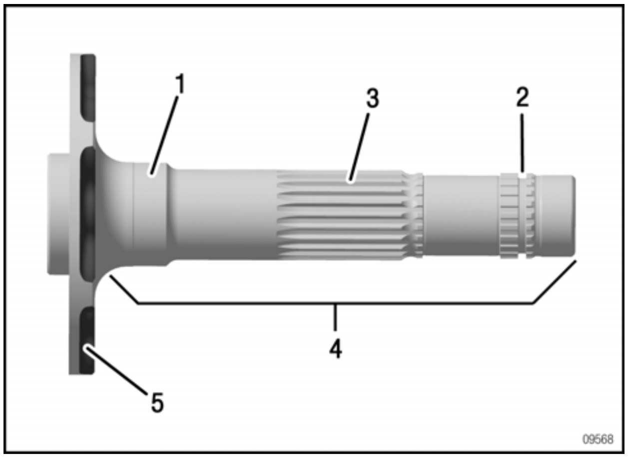

Figure 8.22

1	*Oil seal running surface*	2	*Groove for retaining ring*
3	*Gear-tooth system*	4	*Propeller shaft*
5	*Propeller flange*		

Configuration 3 only

- Measure the inner diameter of the propeller shaft. See wear limits GB05.
- Measure the journal of the oil inlet flange. See wear limits GB06.

NOTE

The dimension GB05 or GB06 by itself is not as important as the radial clearance between GB05/GB06.

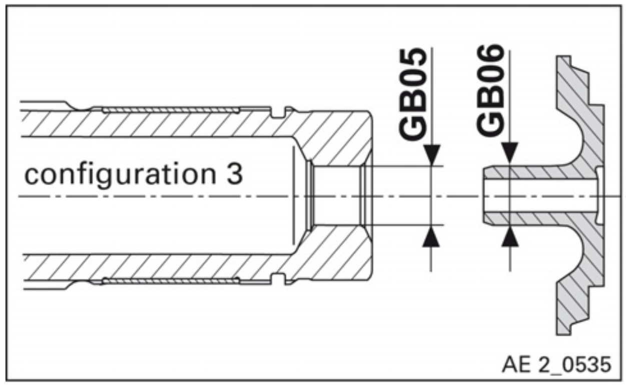

Figure 8.23

Treatment of corrosion damage and surface damage on the propeller flange.
See Chapter 72–10–00 section Wear limits.
The flange of the propeller shaft is susceptible to flash rust. After the propeller shaft has been covered with an adhesive plastic tape or a plastic tube, the propeller flange can be treated with a blasting medium.

NOTICE
To apply the protective paint, carefully cover the flange surface, fastening bores and the propeller shaft.

To prevent corrosion damage, the rear of the propeller flange should be coated with a layer of anti-corrosion paint.
In the event of more severe corrosion damage which has affected the material, the propeller shaft must be replaced.

DOG HUB — INSPECTION

Step	Procedure
1	Visually check the dog hub for visible pitting on the gear-tooth system and/or in the engagement faces of the dogs; see Chapter 72-10-00 section Wear limits (GB08)

NOTE

The cam peaks of the gear must never rest in the trough of the dog hub.

Step	Procedure
2	Measure the gap between the cam peak and the cam trough; see Chapter 72-10-00 section Wear limits (GB07)

NOTE

Slight to moderate traces of wear and pitting on the dogs are permissible.

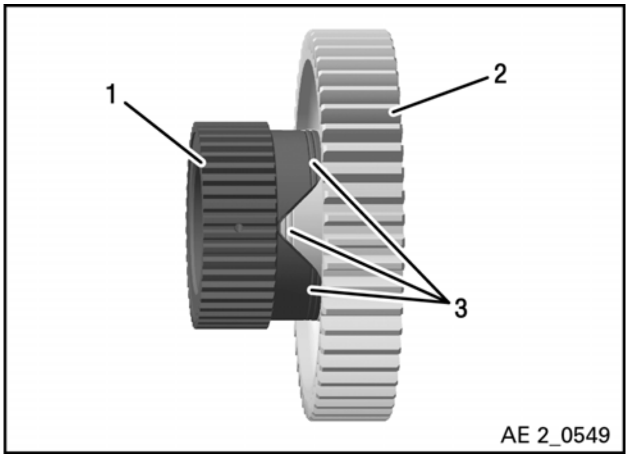

Figure 8.24: TYPICAL

1	*Dog hub*	2	*Gear (propeller shaft)*
3	*Identifying lines*		

NOTE

Verify that the parts are matched, also the lines on the gear and dog hub should be the same.

THRUST WASHER, BEARING BUSHING — INSPECTION

Step	Procedure
1	Measure the thickness of the plastic thrust washer between the gear set and the drive gear; see Chapter 72-10-00 section Wear limits (GB11)
2	Check the heat-treated steel bearing bushing for wear.

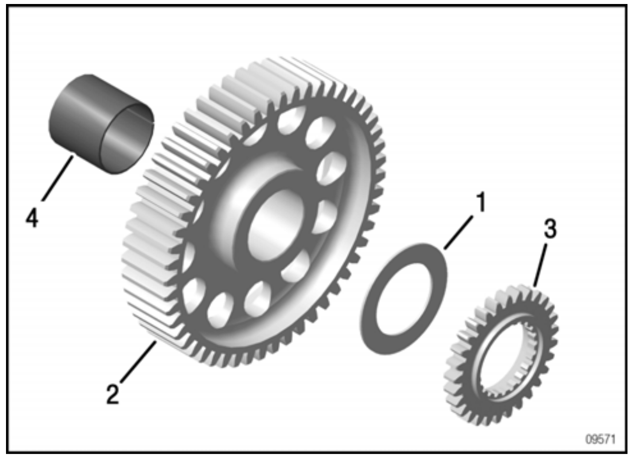

Figure 8.25

1	*Thrust washer*	2	*Gear (propeller shaft)*
3	*Drive gear 29 T*	4	*Bearing bushing*

STEP COLLAR, DISC SPRING — INSPECTION

Step	Procedure
1	Check the step collar in the vicinity of the disc spring support for wear.
2	If wear of the disc springs is visible in the contact area, replace the disc springs. Inspect the dimension (GB13) of the non-tensioned disc spring; see Chapter 72-10-00 section Wear limits.

NOTE

The step collar for gearbox with oil spray nozzle has recesses in bore.

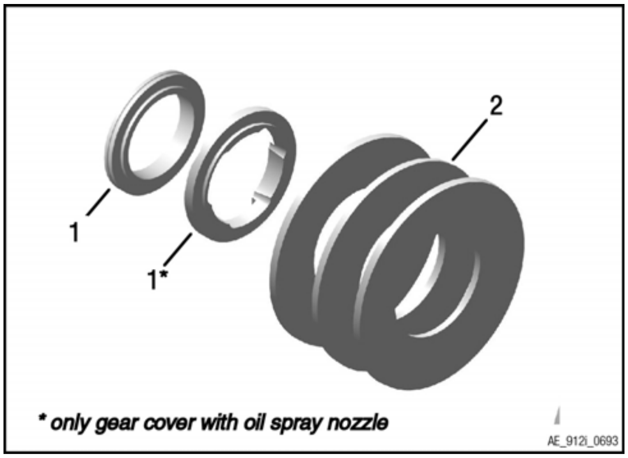

Figure 8.26: TYPICAL

1 Step collar | *2 Disc springs*

CHECKING THE SPLINES

There are 2 essential splined shaft connections in the gearbox.

1. Propeller shaft to clutch hub of the overload clutch.
2. Crankshaft to drive gear.

NOTE

To check the splines, determine the tooth widths at the tip circle of the respective inner or outer gear-tooth system. The smallest value in each case is significant.

CHECKING THE GEAR SET

The gear set is checked to identify any damage to the gear-tooth system.

NOTICE

Check all the tooth flanks for any damage or pitting.

NOTE

*If the gearbox is installed, it is also possible to check the gear set using an endoscope. This must be done in such a manner that an **exact assessment** of the tooth flanks is possible and requires experience.*

Pitting
Pitting is damage which is attributable to fatigue of the material. As far as is known today, this is caused when the Hertzian stress permissible for the material in question is exceeded, the tangential stress on the surface (friction stress) and temperature stress. As well as the material and the heat treatment of it, the surface quality and structure, surface treatment and lubricant (viscosity at operating temperature and additives) are also important.

NOTE

The likely location of pitting formation is the dedendum flank of the driving gear. Therefore, begin by checking the drive gear.

Pitting in the gearbox
Pitting in the gearbox can cause high-frequency vibrations. This vibration can cause several problems as it is transferred via the engine to the connected parts:

- Wear on the gearbox (gear profile and contact faces)
- External accessories
- Wear on the exhaust system
- Leaking of the sealing surface of the crankcase

NOTE

*Vibration can be detected with a dynamic engine analysis; these are units which are also used to balance propellers. **If the propeller cannot be balanced suspect pitting of the gear**.*

PITTING, GENERAL INFORMATION

NOTE

*When pitting occurs it is necessary to distinguish between **tolerable initial pitting** and **flake pitting**. To make the assessment easier for you, see the following assessment tips.*

Pitting is the breaking off of more or less small, flat material particles from the active tooth flank. Whereas tooth breakage results in failure of the gearbox, this is not the case for pitting damage. There are in this case different stages of damage.

Rate of development
The rate of development depends on the lubricant and amount of stress. The pitting surface can become so large that the remaining undamaged flank can no longer transfer the load. During further operation the gear-tooth system is then completely destroyed.

NOTE

Fine pitting or pitted areas hardly affect the running behavior of the gear-tooth system at all.

The rule is however pitting damage which increases over time.
A distinction can be made according to the size, type and number of pitting, as follows.

- Slight pitting (initial pitting)
- Destructive pitting
- Flake pitting (large-area flank fractures)

SLIGHT PITTING

Features:
Individual small pits (up to approx. 0.5% of the flank area) or pore-like areas of pitting, generally only present in the dedendum area of the flank. This pit formation can cease during the operating phase of the gearbox.

Causes:
Locally high stresses in gears which have not yet run in can result in isolated pits. The adjustable running-in wear which results in these areas being relieved of stress, as a result of which the formation of pits can cease. Similarly, changed operating conditions can prevent pits which have already formed from developing.

Conclusion:
These pits are not important for safe operation. The gear set can still be used.

NOTE

The illustrations are sometimes not very informative due to fine pitting or the printing process. If in doubt, consult technical literature or contact the ROTAX® Authorized Distributor or their independent Service Centers.

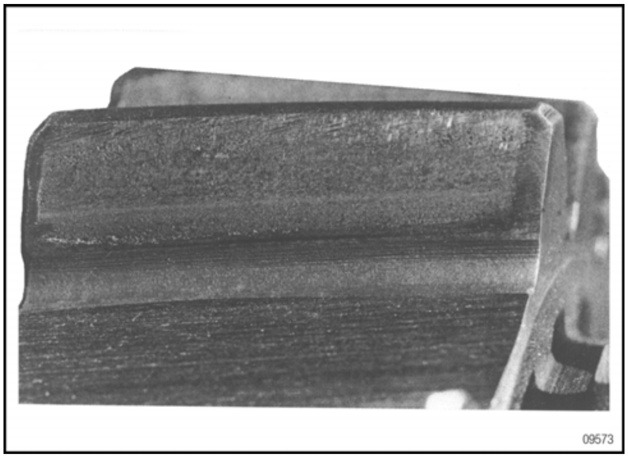

Figure 8.27: Magnification: approx. 2x

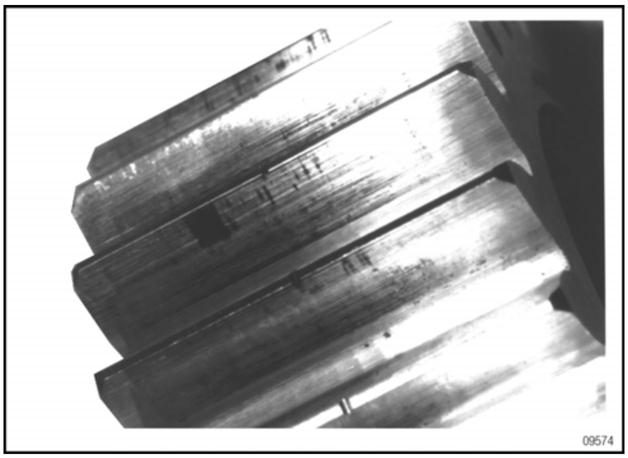

Figure 8.28: Magnification: approx. 1.5x

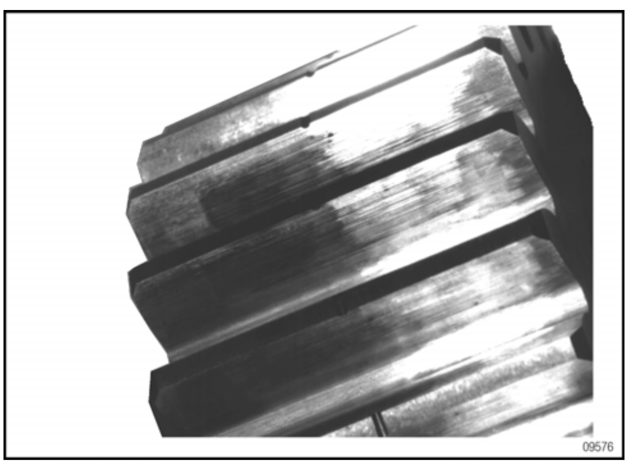

Figure 8.29: Magnification: approx. 1.5x

DESTRUCTIVE PITTING

Features:
Extensive flank fractures, generally occurring as zones of pitting. The bottom of the fracture generally has a mussel-shaped structure. The total pitting area can be so great that the running smoothness is noticeably affected and/or the remaining flank area which still bears the load is rapidly destroyed by wear etc.

Causes:
Pitting is attributable to the fatigue of the material due to combined stresses from compression and sliding. They are triggered when the material strength is exceeded locally. Essential influences on pit strength are: oil viscosity and oil temperature.

Conclusion:
Pitting of up to 5% of the flank area is permissible if the individual flank fractures do not exceed a size (greatest longitudinal extent) of 0.5 mm. Otherwise the gear set must be replaced.

NOTICE
The whole gear set must always be replaced. Dog hubs or drive gears must not be replaced individually.

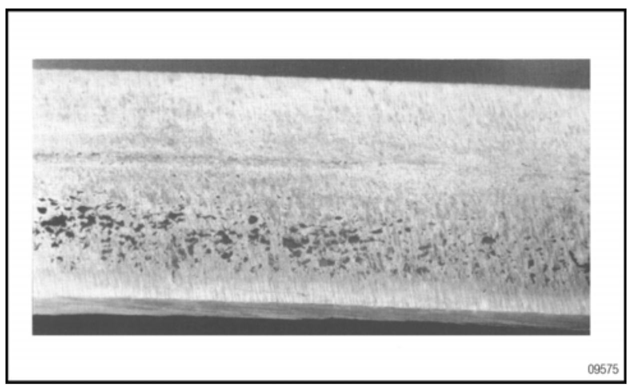

Figure 8.30: Magnification approx. 5x.

Pitted area in the root flank region of a spur gear.

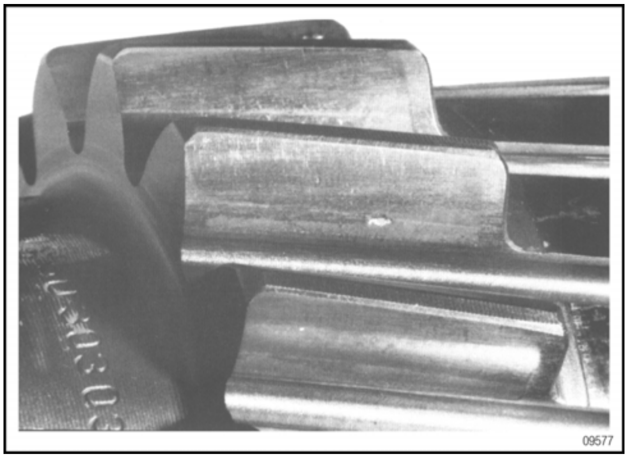

Figure 8.31: Magnification approx. 1.5x.

Pit formation in the root region of a spur gear tooth system

FLAKE PITTING (LARGE-AREA FLANK FRACTURES)

See the following figures.

Features:
A large-area, triangular flank fracture emanating from a micropitting zone or a fine line of pits in the tooth dedendum. The fracture area has a relatively constant depth. Further cracks can run obliquely over the flank from the fracture. The damage sometimes extends into the addendum region, which results in breakage of the tooth tip.

NOTICE

If flake pitting is found, the gear set must be replaced.

Max. permissible pitting or flake pitting. See Destructive pitting.

NOTICE

The whole gear set must always be replaced. Gears must not be replaced individually.

Causes:
This pattern of damage generally occurs at low operating oil viscosities and/or high oil temperatures. Apart from these, the same causes apply as for pitting.

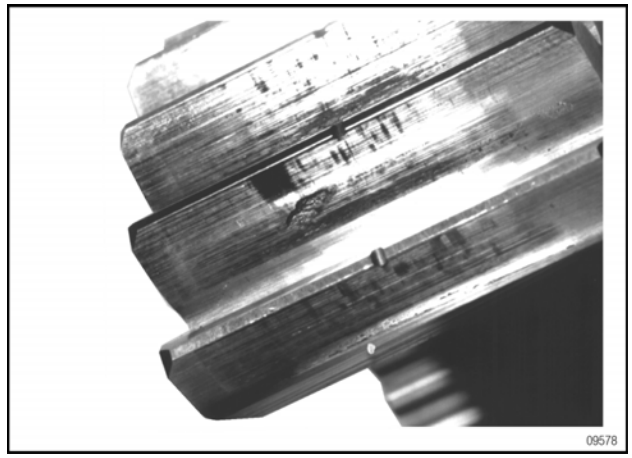

Figure 8.32: Magnification approx. 2x.

Triangular flake pitting

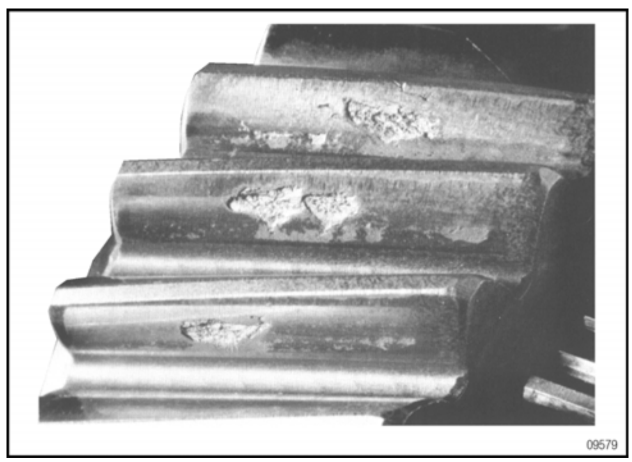

Figure 8.33: Magnification approx. 2x.

Triangular flake pitting

WEAR LIMITS

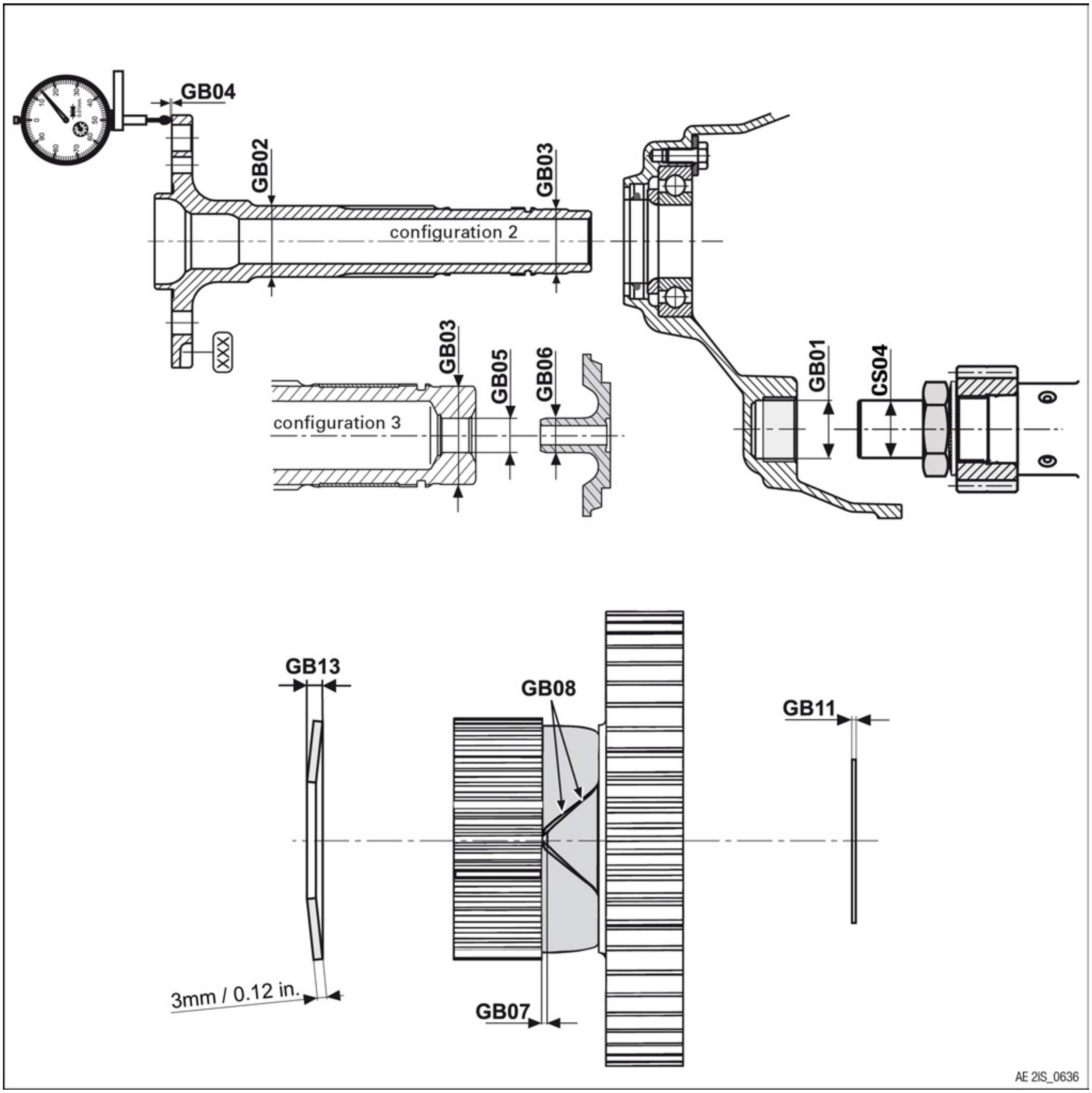

Figure 8.34

Description	Code	Reading new		Wear limit			Read-ings
		min.	max.	100 %	50 %		
Propeller gearbox							
Bearing bushing in gear cover							
Bore	GB01	28.04 mm 1.1035 in	28.05 mm 1.1039 in	28.10 mm 1.1063 in	28.075 mm 1.1051 in	actual	
						renewed	
Radial clearance	GB01/ CS04	0.03 mm 0.0012 in	0.05 mm 0.0020 in	0.12 mm 0.0047 in	0.09 mm 0.0035 in	actual	
						renewed	
Propeller shaft							
Shaft diameter 35 mm	GB02	35.009 mm 1.3783 in	35.020 mm 1.3787 in	35.003 mm 1.3780 in	35.006 mm 1.37815 in	actual	
						renewed	
Shaft diameter 31.5 mm	GB03	31.470 mm 1.2390 in	31.481 mm 1.2394 in	31.460 mm 1.2386 in	31.465 mm 1.2388 in	actual	
						renewed	
Radial run-out, propeller flange at Ø 122 mm	GB04	0.00 mm 0.000 in	0.05 mm 0.0020 in	0.06 mm 0.0024 in	0.055 mm 0.0022 in	actual	
						renewed	
Bore at rear end of propel-ler shaft (only in vers. 3)	GB05	11.00 mm 0.4331 in	11.02 mm 0.4339 in			actual	
						renewed	
Journal diam-eter at oil inlet flange (only in vers. 3)	GB06	10.935 mm 0.4305 in	10.960 mm 0.4315 in			actual	
						renewed	
Radial clear-ance, bore/ journal	GB05/ GB06	0.040 mm 0.0016 in	0.085 mm 0.0033 in	0.160 mm 0.0063 in	0.123 mm 0.0048 in	actual	
						renewed	
Dog gear, thrust washer							
Thickness of thrust washer	GB11	1.075 mm 0.042 in	1.325 mm 0.052 in	1.00 mm 0.039 in	1.04 mm 0.041 in	actual	
						renewed	
Total height of disc spring	GB13	5.20 mm 0.2047 in	5.40 mm 0.2126 in	4.80 mm 0.1889 in	5.00 mm 0.1968 in	actual	
						renewed	

PROPELLER GEARBOX

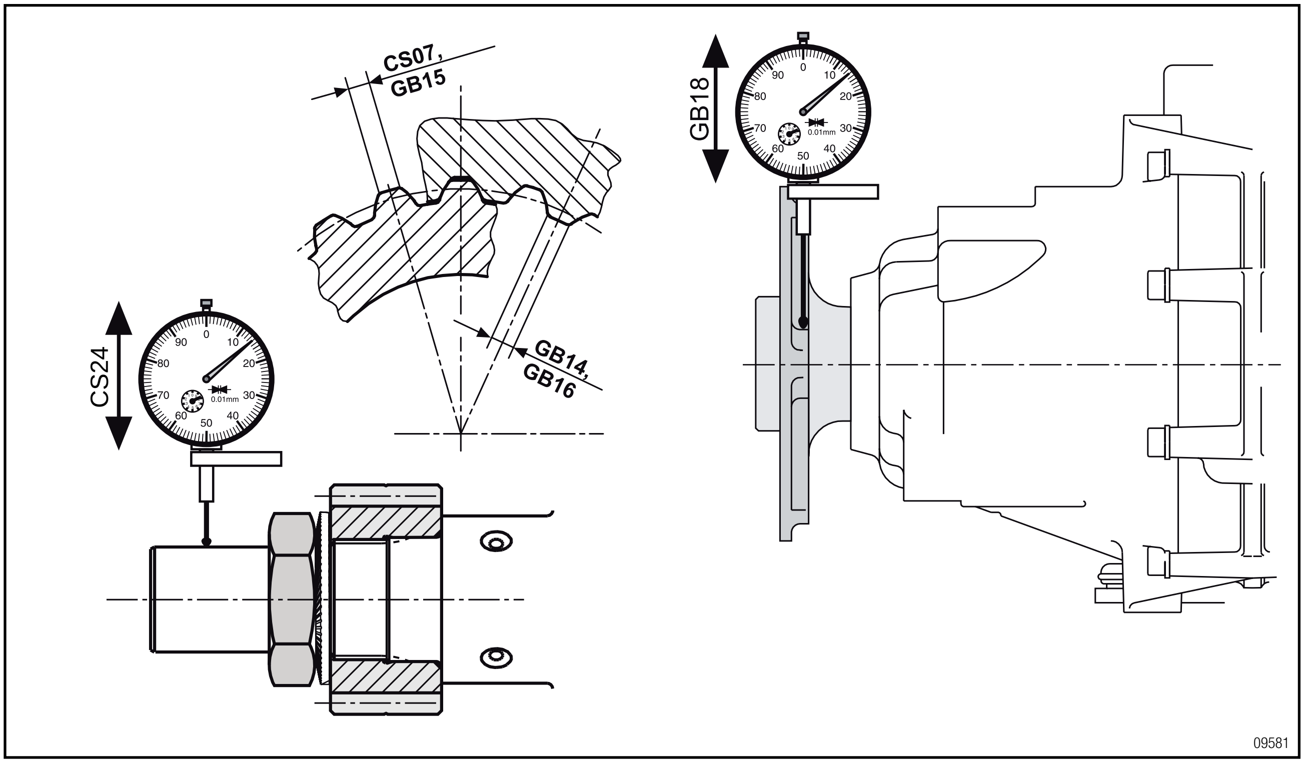

Figure 8.35

Description	Code	Reading new		Wear limit			Readings
		min	max	100 %	50 %		
Tooth profile							
Crankshaft	CS07	0.95 mm 0.0374 in	1.00 mm 0.0374 in.	0.80 mm 0.0315 in.	0.88 mm 0.0344 in.	actual	
						renewed	
Drive gear	GB14	0.95 mm 0.0374 in.	1.00 mm 0.0374 in.	0.80 mm 0.0315 in.	0.88 mm 0.0344 in.	actual	
						renewed	
Propeller shaft	GB15	1.50 mm 0.0591 in.	1.60 mm 0.0630 in.	1.10 mm 0.0433 in.	1.30 mm 0.0512 in.	actual	
						renewed	
Clutch/dog hub	GB16	1.50 mm 0.0591 in.	1.60 mm 0.0630 in.	1.10 mm 0.0433 in.	1.30 mm 0.0512 in.	actual	
						renewed	
Gear set, backlash							
Pitting on drive gear up to 5%		0	0	5%	2.5%	actual	

Description	Code	Reading new		Wear limit			Readings
		min	max	100 %	50 %		
						renewed	
Pitting on dog gear up to 5 %		0	0	5%	2.5%	actual	
						renewed	
Gear backlash	GB18	0.07 mm 0.003 in.	0.15 mm 0.006 in.	0.20 mm 0.008 in.	0.18 mm 0.007 in.	actual	
						renewed	
Overload clutch							
Axial gap	GB07	1.0 mm 0.039 in.	1.2 mm 0.047 in.	0.5 mm 0.020 in.	0.8 mm 0.030 in.	actual	
						renewed	
Clutch/dog hub	GB08	0.0 mm 0.000 in.	0.0 mm 0.000 in.	0.2 mm 0.0079 in.	0.1 mm 0.0039 in.	actual	
						renewed	
Crankshaft							
Measure crank-shaft run-out (in-stalled in housing with drive gear)	CS24	0.00 mm 0.000 in.	0.06 mm 0.002 in.	0.08 mm 0.003 in.		actual	
						renewed	
Crankshaft diameter	CS04	27.99 mm 1.102 in.	28.00 mm 1.102 in.	27.95 mm 1.100 in.	27.97 mm 1.101 in.	actual	
						renewed	

ASSEMBLY

OIL SPRAY NOZZLE — INSTALLATION

Step	Procedure
1	Insert the oil spray nozzle assy. The oil spray jet must point to the step collar.
2	Secure the banjo bolt M8x1 with LOCTITE 243. Tightening torque 18 Nm (159 in.lb.)

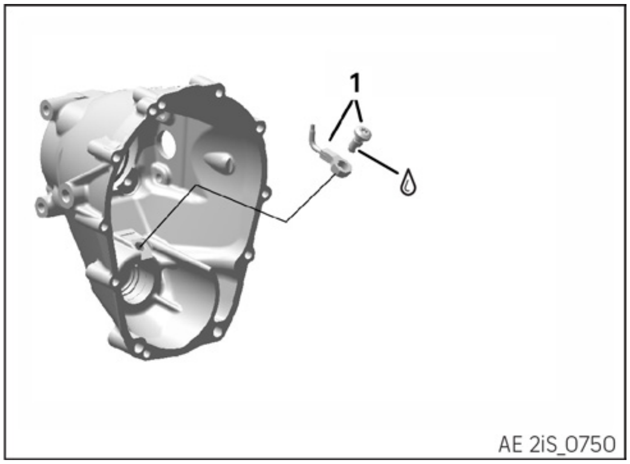

Figure 8.36

1 *Oil spray nozzle assy.*

BALL BEARING — INSTALLATION

Preparation

⚠ WARNING
Danger of severe burns and scalds! Wear heat resistant gloves!

- Heat the gearbox housing with hot air (or in an oven) to approx. 100 °C to 120 °C (212 °F to 248 F °).

NOTE

If the gearbox housing is damaged at the area of the oil seal, LOCTITE 5910 can be applied.

Step	Procedure
1	Press new oil seal AS 40x55x7 into the gearbox housing from the inside using insertion jig part no. 876518.

NOTE

Lubricate sealing lips with engine oil.

Step	Procedure
2	Insert the radius ring 36/50/5.5 with the radius facing the oil seal.
3	Insert new ball bearing. **NOTE** *The balls of the ball bearing must be visible - cage facing the propeller side.*

NOTE

The ball bearing must drop into the bearing position under its own weight!

Step	Procedure
4	Lubricate with LOCTITE 243 and tighten 4 hex. screws M7x16 with hardened washers 7.2/18.8/3. Tightening torque 15 Nm (133 in. lb.).

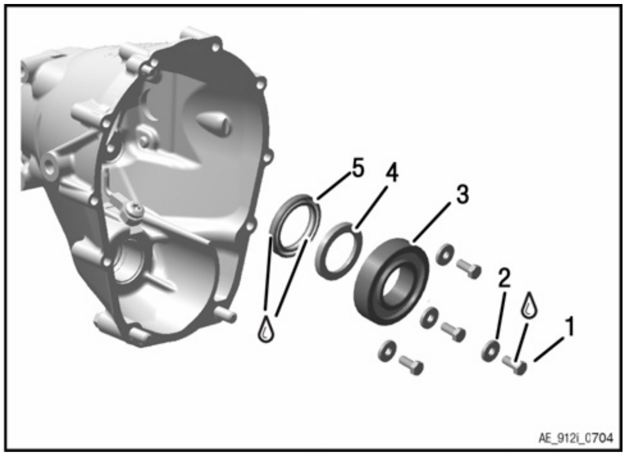

Figure 8.37: Propeller gearbox with oil spray nozzle

1	*Hex. screw M7x16*	*2*	*Washer 7.2/18.8/3*
3	*Ball bearing*	*4*	*Radius ring 36/50/5.5*
5	*Oil seal*		

PROPELLER SHAFT — INSTALLATION

Preparation

- Place the propeller shaft with the gearbox housing placed on it onto a suitable flat support
- Lubricate the propeller shaft with lithium-base grease on the bearing seat

NOTICE
Push or press on, do not tap on.

Step	Procedure
1	Install the sleeve, which is approx. 30 mm (1.18 in.) longer than the propeller shaft.

NOTE

Be careful not to damage or bend the oil spray nozzle.

NOTE

The inner diameter of the sleeve should be selected such that it presses on the inner ring of the bearing.

Step	Procedure
2	Press on the gearbox housing with a slight turning movement.

NOTE

It is advantageous when the gearbox housing is still warm.

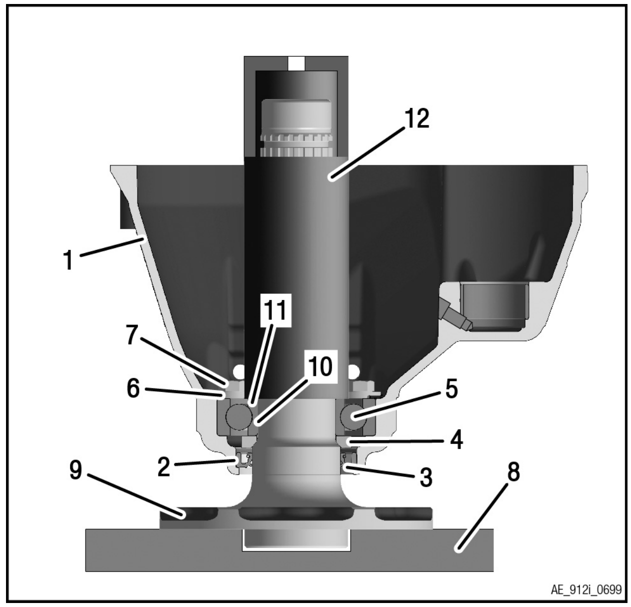

Figure 8.38

1	*Gearbox housing*	*2*	*Oil seal*
3	*Sealing lips*	*4*	*Radius ring 36/50/5.5*
5	*Ball bearing*	*6*	*Washer 7.2/18.8/3*
7	*Hex. screw M7x16*	*8*	*Support*
9	*Propeller shaft*	*10*	*Bearing seat*
11	*Inner ring*	*12*	*Sleeve*

Step	Procedure
3	Push 2 x distance sleeves 35.2/42/8 onto the propeller shaft.

With clutch

Step	Procedure
4	Lubricate 2 disc springs (lying against each other) along with step collar with a diameter of 40.8 mm (1.6 in.) facing the disc spring with lithium-base grease and push them on.

NOTE

The disc springs must lie on the centring collar of the clutch hub!

Step	Procedure
5	Lubricate the third disc spring (with its rear facing the others) with lithium-base grease and push it on.
6	Lubricate the clutch on the gear profile with lithium-base grease and push it onto the propeller shaft.

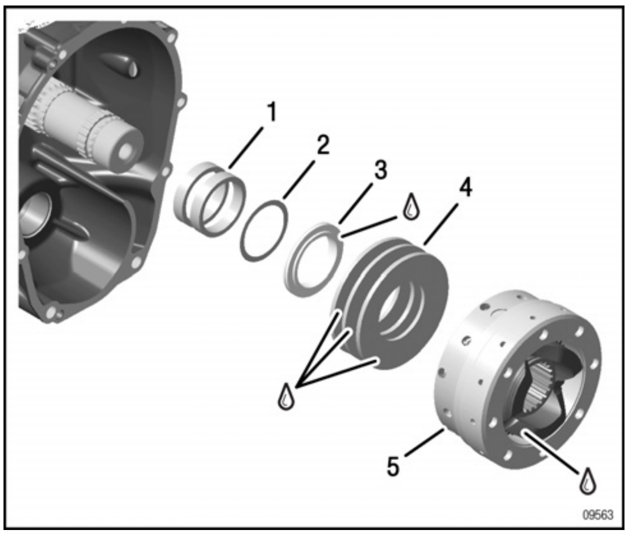

Figure 8.39: Propeller gearbox without oil spray nozzle

1	*Distance sleeve*	2	*Compensating shim (as required)*
3	*Step collar*	4	*Disc springs*
5	*Clutch assy.*		

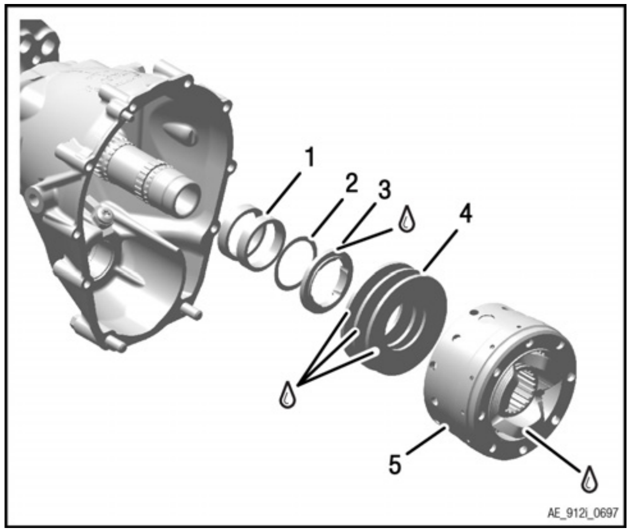

Figure 8.40: Propeller gearbox with oil spray nozzle

1	*Distance sleeve*	2	*Compensating shim (as required)*
3	*Step collar*	4	*Disc springs*
5	*Clutch assy.*		

Step	Procedure
7	Install the lubricated bearing bushing carefully on the propeller shaft with circlip pliers.

NOTE

If the bearing bushing has been stretched, it will have a tight fit inside the gear and must be replaced.

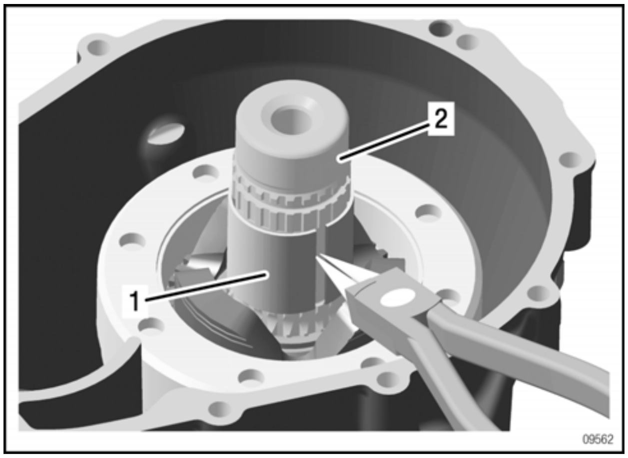

Figure 8.41: Typical

1 Bearing bushing *2 Propeller shaft*

Step	Procedure
8	Push on the gear (propeller shaft).
9	Lubricate the plastic thrust washer 33.2/51/1.2 on both sides with lithium-base grease and push it on along with the drive gear.

NOTICE
The thrust washer must be replaced every repair.

NOTICE
The contact surface of the plastic thrust washer must be level (flat). Risk of breakage!

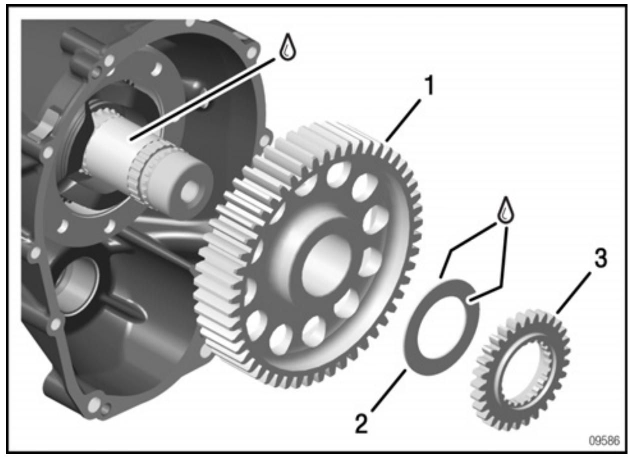

Figure 8.42

1 Gear (propeller shaft) *2 Thrust washer*

3 Drive gear

ADJUSTMENT OF THE DISC SPRING PRETENSION

NOTE

To make adjustment easier, it can be spaced out until the contact face for the ring halves aligns with the upper edge in the groove of the propeller shaft.

Step	Procedure
1	Place compensating shims between the distance sleeve and the step collar.

NOTE

When the propeller shaft assembly is not tensioned, the contact face for the ring halves must lie 1 mm (0.039 in.) above the upper edge in the groove of the propeller shaft.

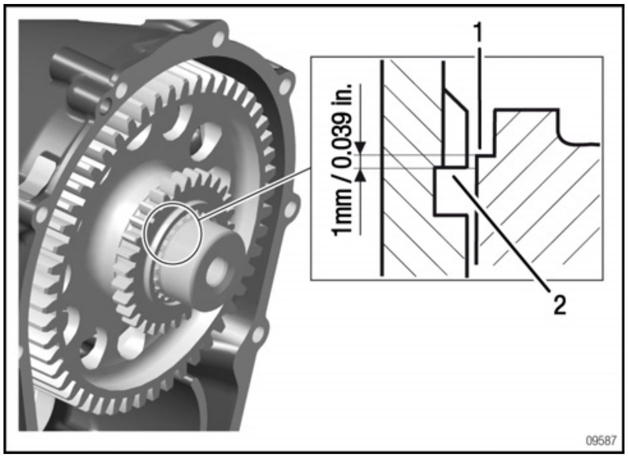

Figure 8.43

1	*Contact face*	2	*Upper edge*

ASSEMBLY OF THE PROPELLER GEARBOX ASSY.

NOTICE
If the disc springs do not sit centrally, the gear (propeller shaft) cannot be pressed down enough to insert the ring halves. Do not increase the force, but remove the clutch again and center the disc springs correctly.

NOTICE
Gearbox housing may be damaged. Only push the dog gear down until the ring halves can be mounted on the propeller shaft. The gear cover must be freely rotatable!

Step	Procedure
1	Place the whole gearbox in a suitable fixture.
2	Press down the gear (propeller shaft) with a mounting yoke part no. 876885 and assemble with new ring halves.

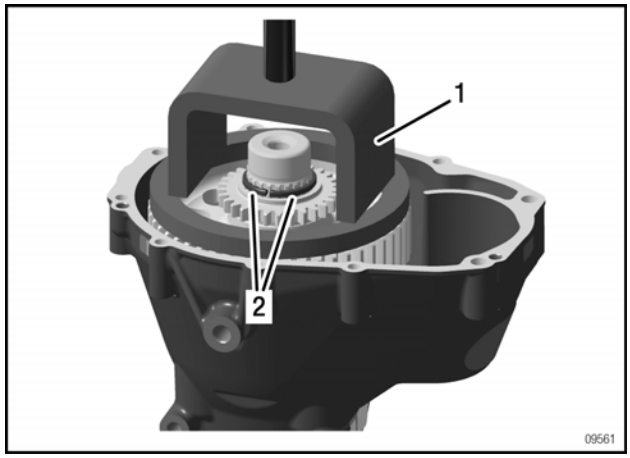

Figure 8.44

1	*Mounting yoke 876885*	2	*Ring halves*

INSTALLATION

BLINDING SHIM – INSTALLATION

CONFIGURATION 2

Step	Procedure
1	Install new O-ring 26.7x1.8 onto the blinding shim.
2	Apply LOCTITE 5910 where the O-ring contacts the crankcase splitting line.
3	Install the blinding shim with the full side into the crankcase. Secure the blinding shim with countersunk screw M5x12 including the thrust washer with LOCTITE 243 and tighten it. Tightening torque 6 Nm (53 in.lb.).

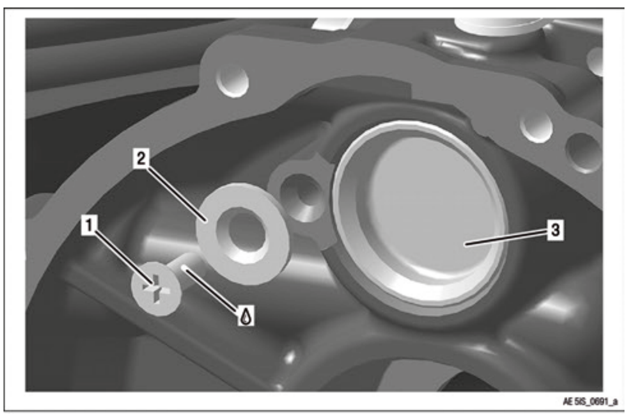

Figure 8.45

1 Countersunk screw M5x12 *2 Thrust washer*

3 Blinding shim

ROLLER BEARING – INSTALLATION (CONFIGURATION 2)

Step	Procedure
1	Apply LOCTITE 5910 sparingly on the outside diameter of the new oil seal 30x52x7 and install it into the crankcase with press-in jig part no. 877594.

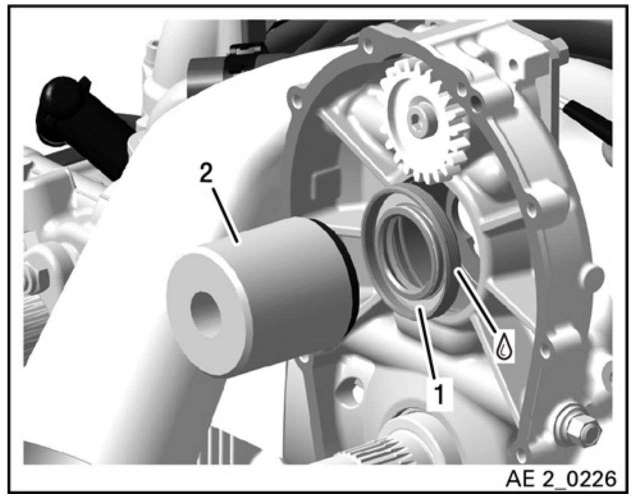

Figure 8.46

1 Oil seal 30x52x7 *2 Press-in jig 877594*

Step	Procedure
2	Install the extractor part no. 877615 with 6 Allen screws M6x25 onto the crankcase, place the press-in mushroom part no. 877590 into the roller bearing, center and press it with the spindle into the crankcase as far as it will go.
3	Insert the retaining ring with the circlip pliers. **NOTE** *Place the circlip into the groove with the sharp edge pointing outwards.*

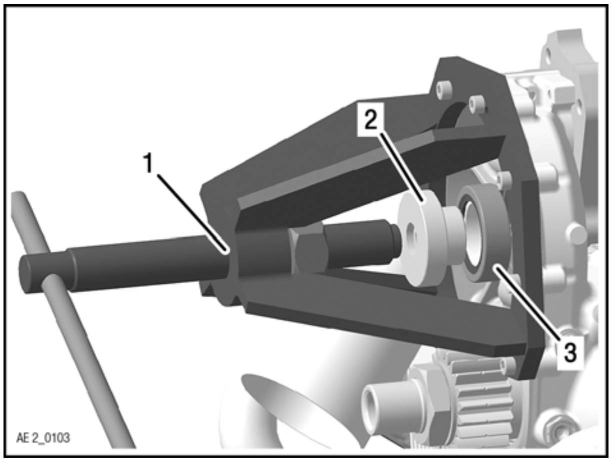

Figure 8.47

1	*Extractor 877615*	2	*Press-in mushroom 877590*
3	*Roller bearing*		

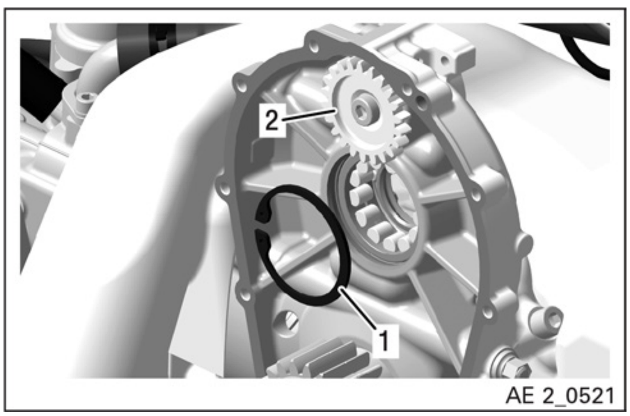

Figure 8.48

1	*Retaining ring 52x2*	2	*Vacuum pump gear*

ROLLER BEARING – INSTALLATION (CONFIGURATION 3)

NOTICE

The oil inlet flange must not be installed tilted and the O-ring must be not pinched.

Step	Procedure
1	Lubricate a new O-ring with engine oil and push it into the crankcase with the oil inlet flange.

NOTE

Ensure that the two M6 threads must be horizontal and scavenge oil hole on upper position. See following figure.

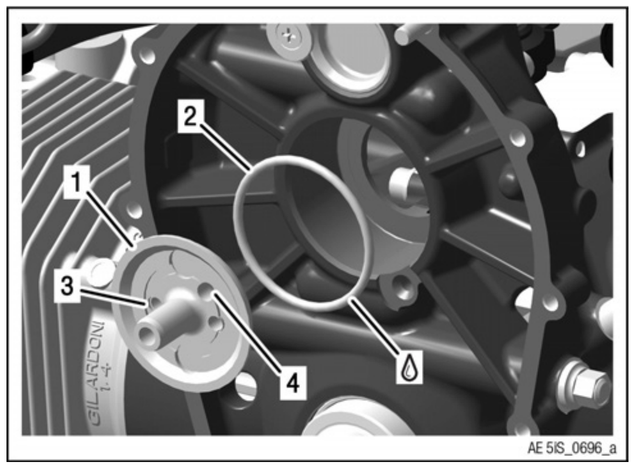

Figure 8.49

1	*Oil inlet flange-Brass*	2	*O-ring*
3	*M6 threaded bores*	4	*Scavenge oil hole*

Step	Procedure
2	Install the governor flange with two Allen screws M6x20 and the brass oil inlet flange with two Allen screws M6x16. At first hand-tight the screws for better positioning.

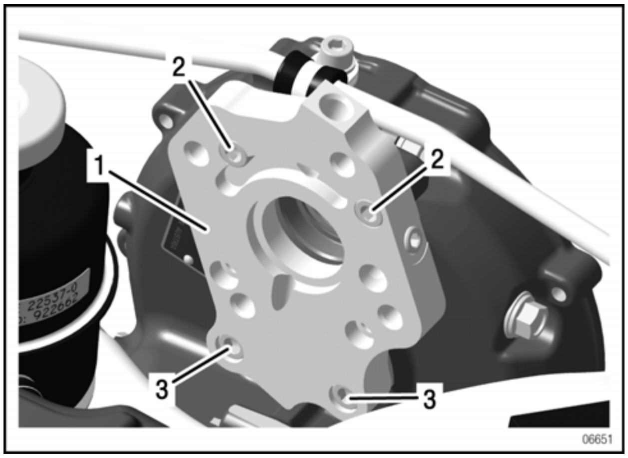

Figure 8.50

1	*Governor flange*	2	*Allen screws M6x20*
3	*Allen screws M6x16*		

Step	Procedure
3	Install the extractor part no. 877615 with 6 Allen screws M6x25 onto the crank-case, place the press-in mushroom part no. 877590 in the roller bearing, put it on the centring and press it with the spindle into the crankcase as far as it will go.
4	Insert the retaining ring with the circlip pliers.

NOTE

Place the circlip in the groove with the sharp edge pointing outwards.

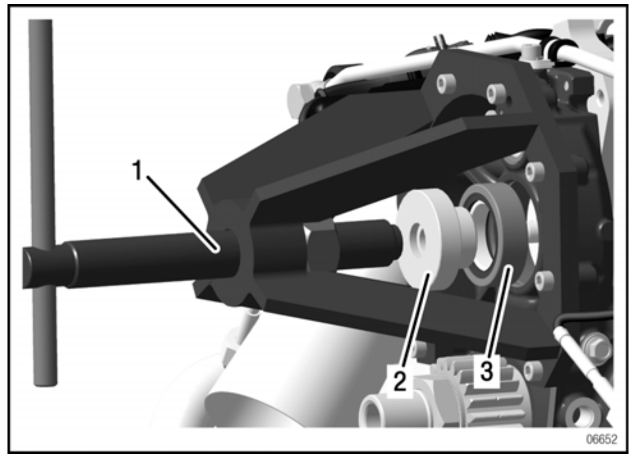

Figure 8.51

1	*Extractor part no. 877615*	2	*Press-in mushroom part no. 877590*
3	*Roller bearing*		

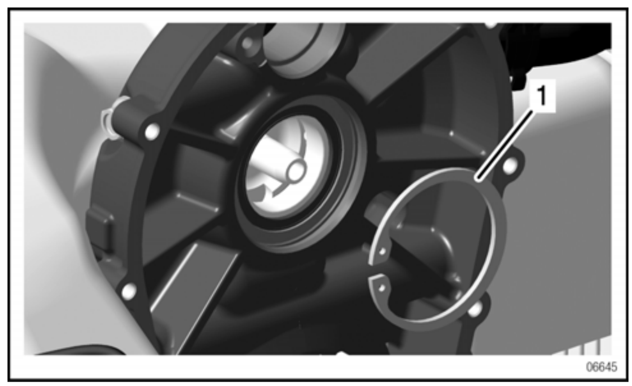

Figure 8.52

1	*Retaining ring 52x2*

FINISHING WORK

- If necessary, install the vacuum pump gear. See Chapter 37–10–00 section Vacuum pump gear.

Install propeller gearbox assy.
See current Maintenance Manual Line (MML) for the respective engine type.

Fill with operating fluids or check filling levels.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-10-00 section Adding operating fluids.

Purge the oil system.
See current Installation Manual (IM) for the respective engine type, Chapter 79-00-00 section Purging the lubrication system.

Carry out an engine test run.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Planned maintenance.

Chapter: 72–20–00
ENGINE BLOCK

TOPICS IN THIS CHAPTER

SPECIAL TOOLS

Description	Part number
Hot air gun	n.a.
Puller	877375
Seeger ring pliers	n.a.
Free wheel gear axial clearance measuring fixture	n.a.
38x20 insert for SW32 hex. nut, magneto side crankshaft	876070
Reducing socket 1/2 ” to 3/4 “	877460
Thread bolt M8x50	240880
Protection mushroom	876557, 877419

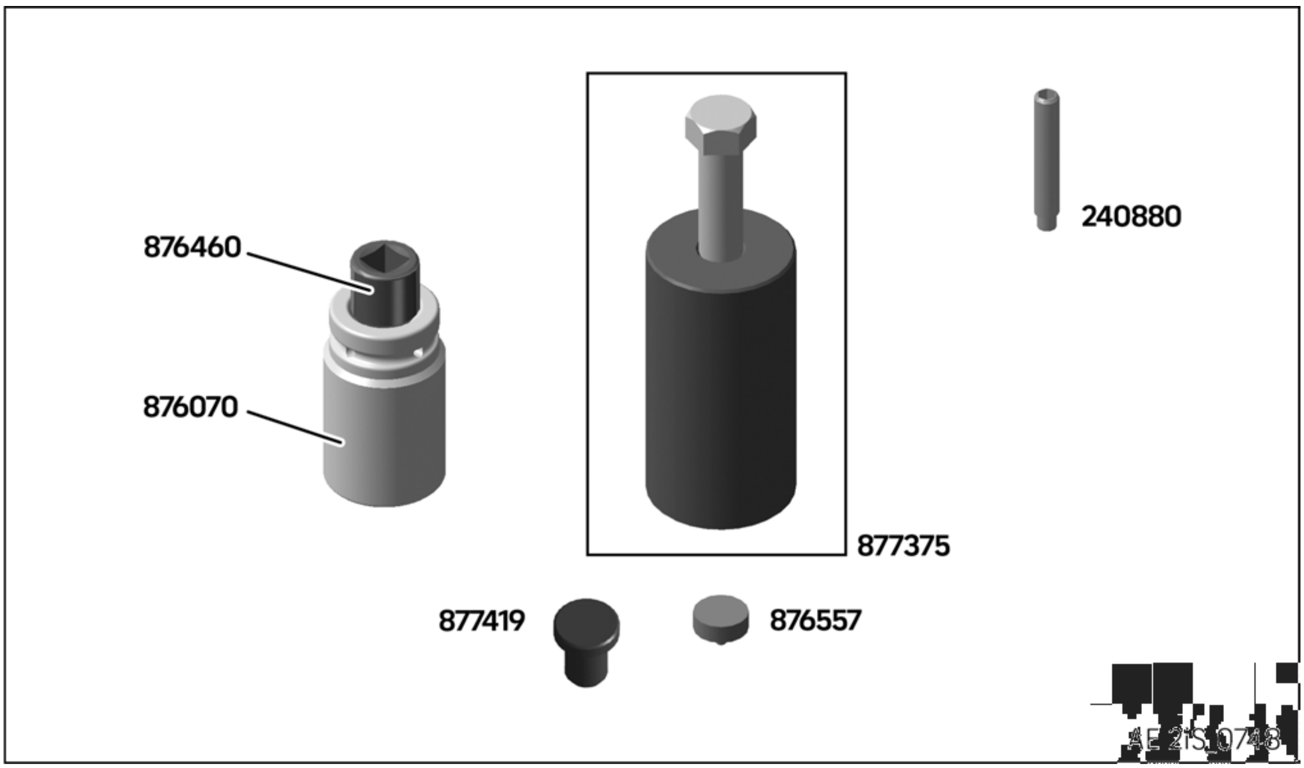

Figure 9.1: Special tools

SERVICE PRODUCTS

Description	Part number
LOCTITE ANTI SEIZE	297434
LOCTITE 7063	898450
LOCTITE 603	899789
Abrasive pad	n.a.

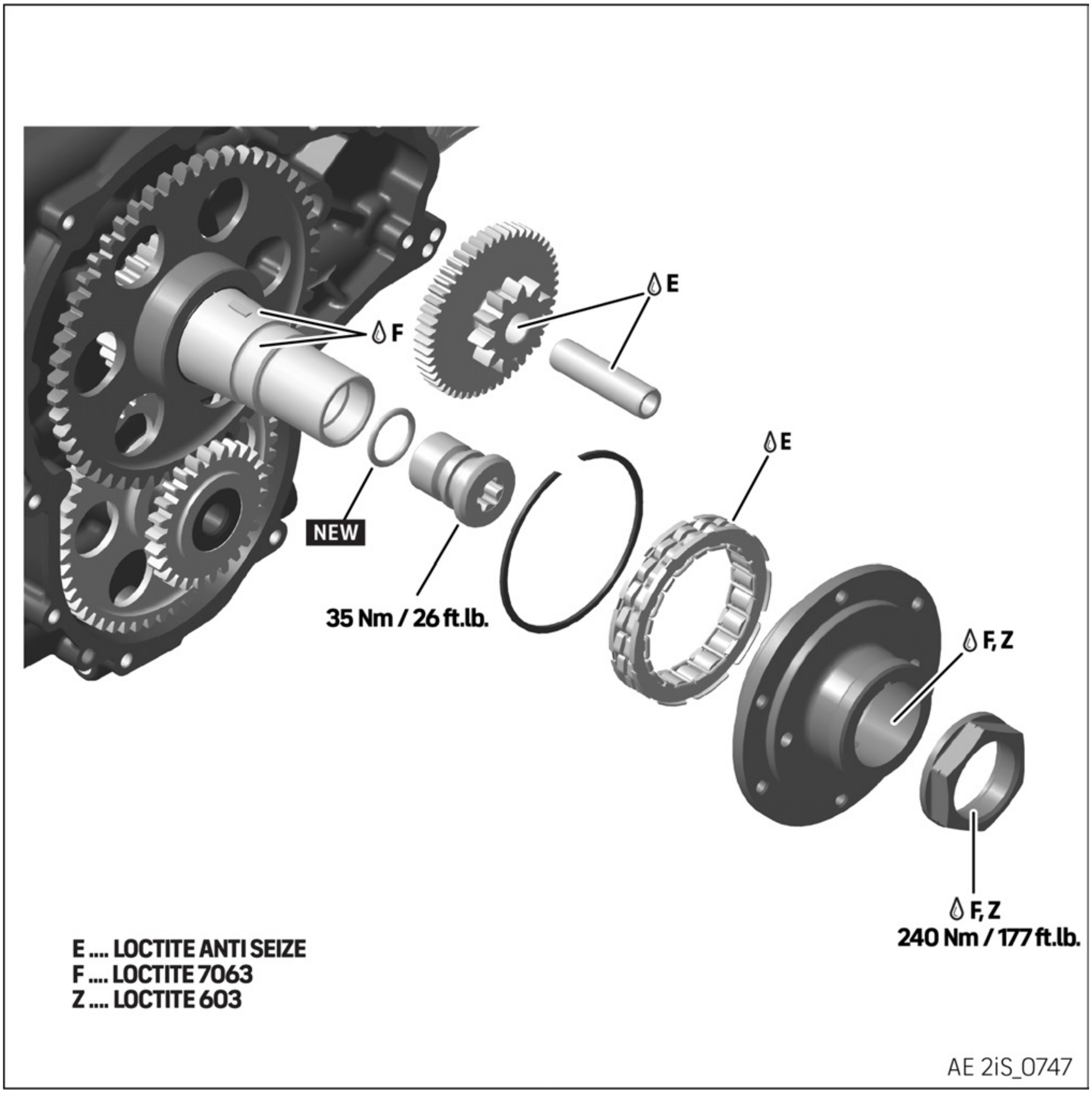
F
E
E
NEW
35 Nm / 26 ft.lb.
F, Z
F, Z
240 Nm / 177 ft.lb.
E .... LOCTITE ANTI SEIZE
F .... LOCTITE 7063
Z .... LOCTITE 603
AE 2iS_0747

Figure 9.2

GENERAL NOTE

This section only describes work relating directly to repairing the engine block and its assemblies. Note the cross-references to maintenance work and work on other assemblies which is necessary when working on the engine block.

SAFETY INSTRUCTIONS

⚠ WARNING
Danger of severe burns and scalds! Always allow the engine to cool down to ambient temperature before starting any work.

MAINTENANCE

As well as the maintenance and special checks, see current Maintenance Manual Line (MML) for the respective engine type.

REMOVAL

Before the sprag clutch is removed, the work described below must be carried out to identify any further faults in the engine block and rectify them as part of repair work.

NOTICE

If these checks are omitted, it may be necessary to dismantle the ignition housing again to rectify any faults after it has been repaired.

Engine cleaning.
See current Maintenance Manual Line (MML) for the respective engine type.

General visual inspection.
See current Maintenance Manual Line (MML) for the respective engine type.

SPRAG CLUTCH — REMOVAL

Preparation

NOTICE

Prevent the ingress of debris particles into all disconnected lines and connections.
Use appropriate protective coverings.

- Remove the electric starter. See Chapter 80-00-00 section Electric starter.
- Remove the ignition housing and fly wheel. See Chapter 24-20-00 section Internal generator.

NOTE

The assemblies and lines are only to be removed if necessary and only as far as is necessary!

NOTE

Remove the plug screw from the crankshaft only if it is absolutely necessary.

SPRAG CLUTCH HOUSING – REMOVAL

NOTE

The fly wheel assy. does not have to be disassembled for changing the sprag clutch.

Step	Procedure
1	Pull out the idle gear shaft.
2	Remove the starter idle gear.

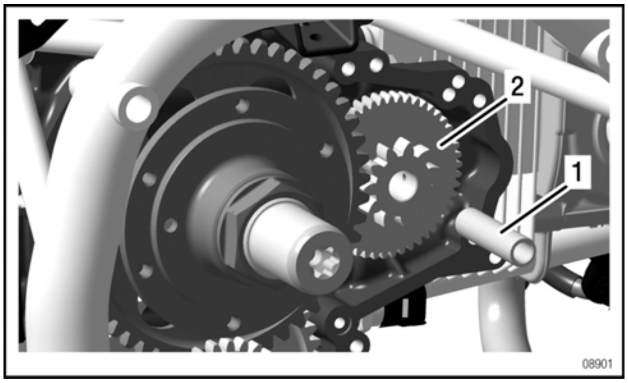

Figure 9.3

1 Idle gear shaft *2 Idle gear*

NOTICE

The M32x1.5 hex. collar nut (secured with LOCTITE 603) must be heated correspondingly. The nut has a left handed thread!

Lock the crankshaft.
See current Maintenance Manual Line (MML) for the respective engine type.

Step	Procedure
3	Heat the hex. collar nut about 100 °C to 120 °C (212 °F to 248 °F) using a hot air gun.
4	Loosen the hex. collar M32x1.5 nut from the crankshaft with the socket wrench 38x20 part no. 876070.

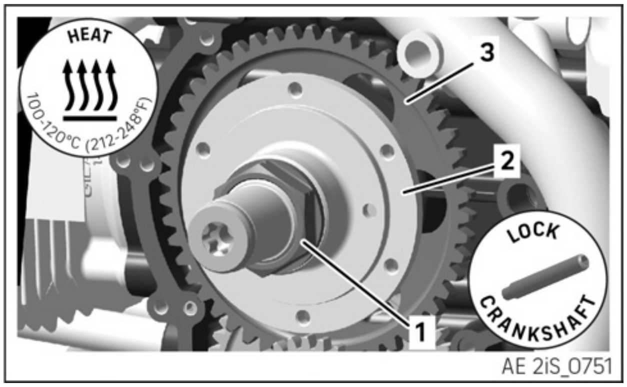

Figure 9.4

1	*Hex. collar nut M32x1.5*	2	*Sprag clutch housing*
3	*Free wheel gear*		

Step	Procedure
5	Lubricate the surface of the crankshaft with lithium-base grease and push the protection mushroom part no. 876557 into the crankshaft.

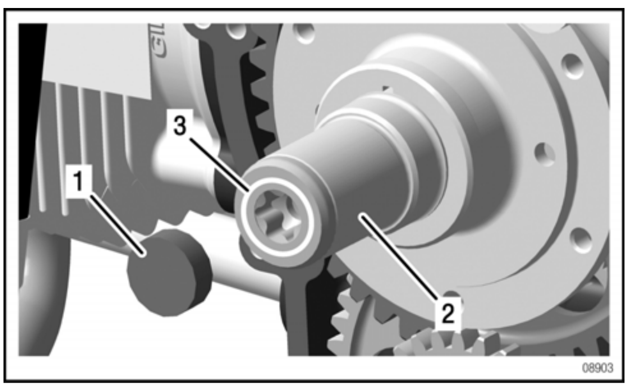

Figure 9.5: TYPICAL

1	*Protection mushroom part no. 876557*	2	*Crankshaft*
3	*Plan surface of crankshaft*		

NOTE

When the crankshaft plug screw M22x1,5 is removed, the protection mushroom with part no. 877419 must be used.

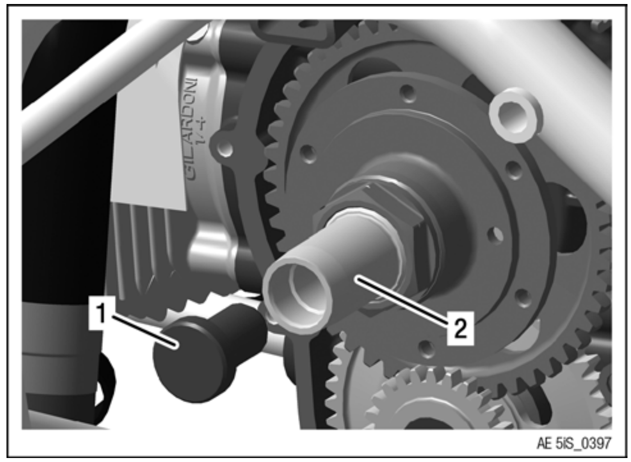

Figure 9.6: TYPICAL

1	*Protection mushroom part no. 877419*	2	*Crankshaft*

Step	Procedure
6	Pull off the sprag clutch housing using the puller part no. 877375.

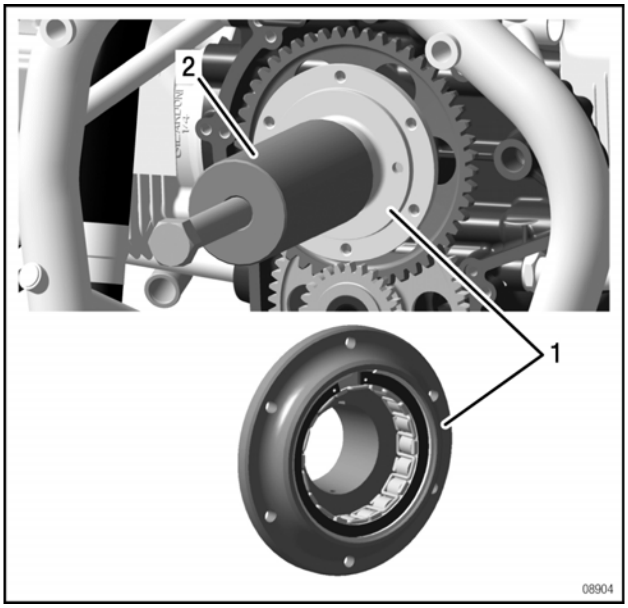

Figure 9.7

1 Sprag clutch housing *2 Puller part no. 877375*

Step	Procedure
7	Remove the woodruff key from the crankshaft.

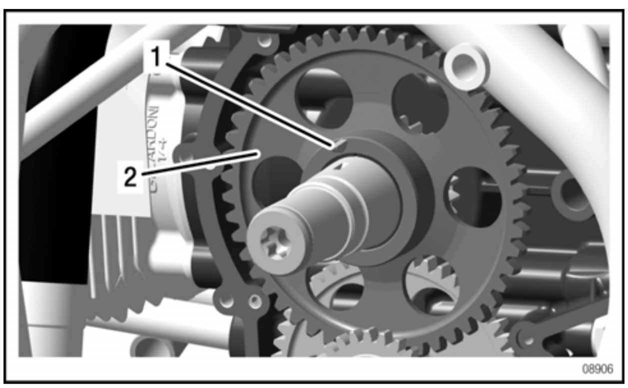

Figure 9.8

1 Woodruff key *2 Free wheel gear*

DISASSEMBLY

DISASSEMBLING THE SPRAG CLUTCH HOUSING

The sprag clutch housing should be disassembled on a clean surface. There must be enough space to lay out the removed parts to ensure that all the parts can be laid out and allocated according to their installation position.

Step	Procedure
1	Remove the circlip from the sprag clutch housing.
2	Compress the Seeger ring slightly using Seeger ring pliers and take the sprag clutch out of the sprag clutch housing while turning it.

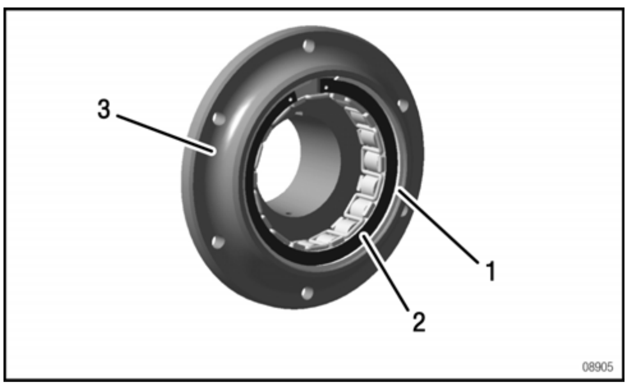

Figure 9.9

1 Circlip *2 Seeger ring*

3 Sprag clutch housing

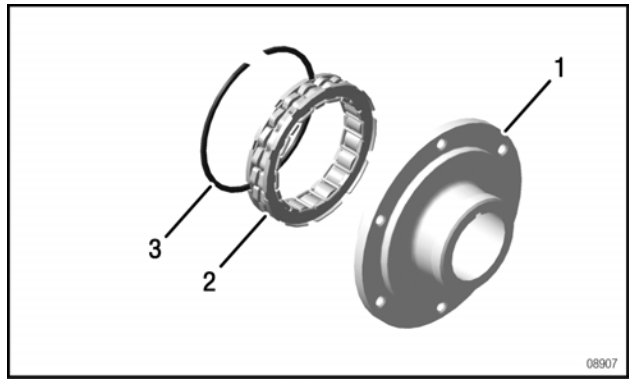

Figure 9.10

1 Sprag clutch housing *2 Sprag clutch*

3 Circlip

INSPECTION

SPRAG CLUTCH HOUSING SINGLE PARTS — INSPECTION

Preparation

Clean all parts carefully.
See current Maintenance Manual Line (MML) for the respective engine type.

SPRAG CLUTCH HOUSING – INSPECTION

Step	Procedure
1	Check whether oil sludge has accumulated in the sprag clutch housing.
2	Check that the oil passage for the generator is clear. **NOTE** *The passage is 0.8 mm (0.030 in.) in diameter. Check using a 0.5 mm (0.020 in.) wire.*
3	Check crankshaft bore.
4	Check the taper surface.
5	Check the sprag clutch engagement faces in the sprag clutch housing.

NOTICE

If the oil passage is clogged, the generator coils are no longer cooled sufficiently.

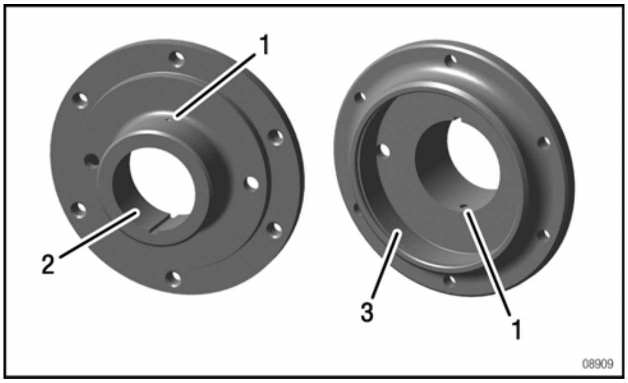

Figure 9.11

1 *Oil passage*

2 *Taper surface*

3 *Sprag clutch engagement face*

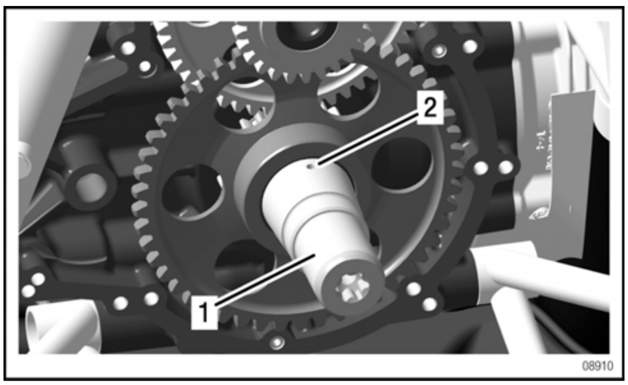

Figure 9.12

1 *Crankshaft*

2 *Crankshaft bore (oil passage)*

SPRAG CLUTCH – INSPECTION

Step	Procedure
1	Check whether oil sludge has accumulated in the sprag clutch and in the spear body.
2	The spear body of the sprag clutch must be freely movable and may not be damaged.
3	The surrounding helical spring must not be loose or bent in a serpentine manner; replace the sprag clutch if necessary.

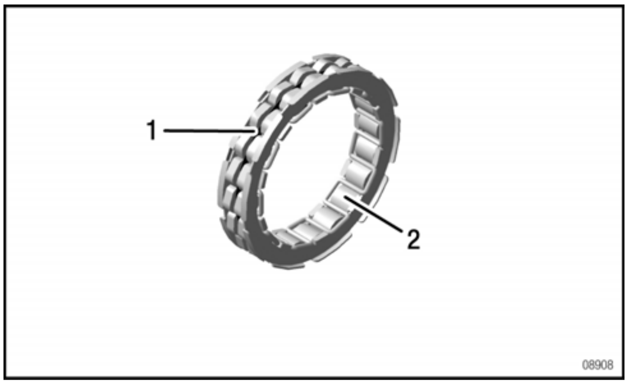

Figure 9.13

1 Helical spring *2 Spear body*

NOTE

If the sprag clutch is damaged it is a good practice to make a precautionary change of the sprag housing. Regardless of the condition or appearance of the housing.

FREE WHEEL GEAR – INSPECTION

Step	Procedure
1	Check the gear-tooth system of the free wheel gear.
2	Check the sprag clutch engagement face on the free wheel gear.
3	Check the taper surface.

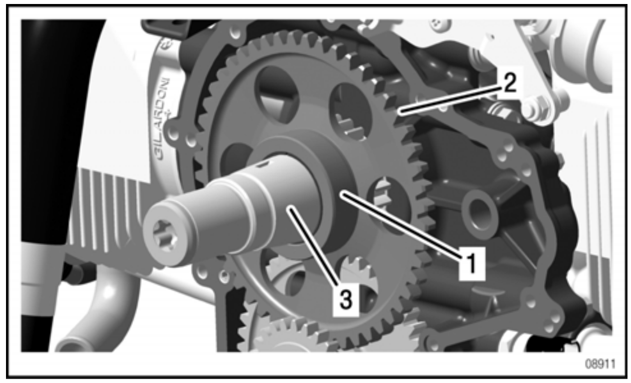

Figure 9.14

1 Sprag clutch engagement face *2 Gear-tooth system*

3 Taper surface

STARTER IDLE GEAR – INSPECTION

Step	Procedure
1	Check the gear-tooth system of the starter idle gear.
2	Check the idle gear shaft for damage.

NOTICE

If the gear-tooth system is deformed, the starter idle gear must be replaced.

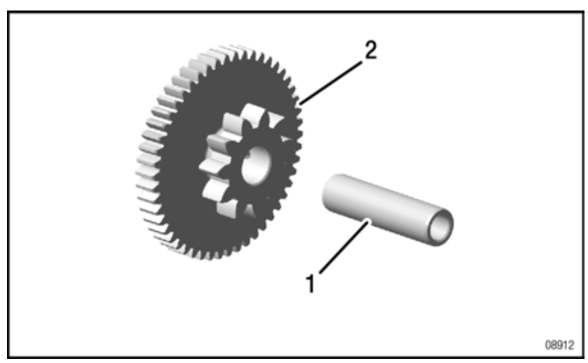

Figure 9.15

1 Idle gear shaft *2 Starter idle gear*

ASSEMBLY

ASSEMBLY OF THE SPRAG CLUTCH HOUSING

Step	Procedure
1	Clean the taper surface of the sprag clutch housing with a cloth.
2	Apply LOCTITE ANTI SEIZE to the spear body.

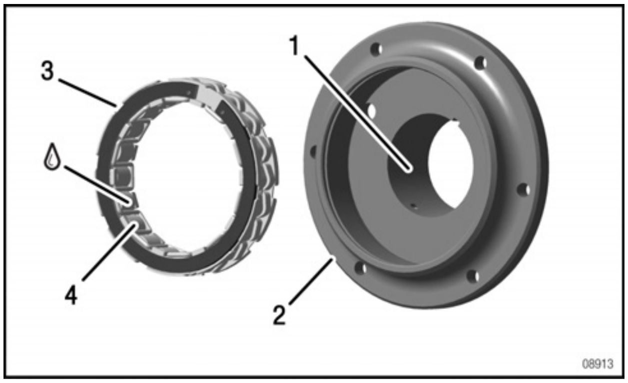

Figure 9.16

1 Taper surface *2 Sprag clutch housing*

3 Sprag clutch *4 Spear body*

Step	Procedure
3	Place the sprag clutch in the sprag clutch housing; the Seeger ring must be visible.
4	Install the circlip so that its chamfer faces the sprag clutch. **NOTE** *To assemble it, compress it slightly with Seeger ring pliers and ensure that the Seeger ring remains in position and latches completely with the teeth in the slots of the sprag clutch body.*

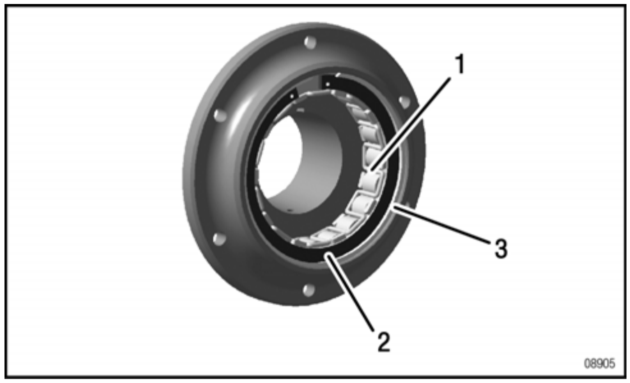

Figure 9.17

1 Sprag clutch *2 Seeger ring*

3 Circlip

INSTALLATION

Preparation

Lock crankshaft.
See current Maintenance Manual Line (MML) for the respective engine type.

- If necessary, install the plug screw M22x1,5 with new O-ring 18x2.5 into the crankshaft. Tightening torque 35 Nm (26 ft.lb.)

SPRAG CLUTCH HOUSING – INSTALLATION

Step	Procedure
1	Degrease the thread and taper surface of the crankshaft with LOCTITE 7063 and place the woodruff key in the crankshaft.

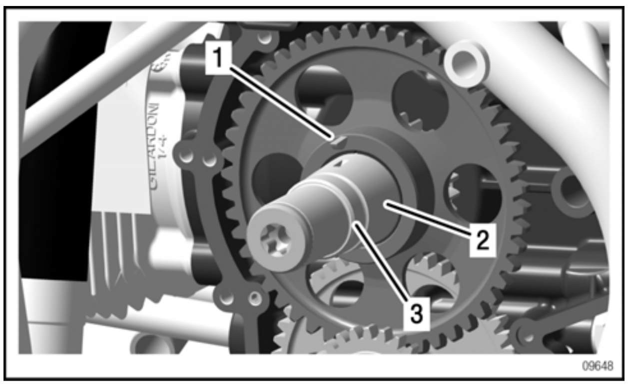

Figure 9.18

1 Woodruff key *2 Taper surface*

3 Thread

Step	Procedure
2	Degrease the taper surface in the sprag clutch housing with LOCTITE 7063 and lubricate thinly with LOCTITE 603.

NOTICE

Bearing bushing and the free wheel gear may stick to the crankshaft and the sprag clutch may be abraded.
Approx. 2 to 3 mm on the underside of the sprag clutch housing must not be in contact with LOCTITE 603.

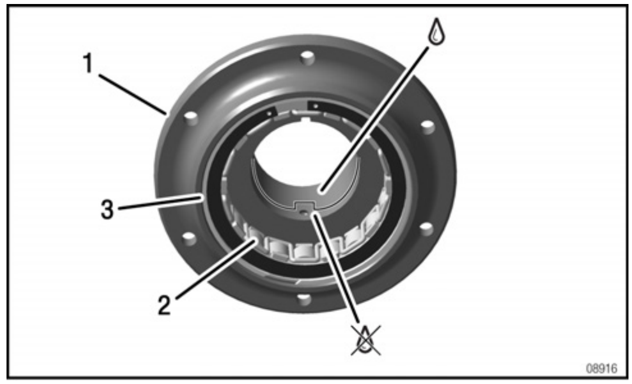

Figure 9.19

1 Sprag clutch housing *2 Spear body*

3 Circlip

Step	Procedure
3	Place the sprag clutch housing on the crankshaft. Turn the free wheel gear in the process to align the spear body.
4	Degrease hex. collar nut M32x1.5 with LOCTITE 7063, then secure it with LOCTITE 603 and tighten it. Tightening torque 240 Nm (177 ft. lb.).

NOTE

The free wheel gear must drive the crankshaft when turned counterclockwise and must be freely rotatable when turned clockwise, viewed towards the magneto side of the engine.

NOTICE
Check that the passage and oil duct of the crankcase are not blocked. If the oil passage is blocked, the generator coils are no longer cooled sufficiently.

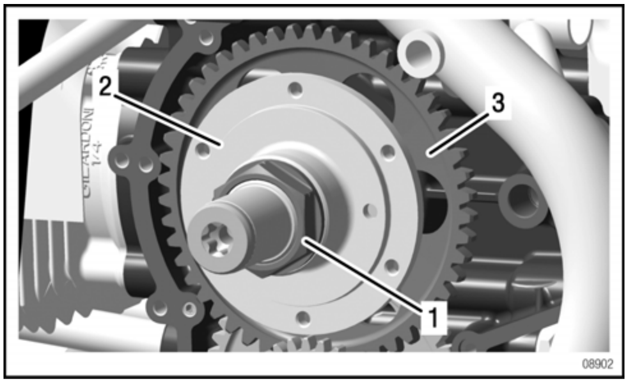

Figure 9.20

1	*Hex. collar nut M32x1.5*	2	*Sprag clutch housing*
3	*Free wheel gear*		

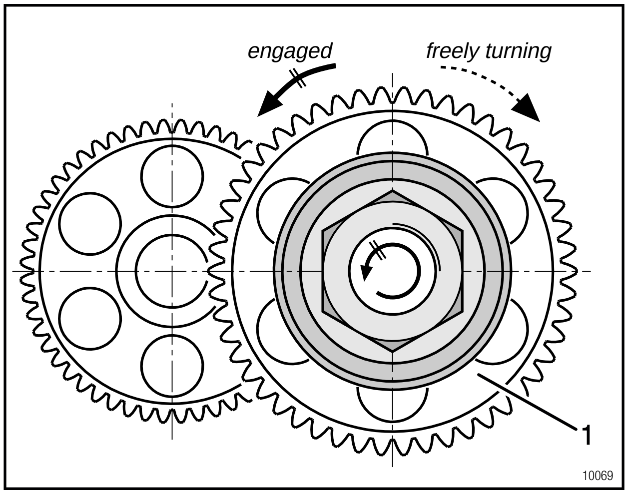

Figure 9.21

1	*Free wheel gear*

Step	Procedure
5	Lubricate the idle gear shaft and bore of the starter intermediate gear with LOCTITE ANTI SEIZE.
6	Install the starter idle gear.
7	Install the idle gear shaft.

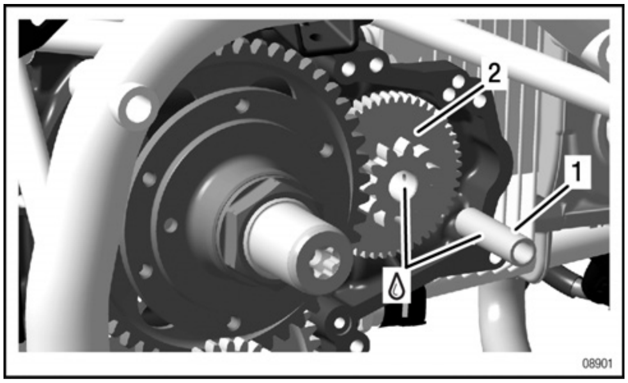

Figure 9.22

1	*Idle gear shaft*	2	*Starter idle gear*

MEASURING THE AXIAL CLEARANCE OF THE FREE WHEEL GEAR

NOTICE
Electric starter may be damaged. If there is no or too little axial clearance, the sprag clutch may not release.

NOTE

For measurement of the axial clearance ES10 of the free wheel gear, see section Wear Limits.

WEAR LIMITS

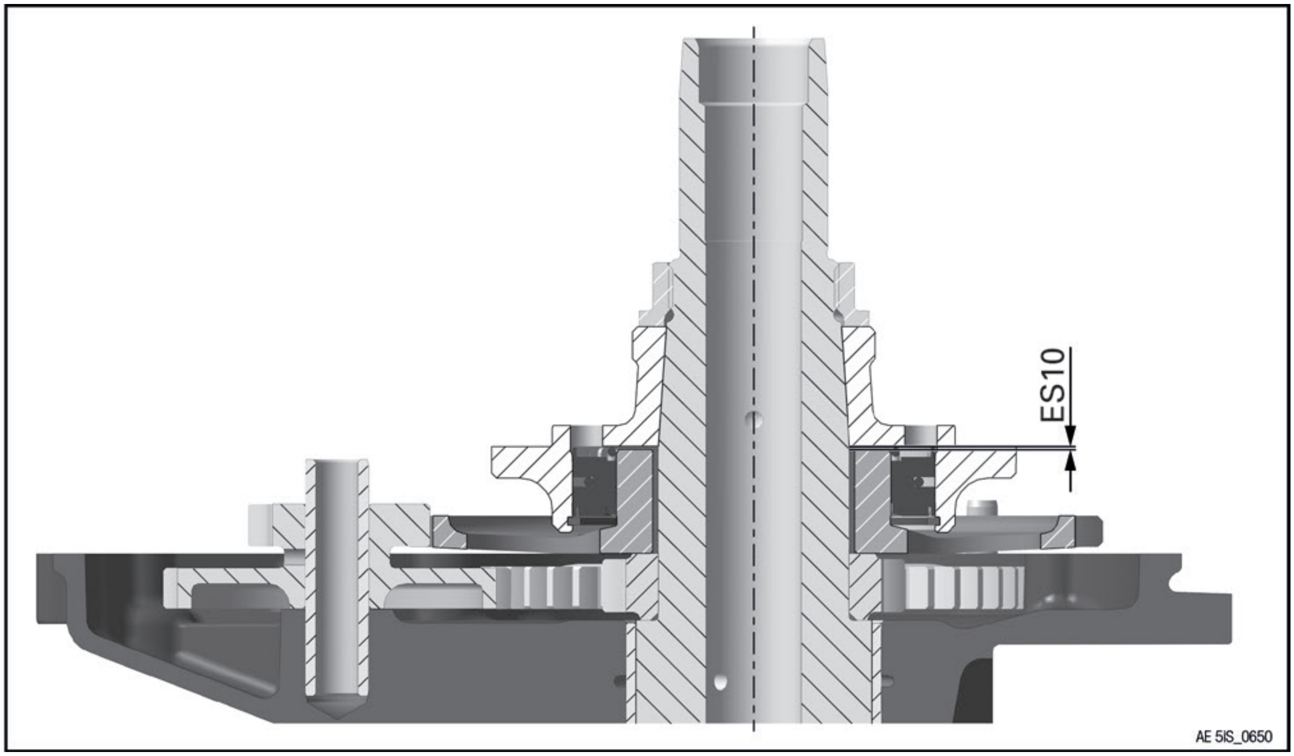

Figure 9.23: Free wheel gear, TYPICAL

Description	Code	**Reading new**		**Wear limit**			Readings
		min.	max.	100 %	50 %		
Axial clearance	ES10	0.5 mm 0.02 in	1.1 mm 0.04 in	0.2 mm 0.01 in	0.4 mm 0.014 in	actual	
						renewed	

FINISHING WORK

- Install the ignition housing and fly wheel. See also Chapter 24-20-20 section Internal generator.
- Install the electric starter. See Chapter 80-00-00 section Electric starter — installation
- Install coolant hoses from cylinder head, water inlet elbow and water pump housing. See Chapter 75-00-00 section Form hose – installation
- Install the surrounding assemblies.

Fill with operating fluids or check filling levels.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-10-00 section Adding operating fluids.

Purge the oil system.
See current Installation Manual (IM) for the respective engine type, Chapter 79-00-00 section Purging the lubrication system. It must be carried out in accordance with SI-912-018/SI-914-020/ SI-912 i-004, “Purging the lubrication system”, latest issue.

Flush the engine cooling system.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Flushing the engine cooling system.

Carry out an engine test run.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Planned maintenance.

Chapter: 72–30–00
CYLINDER HEAD

TOPICS IN THIS CHAPTER

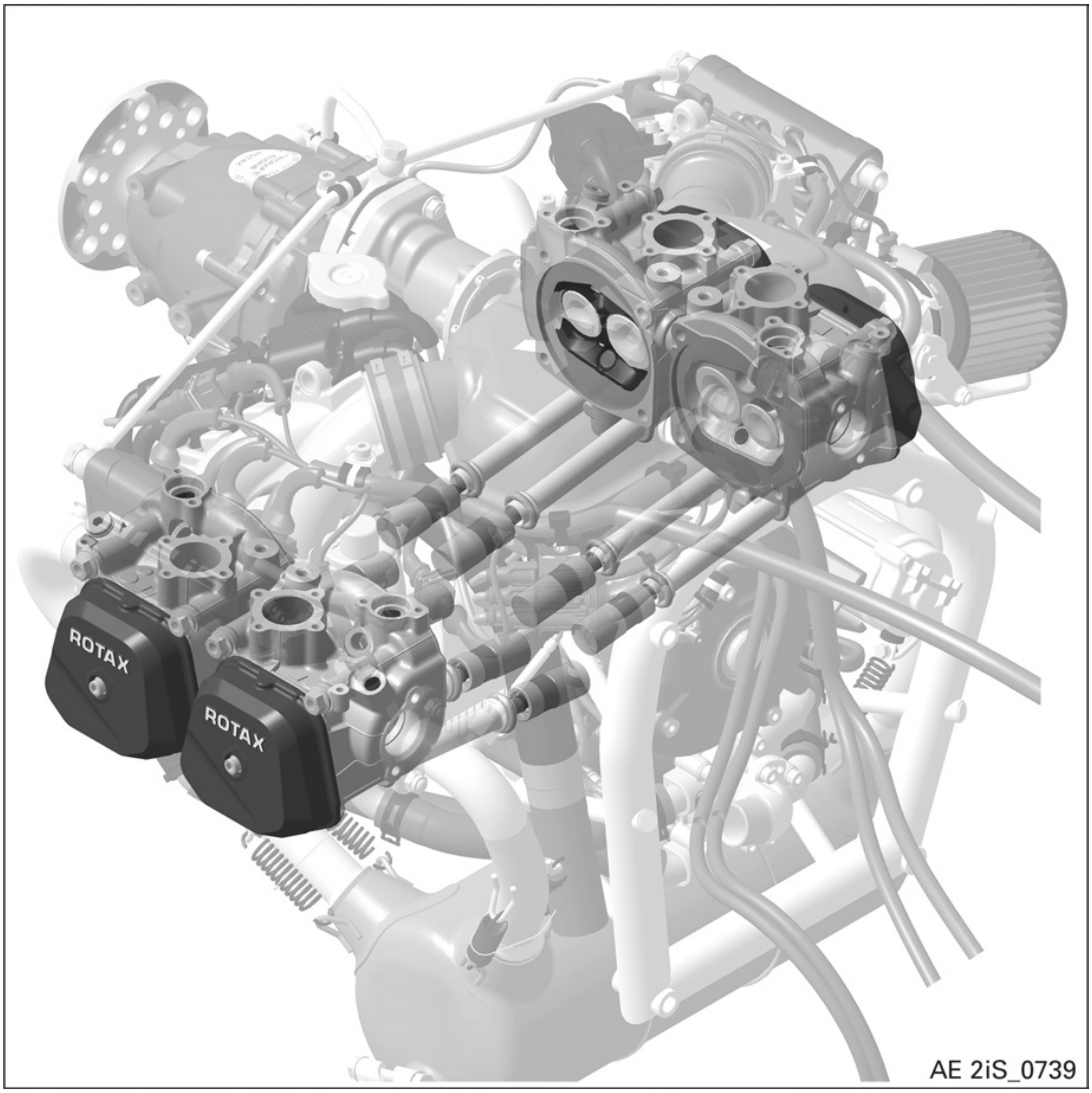

Figure 10.1: Location on the engine

SPECIAL TOOLS

Description	Part number
Cylinder aligning tool	877263
Measuring fixture (valve spring inspection)	n.a.
Spring clamp pliers	877840
Valve spring mounting device	877380
Socket wrench 19x12.5	876130
Torx T30 ball-head insert	876180
Collet	n.a.

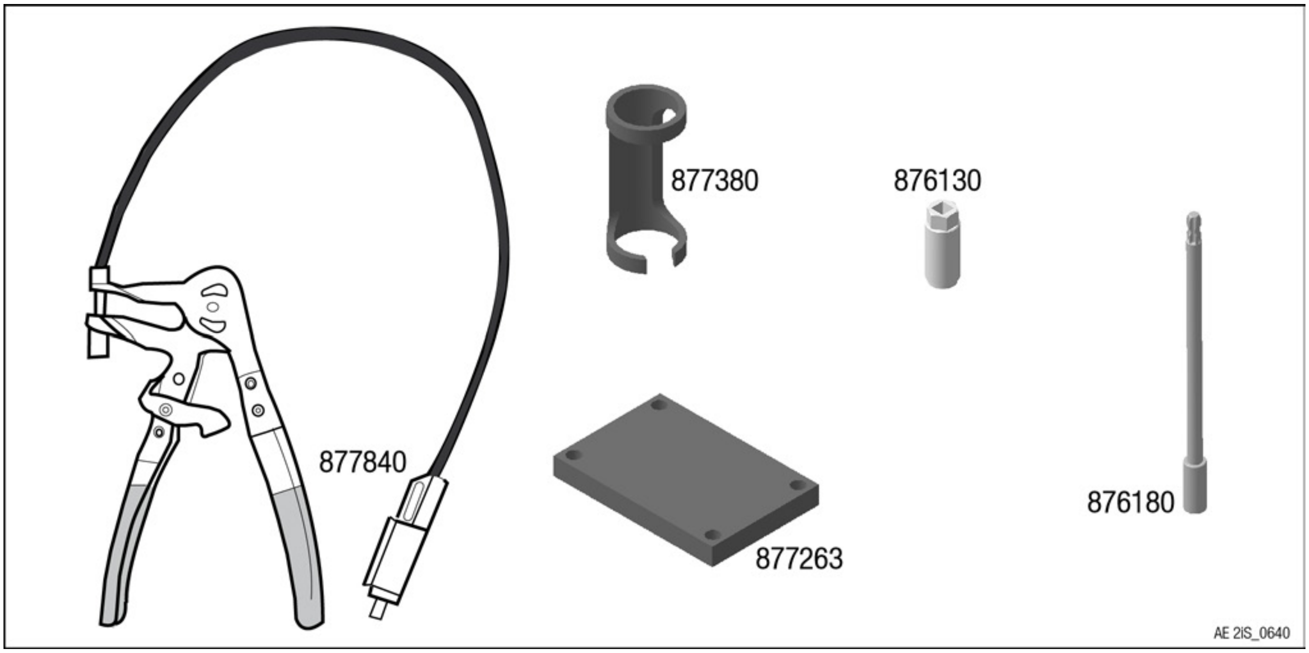

Figure 10.2: Special tools

SERVICE PRODUCTS

Description	Part number
LOCTITE 648	899788
LOCTITE 243	897651
LOCTITE 577	899796
LOCTITE ANTI SEIZE 8151	297434
Engine oil	n.a.

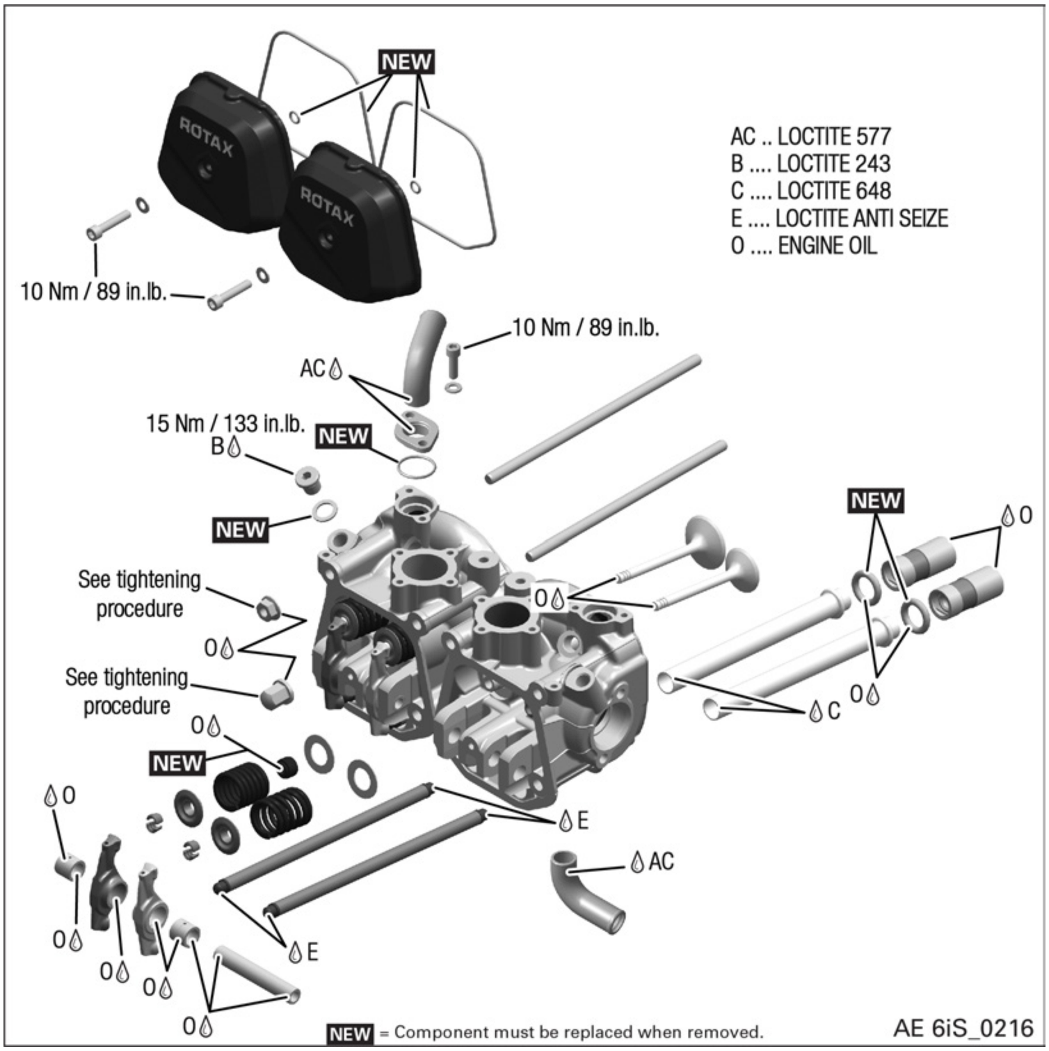

Figure 10.3: Cylinder head

SYSTEM DESCRIPTION

The engine type 912 i Series has 4 liquid-cooled cylinder heads.

SAFETY INSTRUCTION

⚠ WARNING
Danger of severe burns and scalds! Always allow the engine to cool down to ambient temperature before starting any work.

MAINTENANCE

As well as the maintenance and special checks, see current Maintenance Manual Line (MML) for the respective engine type.

REMOVAL

Preparation

Before the cylinder head is removed, the work described below must be carried out to identify any further faults in the cylinder head and rectify them as part of repair work.

NOTICE

If these checks are omitted, it may be necessary to dismantle the cylinder head again to rectify any faults after it has been repaired.

Engine cleaning.
See current Maintenance Manual Line (MML) for the respective engine type.

General visual inspection.
See current Maintenance Manual Line (MML) for the respective engine type.

Carry out an engine test run. See current Maintenance Manual Line (MML) for the respective engine type.

SURROUNDING ASSEMBLIES – REMOVAL

NOTICE

Prevent the ingress of foreign bodies into all disconnected lines and connections.
Use appropriate protective coverings.

NOTE

The assemblies and lines are only to be removed if necessary and only as far as is necessary!

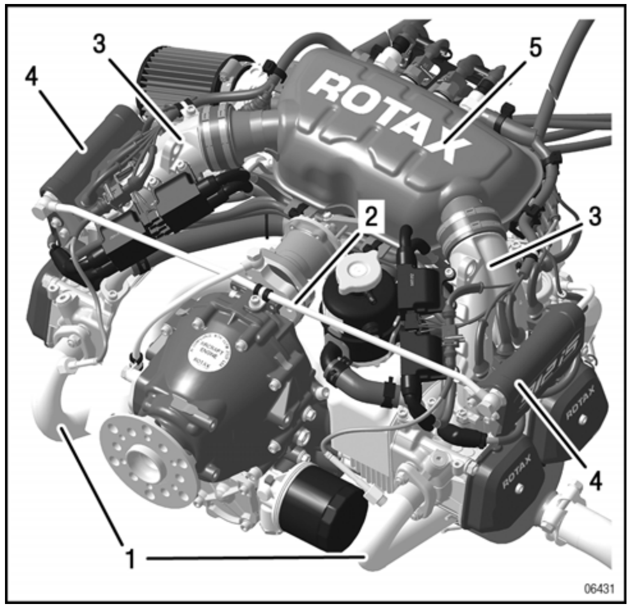

Figure 10.4

1 Exhaust system *2 Fuel line assy.*
3 Intake manifold *4 Fuel rail*
5 Airbox

Step	Procedure
1	Remove the exhaust pipes. See Chapter 78-10-00 section Exhaust.
2	Remove the fuel line assy. and outlet if necessary. To do this, see Chapter 73-10-00 section Fuel pump and distribution.
3	Disconnect the wiring harness from the temperature sensor and remove the temperature sensor. To do this, see Chapter 76-70-00 section Sensors and actuators.
4	Loosen 4 hex./torx collar screws M6x20 from the intake manifold.
5	Remove the 2 insulating flanges between the intake manifold and the cylinder head.
6	Disconnect the resistance spark plug connector and remove the spark plugs. See Chapter 74-20-00 section Distribution.

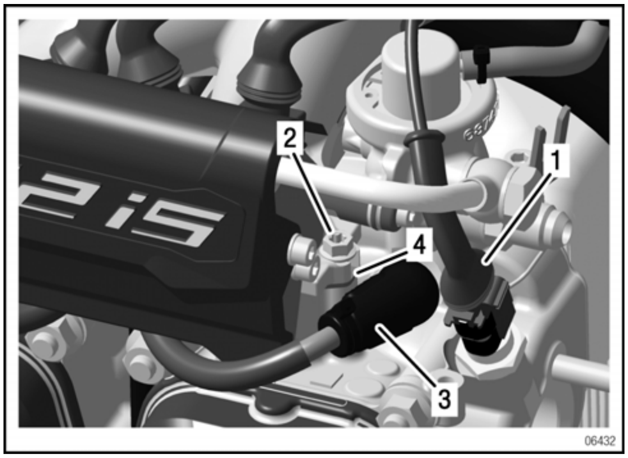

Figure 10.5

1	*Coolant temperature sensor*	2	*Hex./torx collar screw*
3	*Spark plug connector*	4	*Isolating flange*

Step	Procedure
7	Release the attachment of the airbox to the ignition housing.

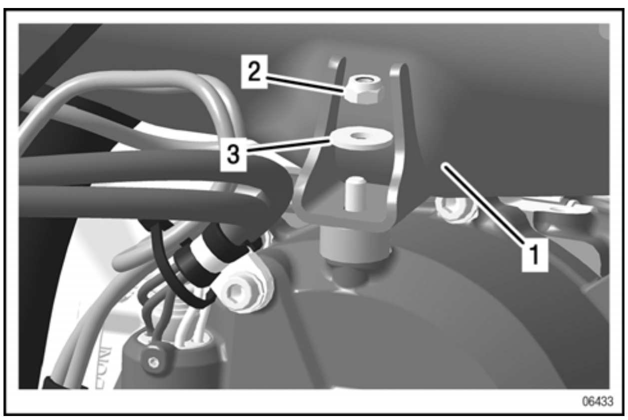

Figure 10.6

1	*Airbox*	2	*Hex. nut*
3	*Washer*		

Step	Procedure
8	Disconnect coolant hoses, see Chapter 75-00-00, section Form hoses — removal.

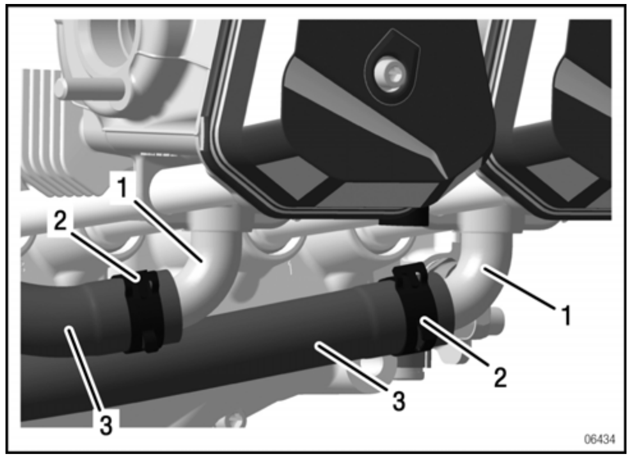

Figure 10.7

1	*Coolant elbow*	2	*Spring type hose clip 25*
3	*Coolant hose*		

Step	Procedure
9	Loosen 2 Allen screws M6x20 along with the washers and remove the elbow flange.

NOTE

There is an O-ring under the elbow flange.

NOTE

Remove the connector brackets on cylinder 3/4.

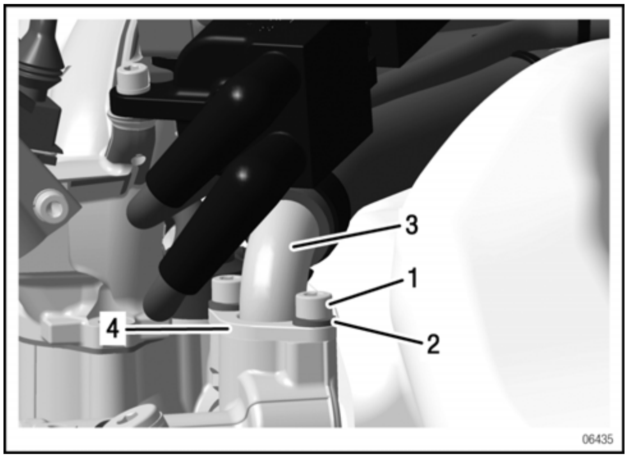

Figure 10.8

1	*Allen screw M6x20*	2	*Washer 6.4*
3	*Coolant elbow*	4	*Elbow flange*

CYLINDER HEAD — REMOVAL

Step	Procedure
1	Loosen the Allen screw with washer.
2	Remove the valve cover with the large and small O-rings.

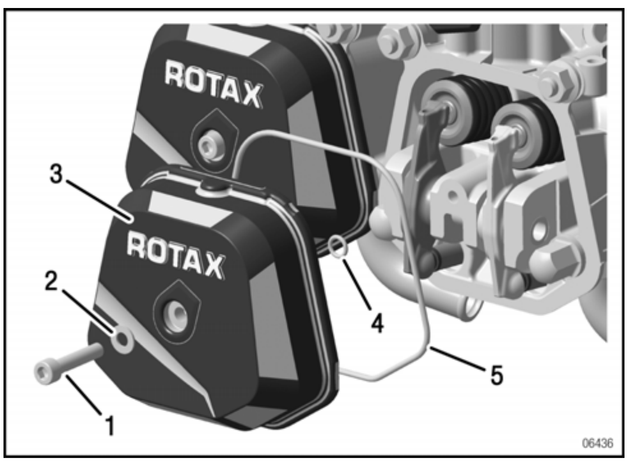

Figure 10.9: Typical

1	*Allen screw*	2	*Washer*
3	*Valve cover*	4	*O-ring 6.4x1.8*
5	*O-ring 105x2.5*		

NOTICE

Do not lose the O-rings!

Step	Procedure
3	Loosen 2 collar nuts and 2 collar cap nuts diagonally.

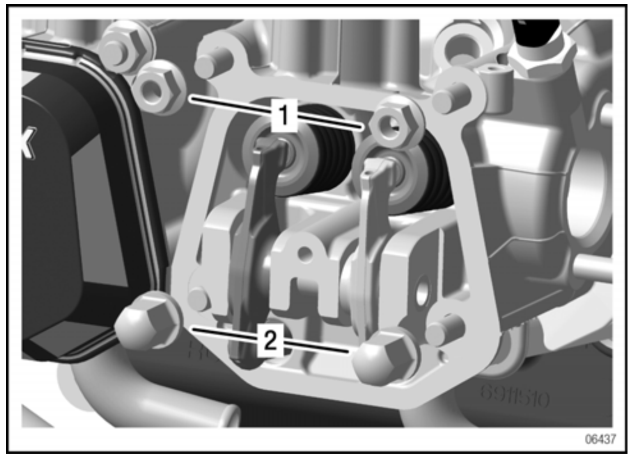

Figure 10.10

1	*Collar nuts*	2	*Collar cap nuts*

Step	Procedure
4	Lift the intake manifold with the fuel rail slightly and carefully pull the entire cylinder head off the cylinder.
5	Hold both push-rods in position in the oil return tubes. Hold the oil bore closed with a finger and remove the cylinder head.
6	Remove O-rings from the oil return tubes and the crankcase.

NOTICE

Damage to the sealing surfaces and the oil return tubes may occur.
Put down the cylinder head in such a manner that the sealing surfaces and the oil return tubes are not damaged.

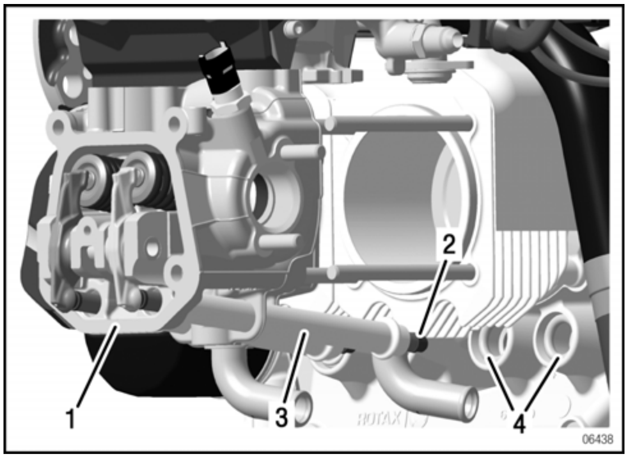

Figure 10.11

1	*Cylinder head assy.*	2	*Push-rod assy.*
3	*Oil return tubes*	4	*O-ring*

Step	Procedure
7	Hold the oil-filled push-rods closed with a finger, remove them and put them down with the corresponding cylinder heads to prevent confusion.

NOTE

Mark the installation position of the push-rod with an appropriate marker.

NOTE

If the parts are installed again with the same position and allocation as before they were removed, the push-rods can be reused. The reason for this is the break-in which takes place on the parts prior to removal.

DISASSEMBLY

CYLINDER HEAD

The cylinder head should be disassembled on a clean surface. There must be enough space to lay out the removed parts to ensure that all the parts can be laid out and allocated according to their installation position.

NOTICE
Danger of consequent damage to engine! During assembly, the valves and all the associated components must be re-installed in their original position. Mark the valves and the associated components correspondingly before removing them.

ROCKER ARM — REMOVAL

NOTICE
The rocker arm shaft should never be forced out.

Step	Procedure
1	Pull out the rocker arm shaft and take out the two rocker arms.

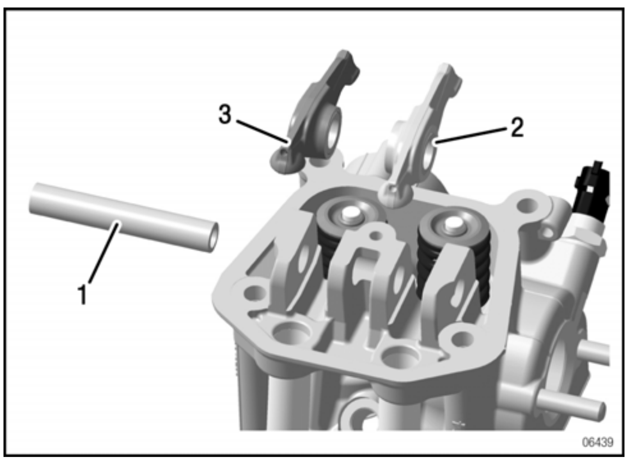

Figure 10.12

1 Rocker arm shaft *2 Right rocker arm*
3 Left rocker arm

VALVE — REMOVAL

NOTICE
Avoid damage to the stem seal or guide. Before taking out the valves, remove any burrs on the valve stem. Mark the valves accordingly.

Step	Procedure
1	Compress the valve springs using the valve spring mounting device part no. 877380 and valve spring collet.
2	Remove the valve cotters.
3	Release the valve spring tension.
4	Remove the valve spring retainer and valve springs with the washer and pull out the valve.
5	Repeat this process for the second valve and clean the cylinder head.

NOTE

There is a valve stem seal only on the intake valve.

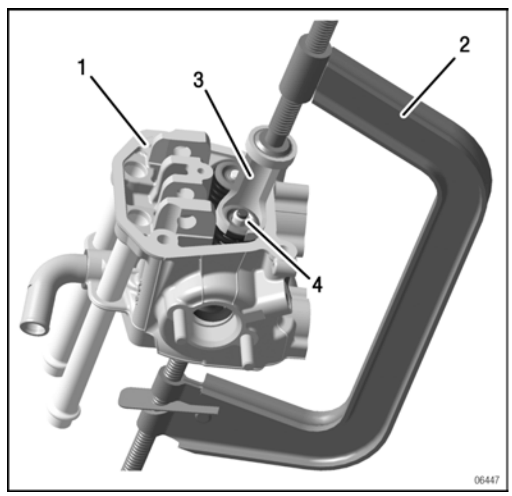

Figure 10.13

1 Cylinder head assy. *2 Valve spring collet*
3 Valve spring mounting device 877380 *4 Valve cotter*

COOLANT ELBOW INLET — REMOVAL

Step	Procedure
1	Heat the coolant elbow with a hot air gun to approx. 100 °C to 120 °C (212 °F to 248 °F).
2	Remove the coolant elbow. **NOTE** *Mark the position of the coolant elbow.*
3	Remove adhesive residues in the bore and check the thread.

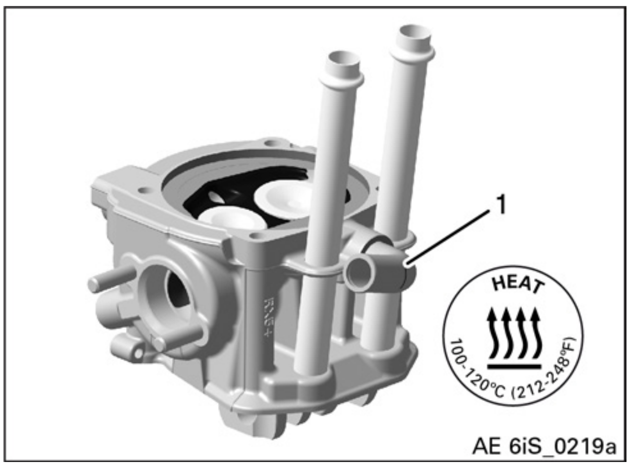

Figure 10.14

1 *Coolant elbow*

OIL RETURN TUBES — REMOVAL

Preparation

General visual inspection. See current Maintenance Manual Line (MML) for the respective engine type.

NOTICE

If there are leaks, the corresponding oil return tubes must be replaced.

Step	Procedure
1	Heat the oil return tubes with a hot air gun to approx. 100 °C to 120 °C (212 °F to 248 °F).
2	Pull out the oil return tube.
3	Remove adhesive residues in the bore.

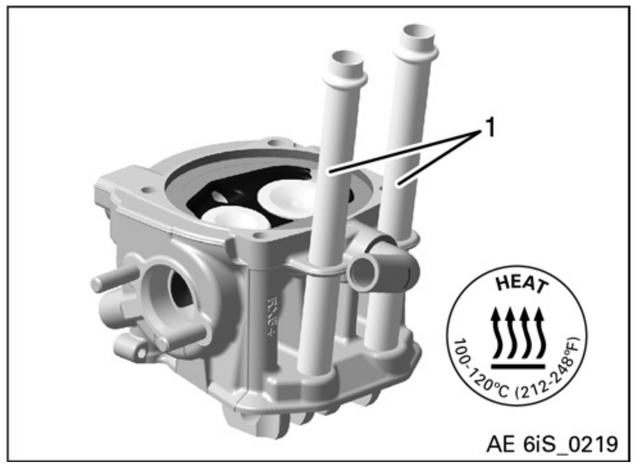

Figure 10.15

1 *Oil return tubes*

COOLANT ELBOW OUTLET — REMOVAL

Step	Procedure
1	Take off the clamp using spring clamp pli-ers part no. 877840.
2	Mark the coolant hoses and the coolant elbows and pull them off.

Step	Procedure
3	Loosen 2 Allen screws with washer. **NOTE** *Remove the connector brackets on cylinder 3/4.*
4	Remove the elbow flange and O-ring.

NOTE

If more than one coolant elbow outlet are removed, they must be numbered.

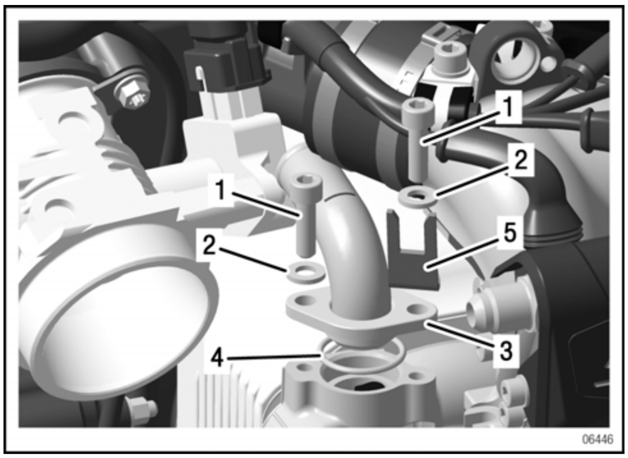

Figure 10.16

1	*Allen screw*	*2*	*Washer*
3	*Elbow flange*	*4*	*O-ring*
5	*Connector bracket*		

Step	Procedure
5	Heat the coolant elbow and elbow flange with a hot air gun to approx. 100 °C to 120 °C (212 °F to 248 °F).
6	Remove the coolant elbow. **NOTE** *Mark the position of the coolant elbow.*
7	Remove adhesive residues in the bore and check the thread.

INSPECTION

CYLINDER HEAD SINGLE PARTS - INSPECTION

Preparation

Clean all parts carefully.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 05-00-00 section Procedure.

CYLINDER HEAD STUDS - INSPECTION

Step	Procedure
1	M8x20/23 studs are used to attach the exhaust manifold. Check that they are securely fitted and undamaged.
2	If replacement is necessary, the stud is installed in such a manner that the longer thread (23 mm (0.91 in.)) is screwed into the cylinder head.
3	Secure studs with LOCTITE 648. Tightening torque 6 Nm (53 in. lb.).

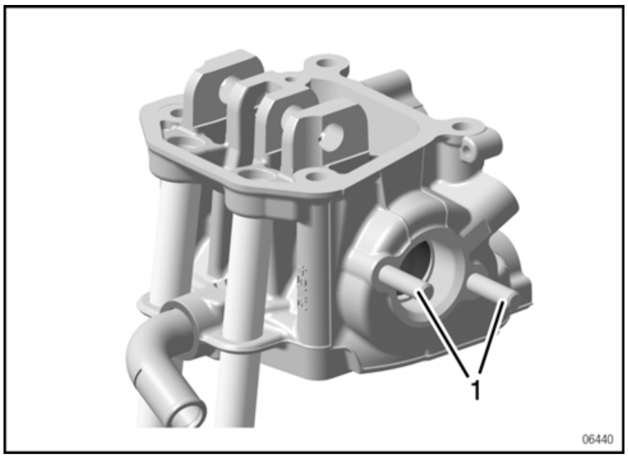

Figure 10.17

1 Stud M8x20/23

CYLINDER HEAD ASSY. — INSPECTION

Step	Procedure
1	Inspect the cone of the exhaust manifold. Indentations and scratches no greater than 0.2 mm (0.0079 in.) are permissible. Bumps no greater than 0.1 mm (0.0039 in.) are permissible.

NOTE

If the sealing cone of the exhaust manifold leaks, post-machining is permissible. In this case the sealing cone has to be overhauled according to the current Overhaul Manual (OHM) for the respective engine type. Overhaul Manual (OHM) and its Appendix are available for any appropriately rated person or entity on request and by following the standards of the original manufacturer.

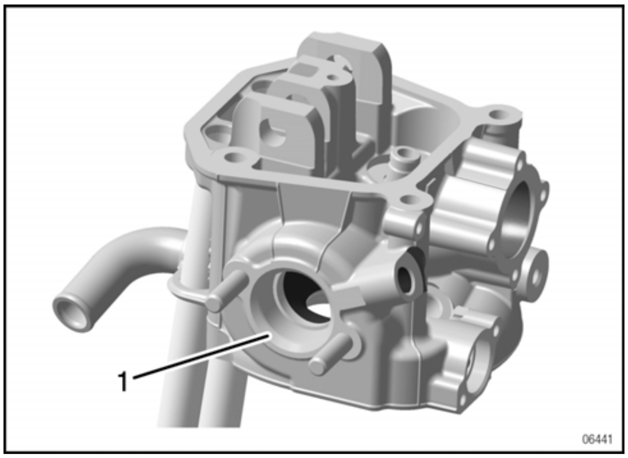

Figure 10.18

1 Cone (exhaust manifold)

NOTICE

Cracks in the cylinder head are not permissible! If in doubt, inspect the affected parts for cracks.

Step	Procedure
2	Check the spark plug bore. Check the thread for damage.
3	Check the sealing surface of the cylinder block.

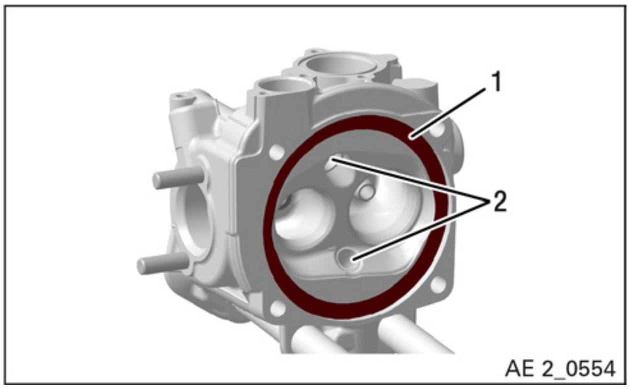

Figure 10.19

1 Sealing surface *2 Spark plug bore*

HARDNESS TEST METHOD

NOTICE

If the engine has been overheated, a hardness test of the cylinder head is necessary.

See current Maintenance Manual Line (MML) for the respective engine type.

The hardness test takes place at measurement point CH08.

CH08: HB2,5/62,5 DIN EN ISO 6506-2

NOTICE

The results of the hardness test must be noted in Chapter 72-30-00, subsection: Wear limits.

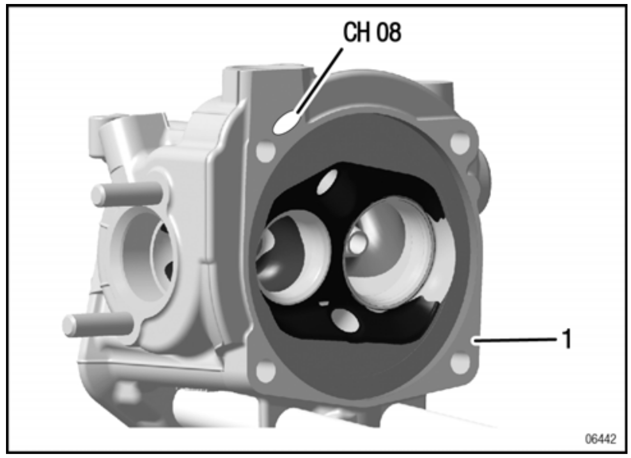

Figure 10.20

1 Cylinder head

VALVE GUIDE — INSPECTION

NOTICE

If the wear limit has been reached, the valve guide must be replaced.

Step	Procedure
1	Check the valve guide visually for damage and wear.
2	Inspect the inner diameter of the valve guide (CH01), see section Wear limits.

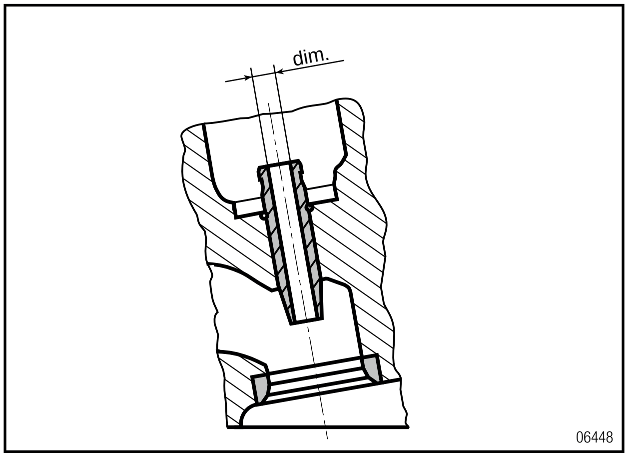

Figure 10.21

VALVE - INSPECTION

NOTICE

Replace the valve if the valve stem is out of specification, is damaged or shows traces of wear.

Step	Procedure
1	Check the valve visually for damage and wear.
2	Determine the valve stem diameter and check the valve disc for wear.
3	Check the valve end face for pitting.
4	Check the valve stem for any deposits.

NOTE

The valve stem diameter VT01 is measured in the edge region of the running surface of the valve stem.

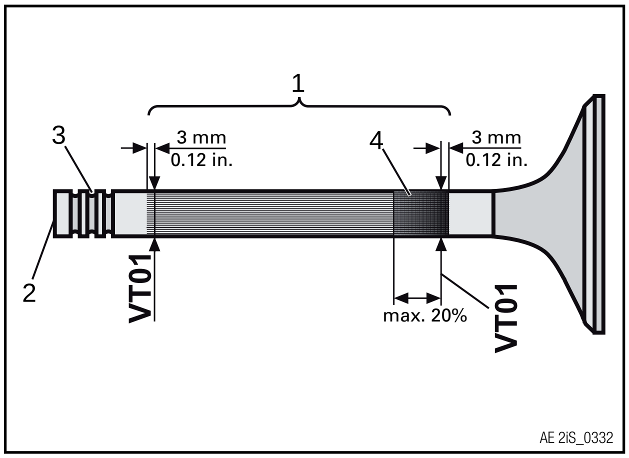

Figure 10.22

1	*Valve stem*	*2*	*Valve end face*
3	*Retaining grooves*	*4*	*Max. oil residues*

NOTICE
Risk of valve fracture at the weld point. Oil residues up to **max. 20 %** of the running surface are permissible.At greater values, the valve may have already been overheated and must be replaced.

Step	Procedure
5	The 3 retaining grooves on the valve stem must be visually inspected for damage and wear.

NOTE

A new valve cotter must be inserted for the wear check. This must have no perceptible axial clearance.

Step	Procedure
6	Place the valve on roller blocks, roll it and measure the max. permissible out of true value VT02 on the valve disk using a dial gauge. See Chapter 72-30-00 section .

NOTE

The out of true value can also be measured with the dial gauge adapter assembly part no. 976140.

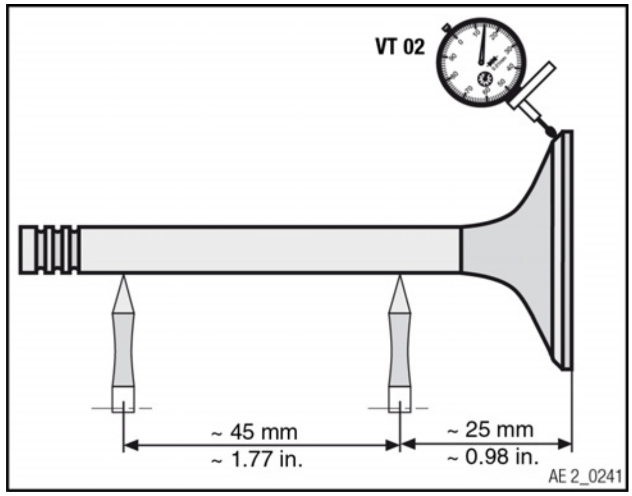

Figure 10.23

Step	Procedure
7	Check the valve face for wear caused by pounding VT03. See Chapter 72-30-00 section .

NOTICE
The end of the valve stem must not be ground.

VALVE SEATS - INSPECTION

Step	Procedure
1	Check the valve seat faces visually for damage and wear.
2	Lubricate the valve seat faces evenly with touch up paste and install the valves in the corresponding valve guides.
3	Turn the valves with moderate pressure so that a clear print of the sealing surface is produced on the valve seat ring.
4	Check that the seal fits properly, if necessary touch up small variances with valve lapping paste.

NOTICE

The ring-shaped print on the valve seat faces of the valve seat rings must be continuous and have no breaks. The width of the print corresponds to the valve seat width CH02.

NOTICE

If there are burn marks or distortion, the cylinder head has to be overhauled according to the current Overhaul Manual (OHM) for the respective engine type. Overhaul Manual (OHM) and its appendix is available for any appropriately rated person or entity on request and by following the standards of the original manufacturer.

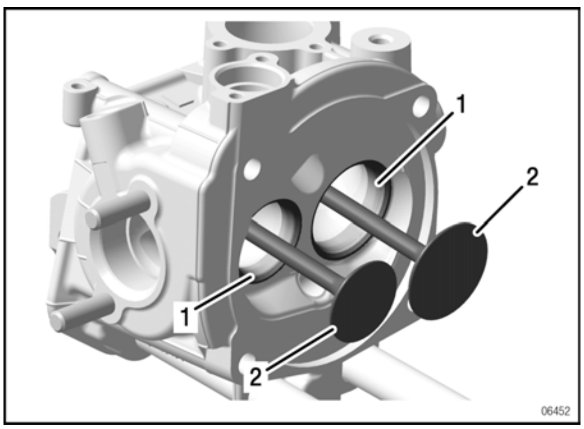

Figure 10.24

1 Valve seat ring *2 Valve*

Step	Procedure
5	Check the valve seat width CH02.

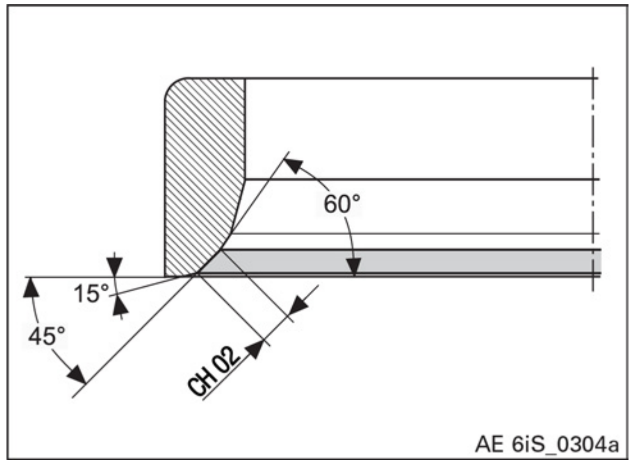

Figure 10.25

VALVE SPRING - INSPECTION

Step	Procedure
1	Check the valve springs visually for damage such as fracture, deformation.

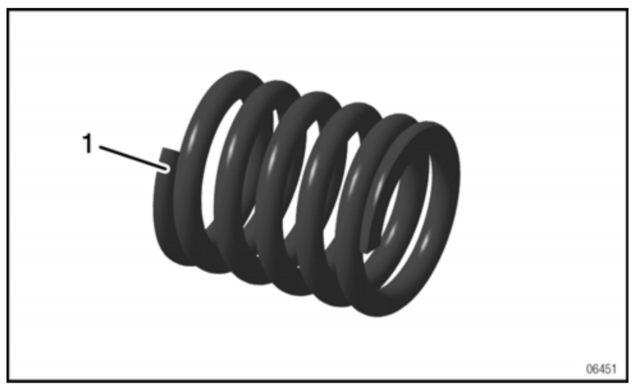

Figure 10.26

1 Valve spring

SPRING FORCE MEASUREMENT

For the measurement necessary tools are available on the free market.

Step	Procedure
1	Apply a test load (F) and measure the remaining spring length VT04.
2	Replace valves shorter than the minimum length.

Test load for single valve spring configuration	
Single valve spring	200 N (45 lbf)

NOTE

The spring length should be as equal as possible on the inlet and outlet sides (max. 0.4 mm (0.016 in) in difference), otherwise replace the springs.

WASHER - INSPECTION

Step	Procedure
1	Check the washers visually for damage and wear.

The wear must be measured starting from the reference face (on the inner part of the valve spring support) radially outwards in the measurement region, using a dial gauge. **Dimension t = max. 0.04 mm (0.0016 in)**.
Wear of more than 0.04 mm is not permissible. If this value is exceeded, the valve, the valve spring support, the valve spring retainer, the valve cotter and the hydraulic valve tappet or other damaged components in the affected valve drive must always be replaced.

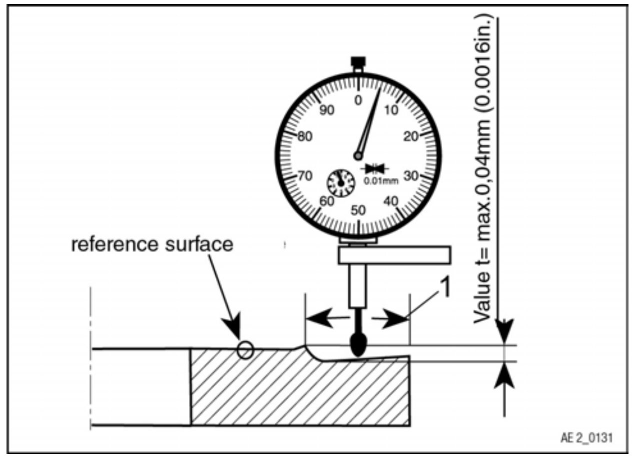

Figure 10.27: Typical

1 *Measurement region*

NOTE

The valve spring support can be used as an indicator of a malfunction of the valve drive relating to poorly or insufficiently purged hydraulic valve tappets. In normal conditions, no measurable wear can be seen even after a relatively long operating time.

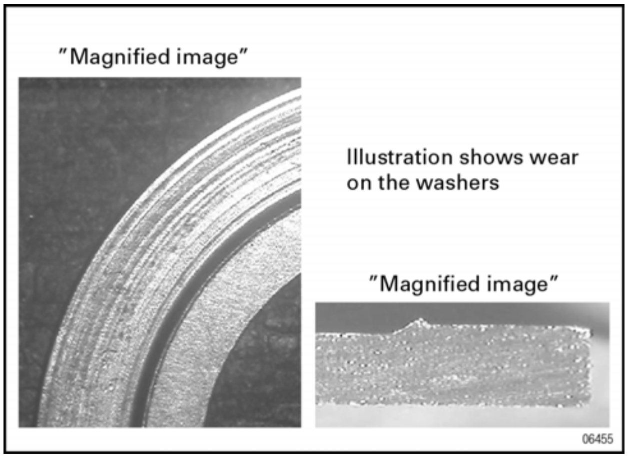

Figure 10.28

ROCKER ARM AND ROCKER ARM SHAFT - INSPECTION

System description

The rocker arm bearing is lubricated by the hollow drilled push-rod of the ball joint socket. The rocker arm bearing is supplied with oil via the oil ducts in the rocker arm. The oil exits and thus lubricates the rest of the valve mechanism via the bore. The rocker arms for the inlet and outlet are different.

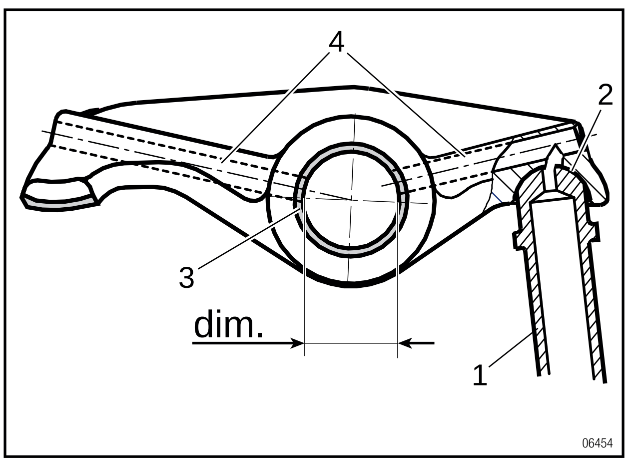

Figure 10.29

1	*Push-rod*	2	*Ball joint*
3	*Rocker arm bushing*	4	*Oil ducts*

Step	Procedure
1	Check the surface of the rocker arm shaft and the inner diameter of the rocker arm bushing for traces of wear.
2	Check the valve support surface and ball joint of the rocker arm.
3	Check oil bores in the rocker arm for free passage.

NOTICE

If excessive wear is visible in the rocker arm bearing, this indicates a lack of oil. The support surface for the valve stem can be re-machined a little bit.

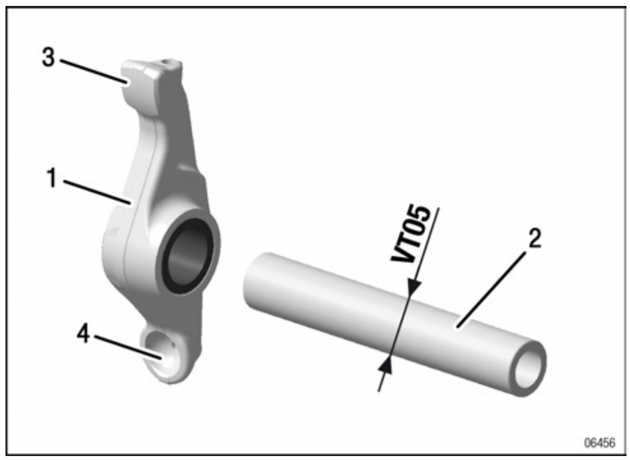

Figure 10.30

1	*Rocker arm*	2	*Rocker arm shaft*
3	*Valve guide*	4	*Ball joint*

Step	Procedure
4	Measure the rocker arm shaft bearing (CH05) if it is worn.

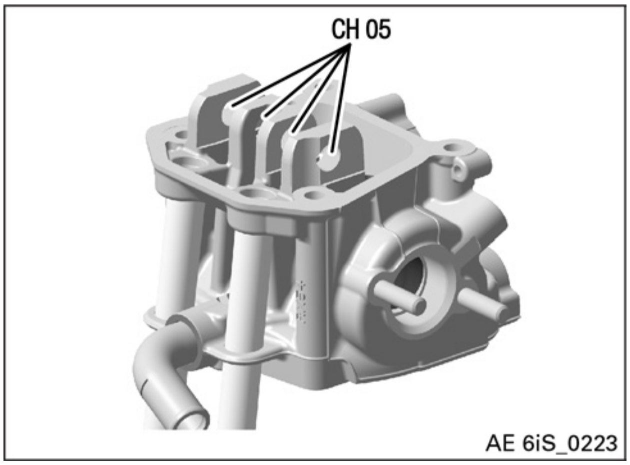

Figure 10.31

ROCKER ARM BUSHING - INSPECTION

With the rocker arm bushings (plastic bushing), ensure that the plastic bushing is slide-fit. This can rotate relative to the rocker arm bore after installation too. The rocker arm bushing is therefore provided with an outer circular groove to allow oil supply. The rocker arm bushing can be installed independently of position.

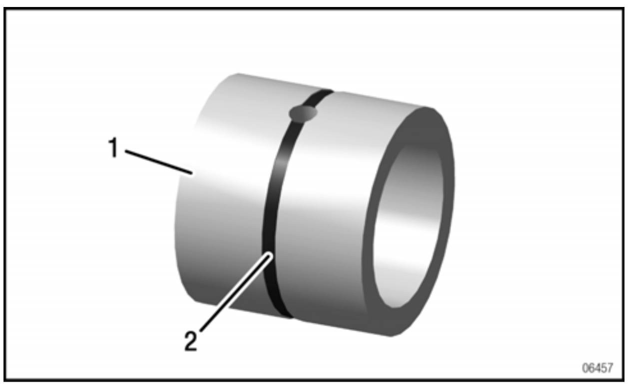

Figure 10.32

1 Rocker arm bushing *2 Groove*

PUSH ROD – INSPECTION

NOTICE

Excessive engine speed can cause bending of the push rods.

Step	Procedure
1	Clean push rods and carry out a visual inspection.

NOTE

Make sure that the two ball heads pressed into the rod fit tightly.

NOTE

Lube oil from the hydraulic valve tappet passes the rocker arm through the bore.

Step	Procedure
2	Roll push rods and check for run out, see section Wear limits (VT09).

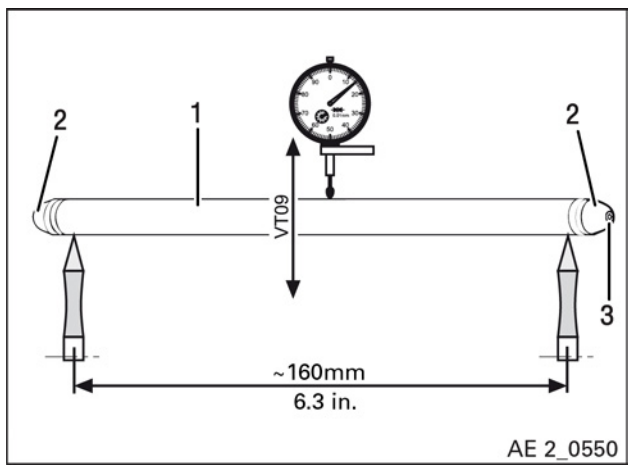

Figure 10.33

1 Push rod *2 Ball heads*
3 Bore

WEAR LIMITS

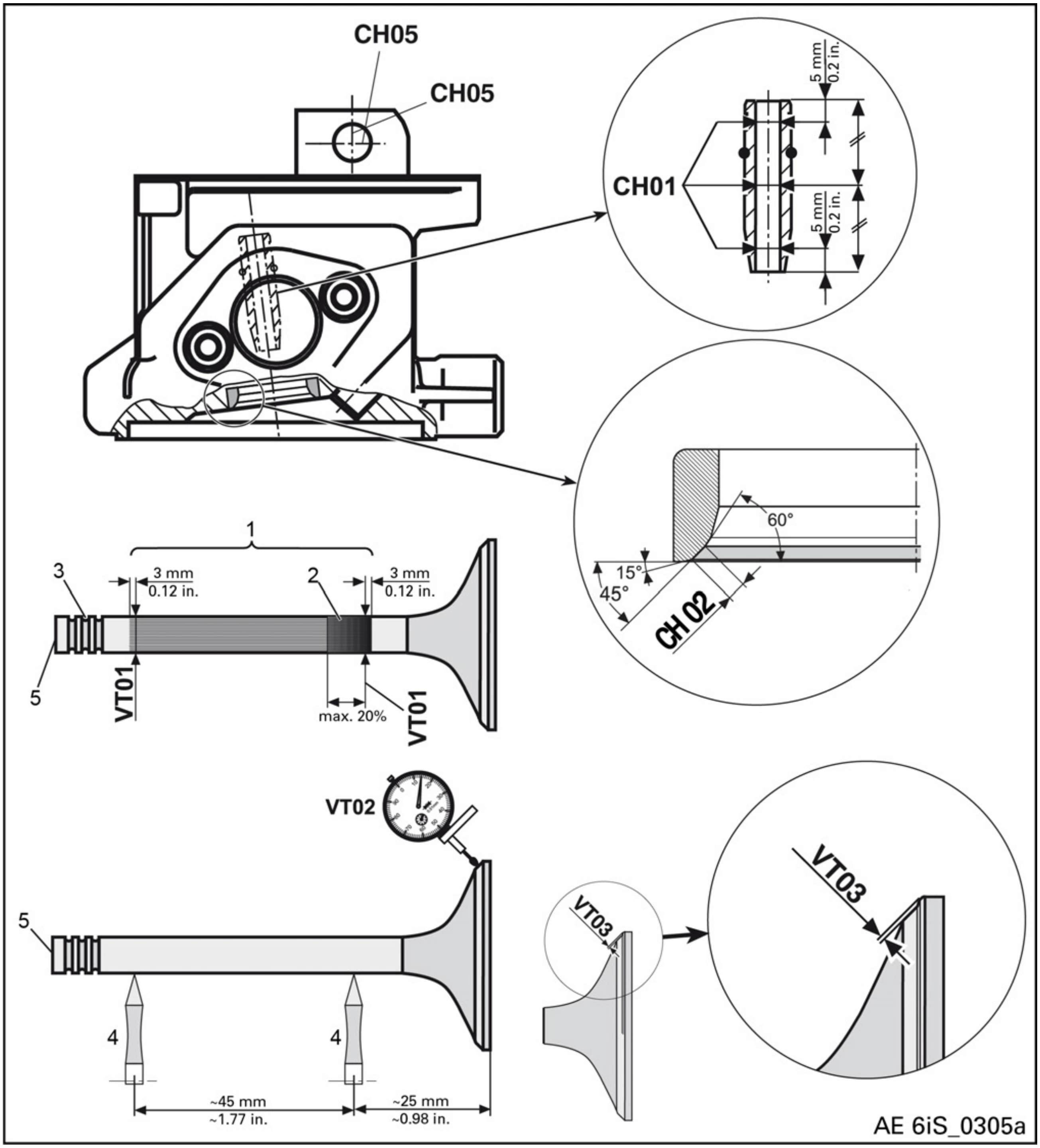

Figure 10.34: Wear Limits

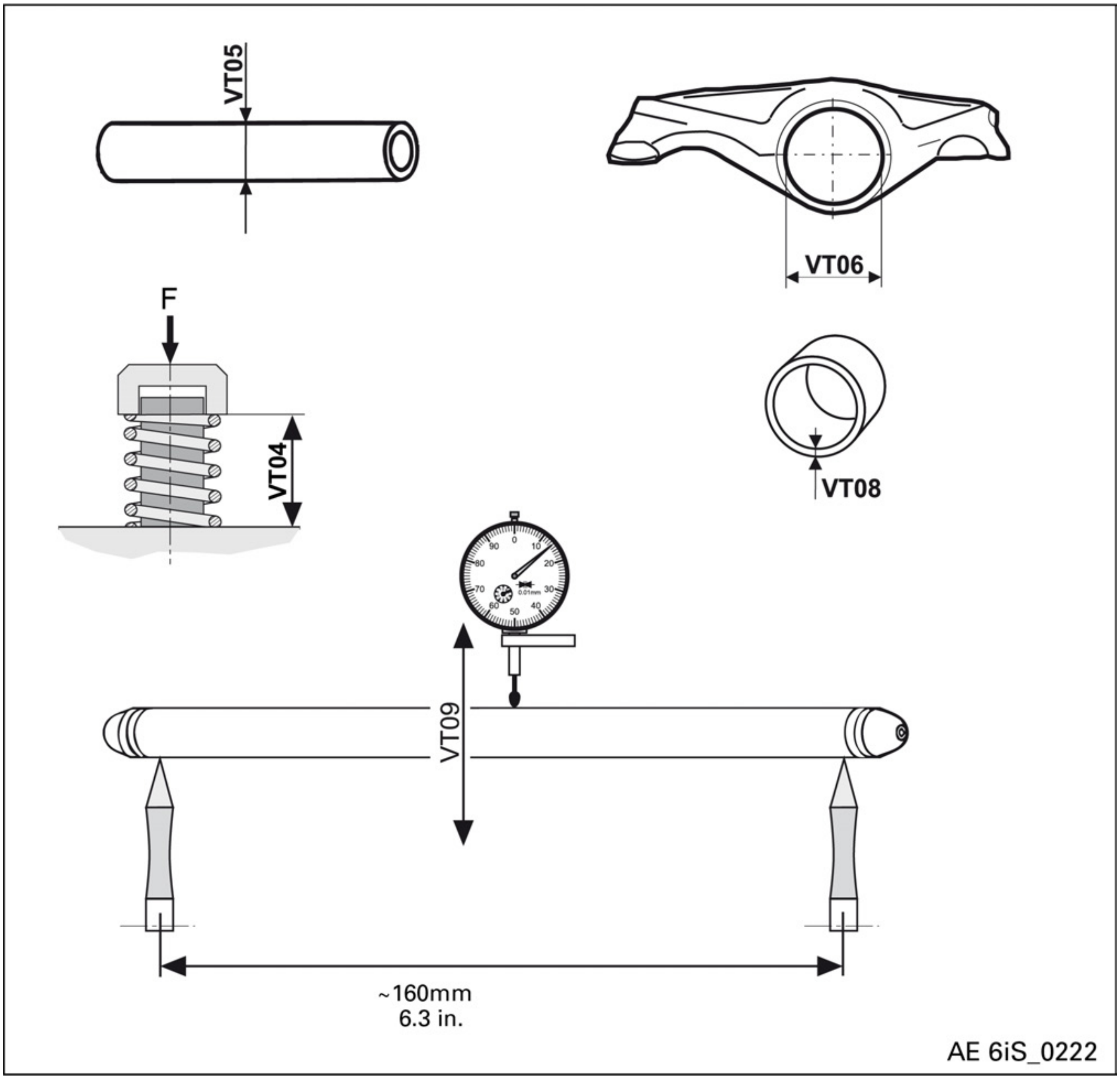

Figure 10.35: Wear Limits

Description		Code	Current measurement value min	Current measurement value max	Tolerance limit 100 %	Tolerance limit 50 %		Measurements Cy. 1	Cy. 2	Cy. 3	Cy. 4
Cylinder head											
Valve guide bore inner diam.	Intake valve	CH01	7.01 mm 0.2758 in.	7.018 mm 0.2763 in.	7.150 mm 0.2815 in.	7.084 mm 0.2789 in.	current re-placed				
	Exhaust valve	CH01	7.006 mm 0.2758 in.	7.018 mm 0.2763 in.	7.150 mm 0.2815 in.	7.084 mm 0.2789 in.	current re-placed				
Width of valve seat	Intake valve	CH02	1.4 mm 0.0551 in.	1.9 mm 0.0748 in.	2.4 mm 0.0945 in.	2.150 mm 0.0846 in.	current re-placed				
	Exhaust valve	CH02	2.5 mm 0.0984 in.	3.0 mm 0.1181 in.	3.5 mm 0.1378 in.	3.25 mm 0.1280 in.	current re-placed				
Hardness test		CH08	85 HB				current re-placed				
Valves											
Diameter of valve stem	Intake valve	VT01	6.965 mm 0.2742 in.	6.980 mm 0.2748 in.	6.940 mm 0.2732 in.	6.953 mm 0.2737 in.	current re-placed				
	Exhaust valve	VT01	6.965 mm 0.2742 in.	6.980 mm 0.2748 in.	6.940 mm 0.2732 in.	6.953 mm 0.2737 in.	current re-placed				
Backlash Valve guide/ valve stem	Intake valve	CH01/ VT01	0.026 mm 0.0010 in.	0.053 mm 0.0021 in.	0.150 mm 0.0059 in.	0.102 mm 0.0040 in.	current re-placed				
	Exhaust valve	CH01/ VT01	0.026 mm 0.0010 in.	0.053 mm 0.0021 in.	0.150 mm 0.0059 in.	0.102 mm 0.0040 in.	current re-placed				
Out of round	Intake valve	VT02	0.00 mm 0.0000 in.	0.03 mm 0.0012 in.	0.04 mm 0.0016 in.	0.035 mm 0.0014 in.	current re-placed				
	Exhaust valve	VT02	0.00 mm 0.0000 in.	0.03 mm 0.0012 in.	0.04 mm 0.0016 in.	0.035 mm 0.0014 in.	current re-placed				

Description		**Code**	**Current measurement value**		**Tolerance limit**	**Tolerance limit**		**Measurements**			
			min	**max**	**100 %**	**50 %**					
Wear on Valve disc	Intake valve	VT03	0.00 mm 0.0000 in.	0.00 mm 0.0000 in.	0.2 mm 0.0080 in.	0.1 mm 0.0040 in.	current re- placed				
	Exhaust valve	VT03	0.00 mm 0.0000 in.	0.00 mm 0.0000 in.	0.2 mm 0.0080 in.	0.1 mm 0.0040 in.	current re- placed				
Length of valve spring at test, load each	Intake valve	VT04	32.4 mm 1.276 in.	33.6 mm 1.323 in.	32.0 mm 1.260 in.	32.2 mm 1.2680 in.	current re- placed				
	Exhaust valve	VT04	32.4 mm 1.276 in.	33.6 mm 1.323 in.	32.0 mm 1.260 in.	32.2 mm 1.2680 in.	current re- placed				
Rocker arm											
Bore for rocker arm shaft	Intake valve	CH05	12.000 mm 0.4724 in.	12.018 mm 0.4731 in.	12.090 mm 0.4760 in.	12.054 mm 0.4746 in.	current re- placed				
	Exhaust valve	CH05	12.000 mm 0.4724 in.	12.018 mm 0.4731 in.	12.090 mm 0.4760 in.	12.054 mm 0.4746 in.					

Description		Code	Current measurement value min	Current measurement value max	Tolerance limit 100 %	Tolerance limit 50 %		Measurements			
Rocker arm											
Diameter of Rocker arm shaft	Intake valve	VT05	11.983 mm 0.4718 in.	11.994 mm 0.4722 in.	11.950 mm 0.4705 in.	11.967 mm 0.4711 in.	current re-placed				
	Exhaust valve	VT05	11.983 mm 0.4718 in.	11.994 mm 0.4722 in.	11.950 mm 0.4705 in.	11.967 mm 0.4711 in.	current re-placed				
Radial clearance Bore/ rocker arm shaft	Intake valve	CH05 /VT05	0.006 mm 0.0002 in.	0.035 mm 0.0014 in.	0.150 mm 0.0059 in.	0.093 mm 0.0036 in.	current re-placed				
	Exhaust valve	CH05 /VT05	0.006 mm 0.0002 in.	0.035 mm 0.0014 in	0.150 mm 0.0059 in.	0.093 mm 0.0036 in.	current re-placed				
Rocker arm bushing (plastic)	Intake valve	VT06	16.000 mm 0.6299 in.	16.018 mm 0.6306 in.	16.038 mm 0.6314 in.	16.028 mm 0.6310 in.	current re-placed				
	Exhaust valve	VT06	16.000 mm 0.6299 in.	16.018 mm 0.6306 in.	16.038 mm 0.6314 in.	16.028 mm 0.6310 in.	current re-placed				
Wall thickness of rocker arm shaft (plastic)	Intake valve	VT08	1.95 mm 0.0768 in.	1.98 mm 0.0780 in.	1.90 mm 0.0748 in.	1.93 mm 0.0758 in.	current re-placed				
	Exhaust valve	VT08	1.95 mm 0.0768 in.	1.98 mm 0.0780 in.	1.90 mm 0.0748 in.	1.93 mm 0.0758 in.	current re-placed				
Push-rod assy.											
Deflection of Push-rod	Intake valve	VT09	0.000 mm 0.0000 in.	0.100 mm 0.0039 in.	0.200 mm 0.0079 in.	0.150 mm 0.0059 in.	current re-placed				
	Exhaust valve	VT09	0.000 mm 0.0000 in.	0.100 mm 0.0039 in.	0.200 mm 0.0079 in.	0.150 mm 0.0059 in.	current re-placed				

ASSEMBLY

CYLINDER HEAD — ASSEMBLY

Preparation

- Clean all parts carefully.

NOTICE
Check sealing surface for damage! Remove carbon residues!

NOTICE
Sandblasting on valves is not allowed (as cleaning method).

OIL RETURN TUBE INSTALLATION

Step	Procedure
1	Secure the oil return tube with LOCTITE 648 and install it in the cylinder head.
2	Allow the cylinder head to harden for at least 12 hours at room temperature.

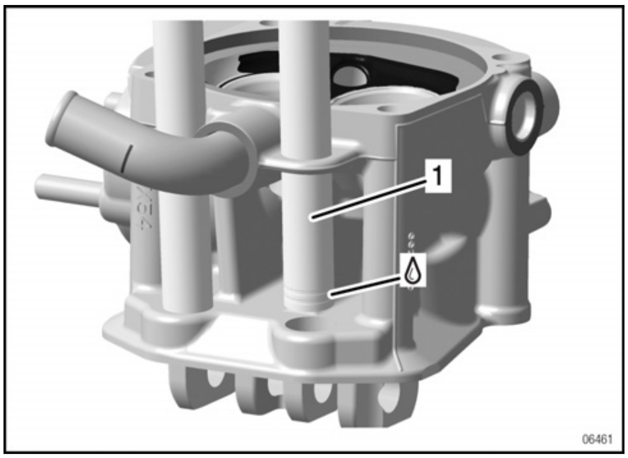

Figure 10.36

1 Oil return tube

NOTE

To prevent leakage between oil return tube and cylinder head, roughen the contact surfaces before lubrication with LOCTITE 648.

COOLANT ELBOW INLET – INSTALLATION

Step	Procedure
1	Secure the coolant elbow with LOCTITE 577 and install the elbow in the cold cylinder head. **NOTE** *The coolant elbow must be screwed in at least 4 turns.*

NOTE

Also apply LOCTITE 577 to the thread in the cylinder head.

Step	Procedure
2	Allow the cylinder head to harden for at least 12 hours at room temperature.

NOTE

If the sealing surface of the cylinder has carbon residues, it must be removed carefully.

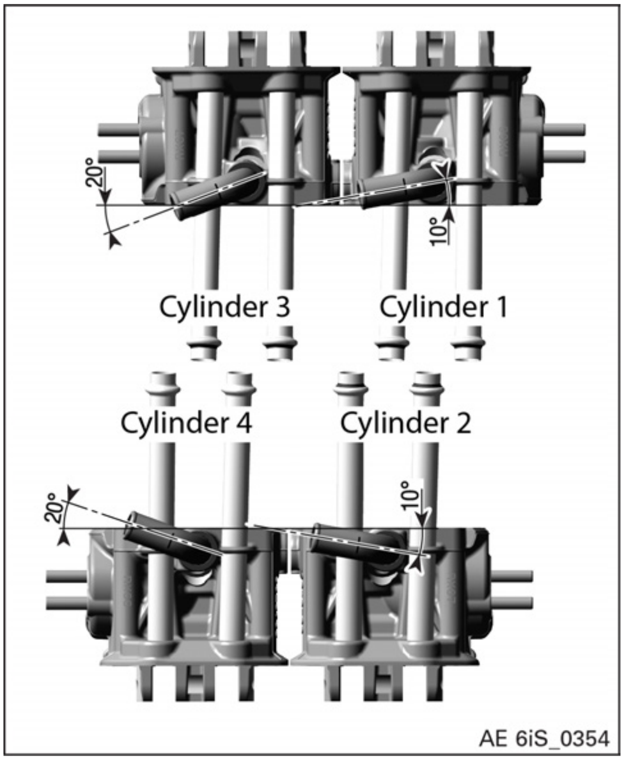

Figure 10.37

COOLANT ELBOW OUTLET — ASSEMBLY

Step	Procedure
1	Secure the coolant elbow with LOCTITE 577 and install the elbow in the cold elbow flange. **NOTE** *The coolant elbow must be screwed in at least 4 turns.*

NOTE

Also coat the thread in the elbow flange with LOCTITE 577.

Step	Procedure
2	Allow the elbow flange to harden for at least 12 hours at room temperature.

NOTE

Remove excess LOCTITE.

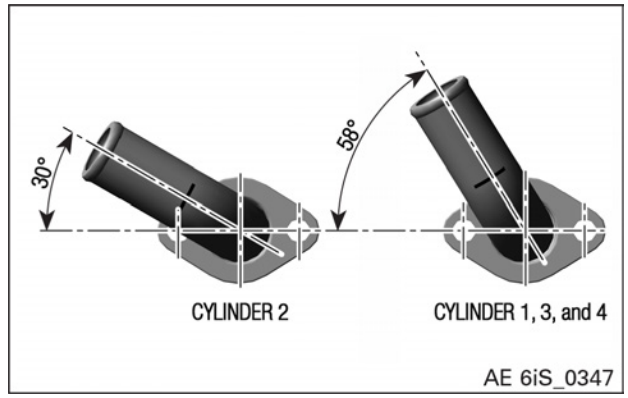

Figure 10.38

COOLANT ELBOW — INSTALLATION

Step	Procedure
1	Install a new O-ring 19x2 in the cylinder head.
2	Fasten the coolant elbow with 2 Allen screws M6x20 and washers 6.4. Tightening torque 10 Nm (89 in. lb.).

NOTE

Install the connector brackets on cylinder 2/4.

NOTE

Installation position: 30° coolant elbow on cyl. 2 and 58° coolant elbow on cyl. 1, 3 and 4.

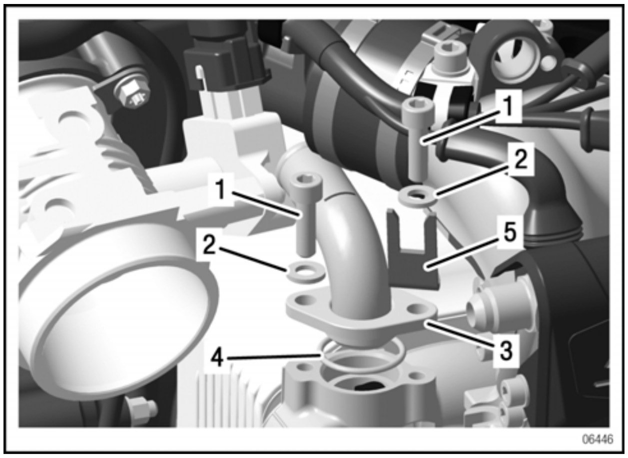

Figure 10.39

1	*Allen screws M6x20*	2	*Washers 6.4*
3	*Elbow flange*	4	*O-ring 19x2*
5	*Connector brackets*		

VALVE INSTALLATION

NOTICE
Risk of engine damage if damaged parts are installed! All parts must be measured and assessed before installation. All moving parts must be lubricated with engine oil before installation!

NOTICE
Oil residues up to max. 20% of the running surface are permissible.

Step	Procedure
1	Place shim 16/27.9/1 onto the valve guide and install a new valve stem seal on the intake side.
2	Lubricate the valve stem with engine oil and push the intake valve from outside into the valve guide.

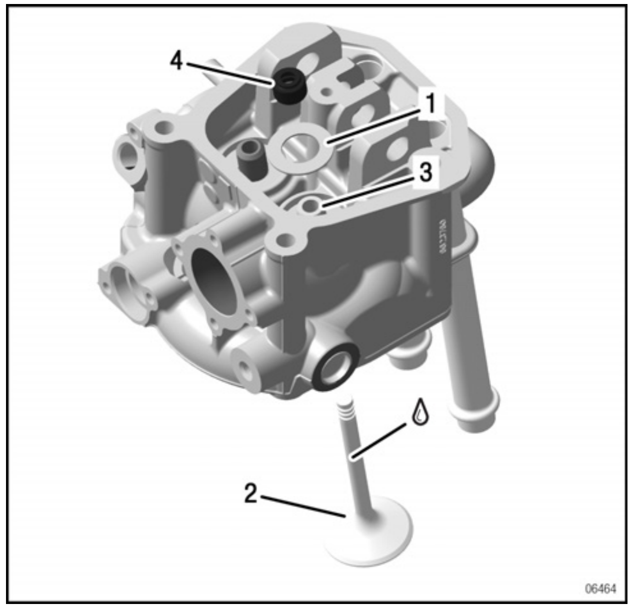

Figure 10.40

1	*Washer 16/27.9/1*	2	*Intake valve*
3	*Valve spring retainer*	4	*Valve stem seal*

Step	Procedure
3	Install the valve springs and the valve spring retainer

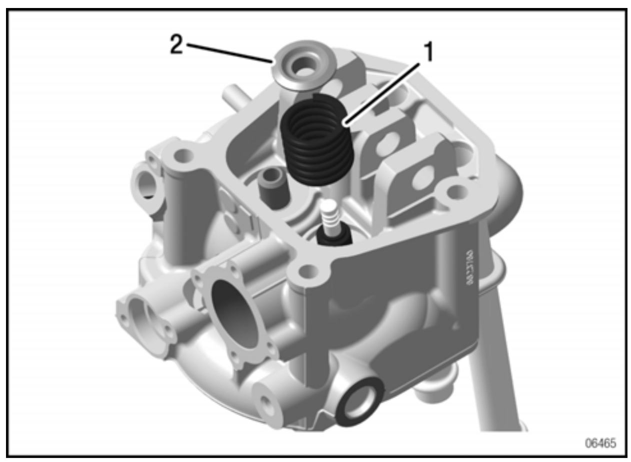

Figure 10.41

1	*Valve spring*	2	*Valve spring retainer*

Step	Procedure
4	Compress valve springs with the mounting device part no. 877380 and collet.
5	Insert the valve cotters and de-tension the valve springs.
6	Carry out the same procedure for the exhaust valve.

NOTE

Ensure they are positioned correctly and that there is a uniform gap between the valve cotters.

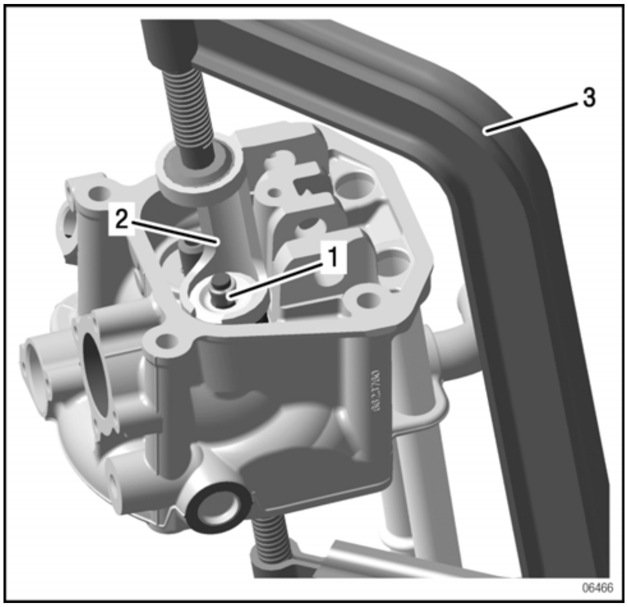

Figure 10.42

1 Valve cotter *2 Mounting device 877380*
3 Collet

ROCKER ARM — INSTALLATION

NOTICE

Do not use force! The rocker arm bearing is slide fit.

Step	Procedure
1	Lubricate the rocker arm shaft (on both sides), rocker arm bore and valve spring support with engine oil.
2	Bring the intake rocker arm and the exhaust rocker arm with the rocker arm bushing into position depending on the state of construction.
3	Insert the rocker arm shaft.

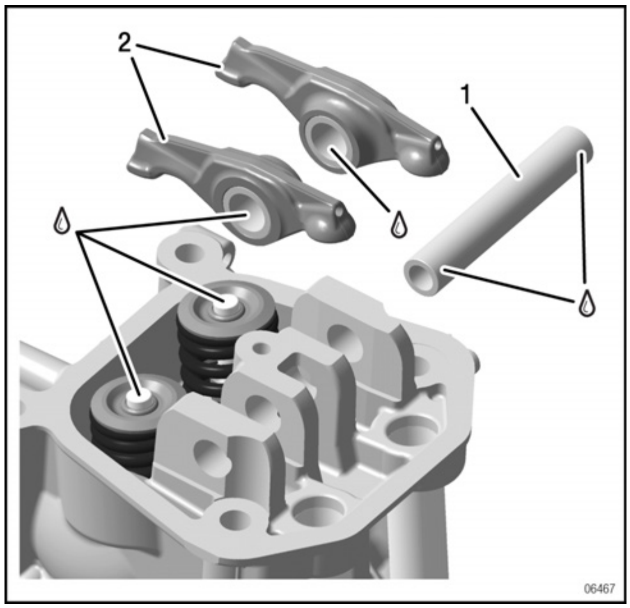

Figure 10.43

1 Rocker arm shaft *2 Rocker arm*

INSTALLATION

CYLINDER HEAD – INSTALLATION

Preparation

- Clean all parts carefully.
- Lightly grease or lubricate O-rings and gaskets.
- New studs must be installed, see Chapter 72-30-10, section Studs – installation

NOTICE

Studs (expansion screws) may only be used once.

NOTICE

To ensure constant tightening torque, lightly lubricate the flat surfaces of the collar cap nuts.

NOTICE

Place the cylinder at TDC. The valves are then in overlap. This prevents a situation in which a valve is open and the cylinder head lifts off again from the cylinder head gasket face. Otherwise the oil return line O-rings can be damaged.

Step	Procedure
1	Install the corresponding push-rods in the oil return lines.
2	Lubricate the push-rod heads with LOCTITE ANTI SEIZE.
3	Lubricate new O-ring 16x5 with engine oil and install it on the oil return tube.

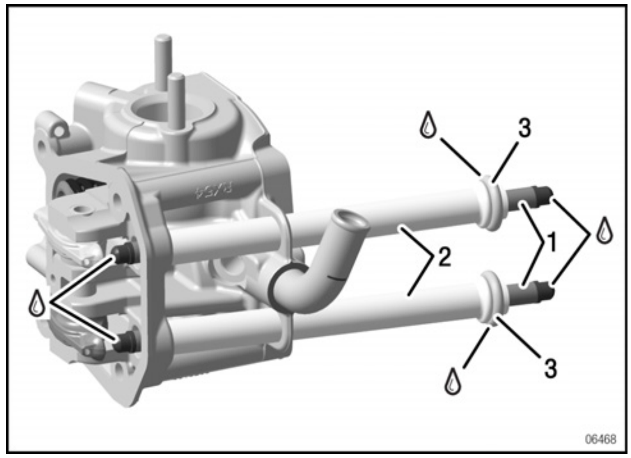

Figure 10.44

1 Push-rods *2 Oil return tubes*
3 O-ring 16x5

NOTE

The intake manifold with the fuel rail must be raised slightly for part repairs.

Step	Procedure
4	Place on the cylinder head until the O-rings of the two oil return lines rest in the crankcase.
5	Raise the cylinder until the centring collar of the cylinder engages in the cylinder head recess.

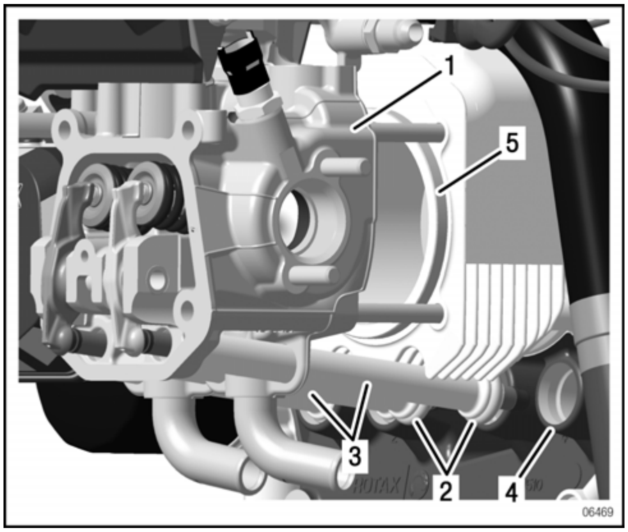

Figure 10.45

1	*Cylinder head assy.*	2	*O-ring*
3	*Oil return tubes*	4	*Crankcase*
5	*Centring collar of cylinder*		

NOTICE

O-rings must be seated into the crankcase at the same time as cylinder head is tightened onto cylinder.

Step	Procedure
6	Clean and degrease all threads of studs. **NOTE** *Collar cap M8 and collar nuts M8 also must be clean and free from residues.*
7	Squeeze the cylinder head and the cylinder together by hand and push towards crankcase. **NOTE** *A slight “click” can be heard as they align together.*
8	Lubricate the contact area for the collar cap nuts M8 with grease. **NOTE** *No grease for collar nuts M8 contact areas!*
9	Hand-tighten 2 M8 collar cap nuts M8 and 2 collar nuts M8 diagonally (maximum 5 Nm/44 in.lb), until cylinder head rests on cylinder.

NOTE

If necessary, repeat the process for the other cylinder heads.

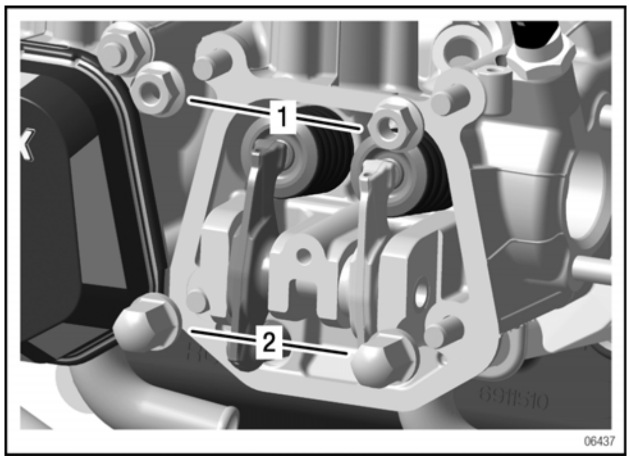

Figure 10.46

1	*Collar nut M8*	2	*Collar cap nut M8*

CYLINDER HEAD (SINGLE) REPAIRED PER ENGINE SIDE

Step	Procedure
1	Position the insulating flange between the intake manifold and the cylinder head.
2	Install the intake manifold on the cylinder head which has not been removed with 2 hex./torx collar screws M6x20. Tightening torque 10 Nm (89 in. lb.).

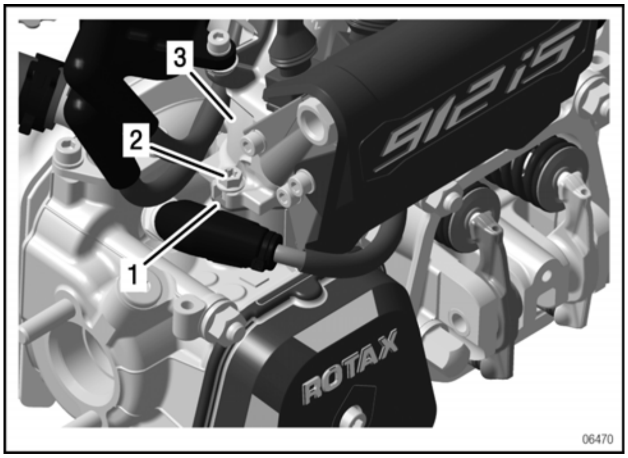

Figure 10.47

1	*Insulating flange*	2	*Hex./torx collar screw M6x20*
3	*Intake manifold*		

Step	Procedure
3	Align the second cylinder head on the intake manifold and fasten it with 2 hex./torx collar screws M6x20. Tightening torque 10 Nm (89 in. lb.).
4	See section Cylinder head — tightening torque procedure.

NOTE

This aligns the cylinder heads to ensure a flat support for the intake manifold.

CYLINDER HEADS (BOTH) REPAIRED PER ENGINE SIDE

NOTE

Assemble with clean parts only! Remove any residual carbon or oil from the mating surfaces of cylinder heads and cylinders.

Step	Procedure
1	Clean and degrease all threads of studs. **NOTE** *Collar cap nuts M8 and collar nuts M8 also must be clean and free from residues.*
2	Squeezes the cylinder head and the cylinder together by hand and push towards crankcase. **NOTE** *A slight “click” can be heard as they align together.*
3	Lubricate the contact area for the collar cap nuts M8 with grease. **NOTE** *No grease for collar nuts M8 contact areas!*
4	Hand-tighten 2 collar cap nuts M8 and 2 collar nuts M8 evenly (maximum 5 Nm/44 in. lb), until cylinder head rests on cylinder. **NOTE** *Same procedure for the second cylinder.*

CYLINDER HEAD — TIGHTENING TORQUE PROCEDURE

NOTE

The installation and tightening of a single cylinder head or any individual cylinder head nut is not allowed. The entire procedure to torque both cylinder heads together in one torque sequence must be performed. This aligns the cylinder heads to ensure a flat support for the intake manifold.

Step	Procedure
1	Attach the cylinder aligning tool part no. 877262 to the intake flange of the cylinder heads with 4 Allen screws M6x25 and tighten to 10 Nm (89 in. lb.). **NOTE** *Only necessary to install alignment tool if 2 adjacent cylinder heads are being repaired.*

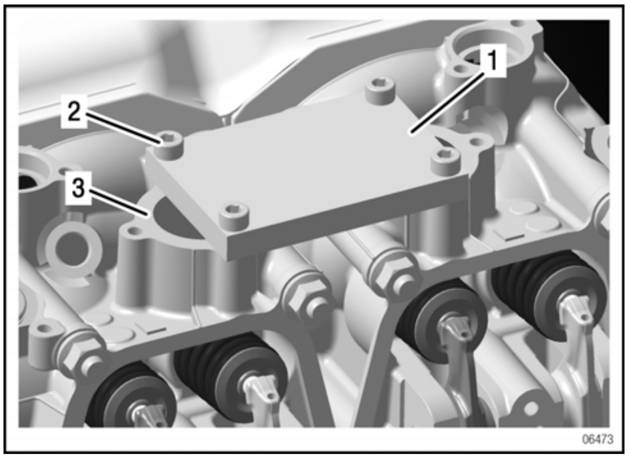

Figure 10.48: TYPICAL

1	*Cylinder aligning tool 877263*	*2*	*Allen screw M6x25*
3	*Intake flange*		

Step	Procedure
2	See Fig. “screw diagram”. Tighten the nuts in torque sequence following these steps: – Step 1: all collar cap nuts M8 and collar nuts M8 with 10 Nm (89 in. lb.). – Step 2: all collar cap nuts M8 and collar nuts M8 with 30 Nm (-5 Nm) / 265 in. lb. (-44 in. lb). **NOTE** *Perform step 3 sequentially for each cylinder head nut one at a time following the torque sequence in figure “screw diagram”.* – Step 3: Loosen each collar cap nut M8 or collar nut M8 360° then tighten to 10 Nm (89 in. lb.) + 150°.

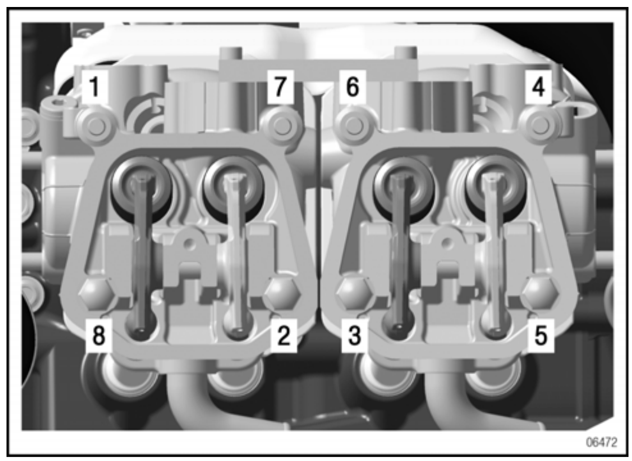

Figure 10.49: Screw diagram

Step	Procedure
3	Loosen 4 Allen screws M6x25 and remove the cylinder aligning tool.

VALVE COVER INSTALLATION

NOTICE

There must be a minimum gap of 0.2 mm (0.008 in.) between the valve covers on the outer contour. The valve covers must not touch each other!

NOTICE

Ensure the valve cover screw is the correct length! Look out for damaged threads. If the screw is loose or the valve cover leaks, the oil will not return to the oil tank.

NOTICE

The thread of screw and head must be cleaned from oil.

Step	Procedure
1	Install new O-ring 105x2.5 and new O-ring 6.4x1.8 into the valve cover.
2	Install the valve cover and fasten it with an Allen screw M6x30 and washer 6/12/1. Tightening torque 10 Nm (89 in. lb.).

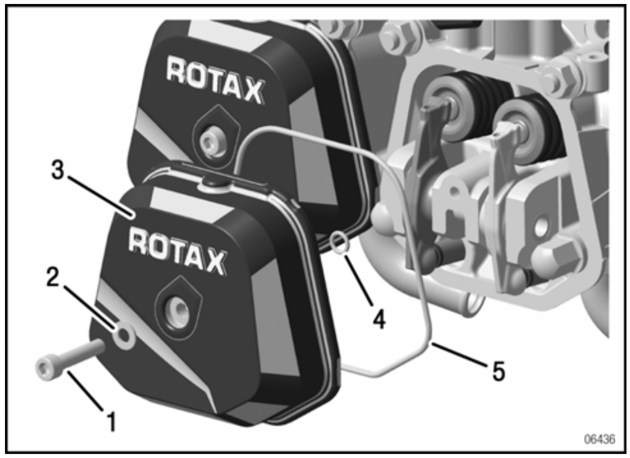

Figure 10.50

1	*Allen screw M6x30*	*2*	*Washer 6/12/1*
3	*Cylinder head cover*	*4*	*O-ring 6.4x1.8*
5	*O-ring 105x2.5*		

FINISHING WORK

- Install the coolant hoses to the inlet and outlet elbow. See Chapter 75-00-00 section Form hose – installation.
- Install the intake manifold. See Chapter 73-10-00 section Intake manifold — installation.
- Install the fuel line assy. See Chapter 73-10-00 section .
- Install the spark plugs and connect the spark plug connectors. See Chapter 74-20-00 section and .
- Install the Coolant Temperature Sensor (CTS) and connect the wiring harness. See Chapter 76–70–00 Coolant temperature sensor (CTS) — installation.
- Install the exhaust pipes. See Chapter 78-10-00 section Exhaust pipe on cylinder head – installation..
- Connect the wiring harness. See Chapter 76-50-00.

Fill with operating fluids or check filling levels.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-10-00 section Adding operating fluids.

Flush the engine cooling system.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Flushing the engine cooling system.

Purge the oil system. See current Installation Manual Line (IM) for the respective engine type, Chapter 79-00-00 Purging the lubrication system.

Carry out an engine test run.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Planned maintenance

Chapter: 72–30–10
DISPLACEMENT PARTS

TOPICS IN THIS CHAPTER

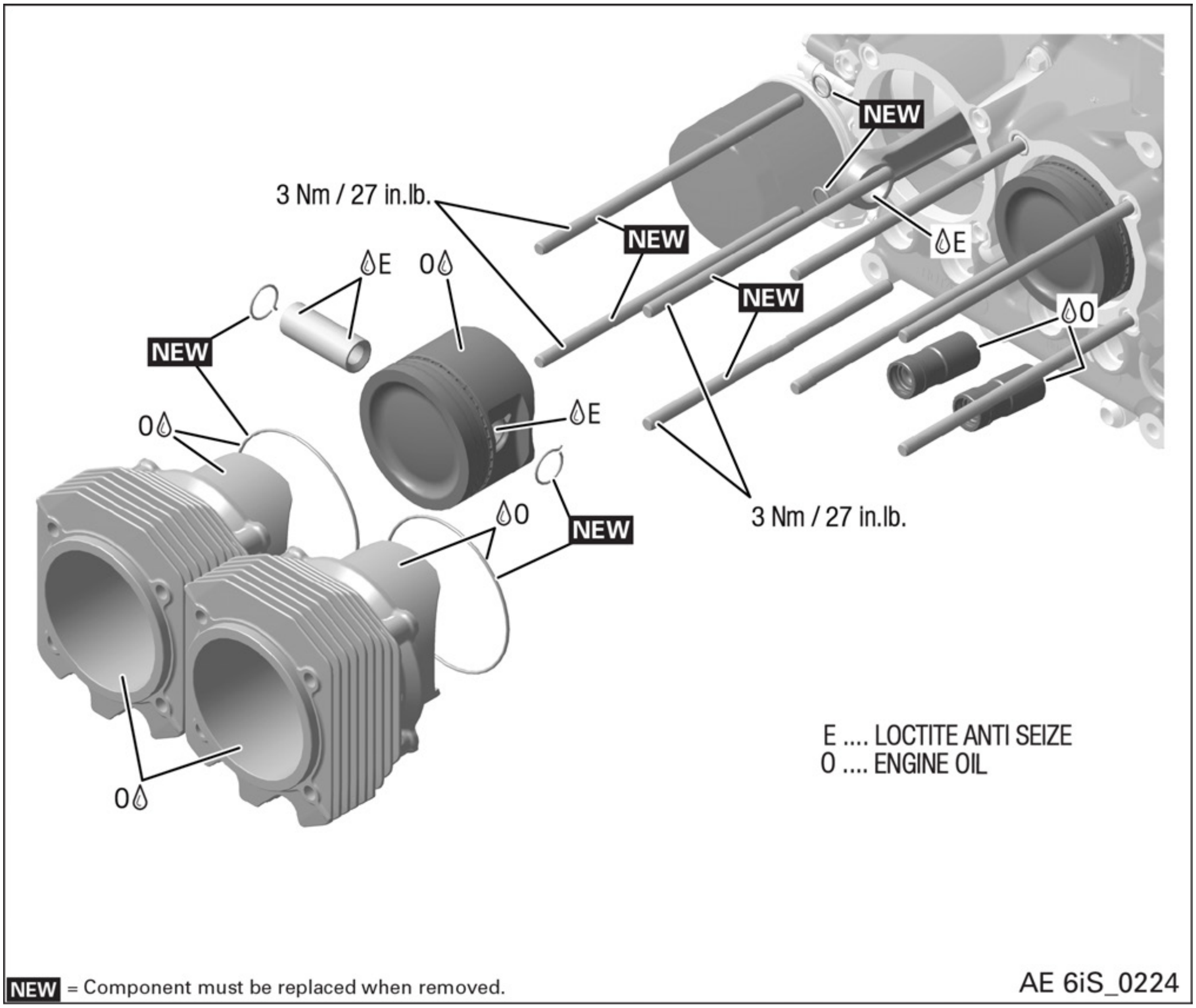
3 Nm / 27 in.lb.
NEW
NEW
E
O
NEW
NEW
E
NEW
O
O
E
O
NEW
3 Nm / 27 in.lb.
O
E .... LOCTITE ANTI SEIZE
O .... ENGINE OIL
NEW = Component must be replaced when removed.
AE 6iS_0224

Figure 11.1

SPECIAL TOOLS

Description	Part number
Piston pin extractor assy.	877091
Piston ring spanner, 84 mm	876967
Monohook circlip remover	976380
Installation tool assy.	877802

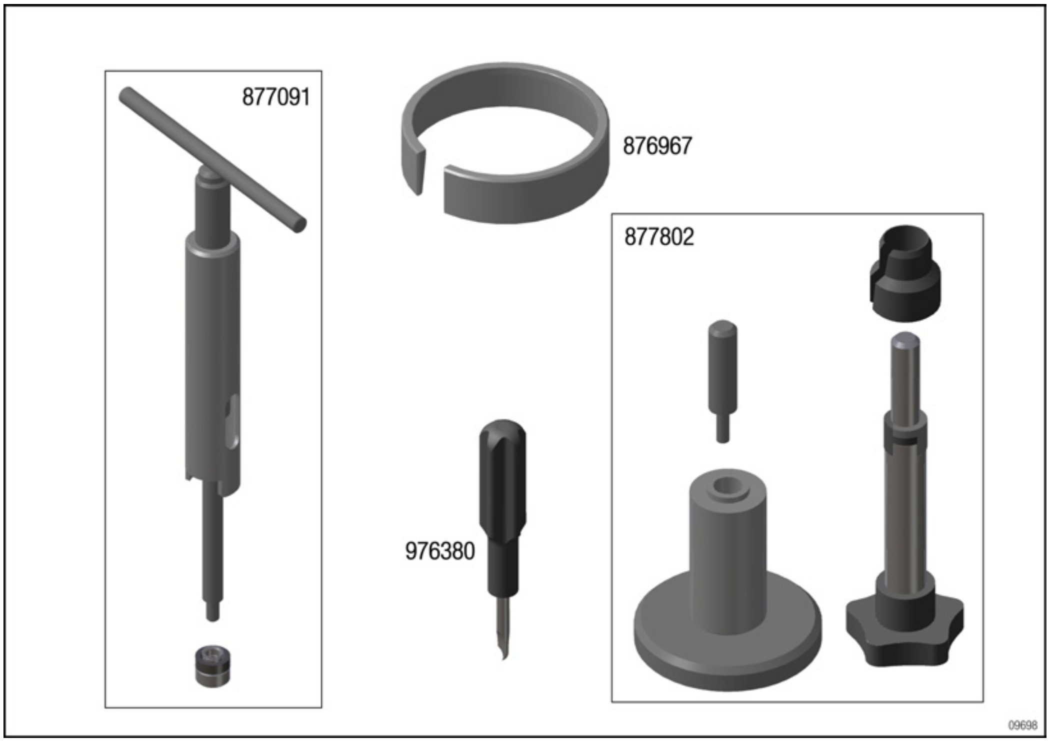

Figure 11.2: Special tools

SERVICE PRODUCTS

Description	Part number
LOCTITE ANTI SEIZE	297434
Engine oil	n.a.
Abrasive pad	n.a.

SYSTEM DESCRIPTION

In the 912 i Series engine, 4 cylinders with "GILNISIL"- coated running surfaces are used. The pistons are light alloy full skirt pistons. The piston pin is axially offset by 1 mm (0.03937 in.) with respect to the piston skirt, this is to minimize rocking of the piston.

SAFETY INSTRUCTION

⚠ WARNING
Danger of severe burns and scalds! Always allow the engine to cool down to ambient temperature before starting any work.

MAINTENANCE

As well as the maintenance and special checks, see current Maintenance Manual Line (MML) for the respective engine type.

REMOVAL

Preparation

- Remove the cylinder head. See Chapter 72-30-00 of this Manual.

CYLINDER AND PISTON — REMOVAL

NOTE

Before the cylinders and pistons are removed, they must be marked in pairs to prevent confusion. The cylinders are all identical. The pistons are axially offset!

Step	Procedure
1	Put the piston in the TDC position and apply the marking arrow in the direction of the gearbox.

NOTE

When the piston is cleaned the marking arrow becomes visible. It points in the direction of the gearbox for all four cylinders and aids correct assembly of the axially offset piston.

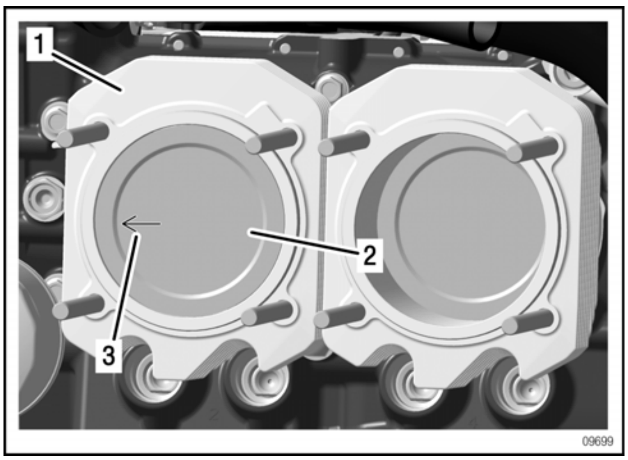

Figure 11.3

1 Cylinders *2 Pistons*
3 Marking arrow

NOTICE

Pistons and piston rings can be damaged.
Support pistons by hand!

Step	Procedure
2	Support the piston by hand and carefully remove the cylinder along with the O-ring.

NOTICE

Cover the crankcase to ensure that no foreign bodies can get inside.

NOTE

2 O-rings 10.82x1.78 are placed under the cylinder on the crankcase.

NOTE

Remove studs M8x200 and M8x186 for easier disassembly and protection from damage of the piston.

NOTICE

When removing the studs, make sure the conrod does not fall onto the crankcase as both can be damaged.

⚠ WARNING

Wear eye protection.
The monohook circlip is under tension!

Step	Procedure
3	Remove the monohook circlip with monohook circlip remover part no. 976380.

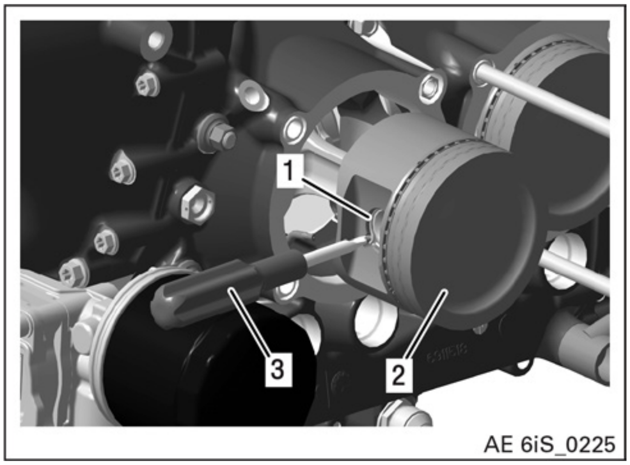

Figure 11.4: TYPICAL

1	*Monohook circlip*	2	*Pistons*
3	*Monohook circlip remover part no. 976380*		

NOTE

Piston pin extractor assy. part no. 877091 is used to pull out the piston pin.

Step	Procedure
4	Install the extractor spindle in the piston pin and mount M6 extracting nut (part no. 877155).
5	Turn the extractor spindle clockwise to pull the piston pin out of the conrod into the puller sleeve until the piston can be taken off.

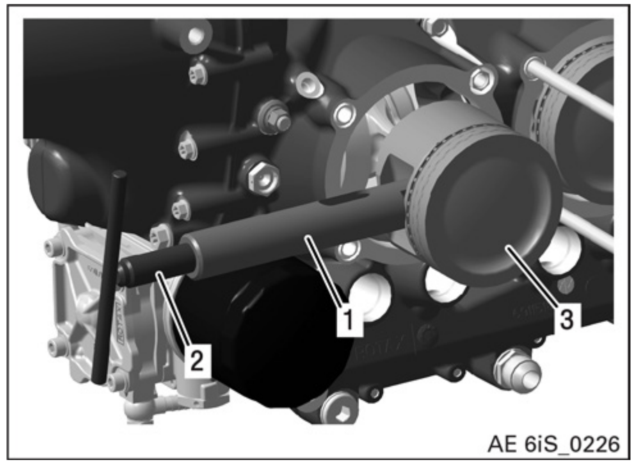

Figure 11.5: TYPICAL

1	*Piston pin extractor part no. 877091*	2	*Extractor spindle*
3	*Pistons*	4	*Extracting nut M6 part no. 877155*

Step	Procedure
6	Loosen the nut and remove the piston pin extractor. Remove the piston and put it down with the corresponding cylinder.

HYDRAULIC VALVE TAPPET – REMOVAL

NOTE

Store and identify the hydraulic valve tappet so that it can be installed in the same place when it is reused.

Step	Procedure
1	Remove the hydraulic valve tappet from the housing with the mono hook circlip remover part no. 976380.

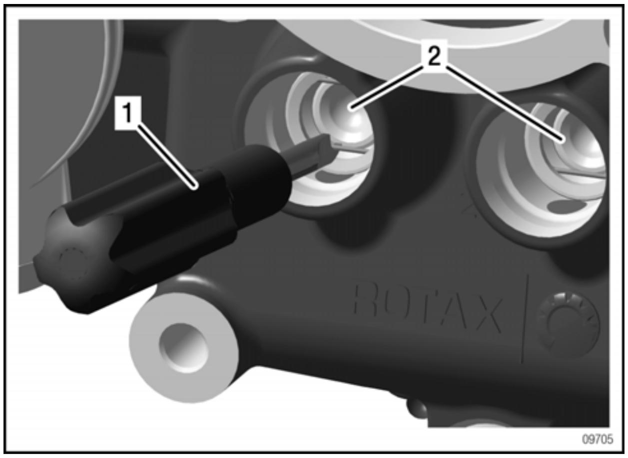

Figure 11.6

1	*Mono hook circlip remover part no. 976380*	*2*	*Hydraulic valve tappet*

INSPECTION

DISPLACEMENT PARTS — INSPECTION

Preparation

Clean all parts carefully.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 05-00-00 section Procedures.

PISTON — INSPECTION

Step	Procedure
1	Remove the piston rings with the piston ring pliers.

NOTE

Removed rings must be re-installed in the same position and location.

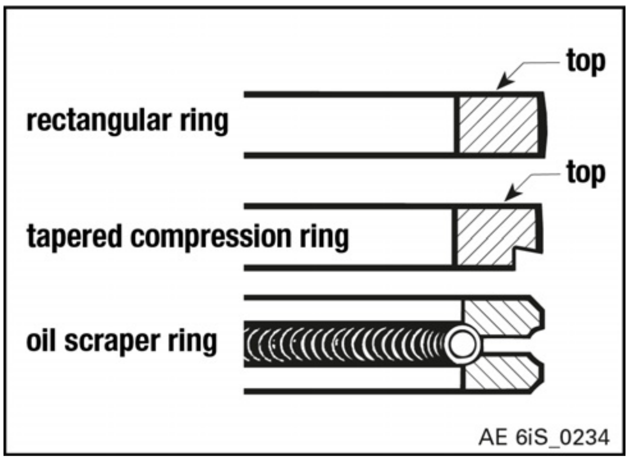

Figure 11.7

Step	Procedure
2	Remove carbon residues from piston rings and ring grooves and from the piston crown.

NOTE

The best way to clean the groove root is with an old, broken piston ring. Multiple deposits are likely if AVGAS 100LL is used.

Step	Procedure
3	Check the groove for the piston pin circlip. Carefully remove any burrs.

NOTE

If the groove is excessively worn (>0.3 mm (0.0118 in.), more than the retaining ring), the piston must be replaced.

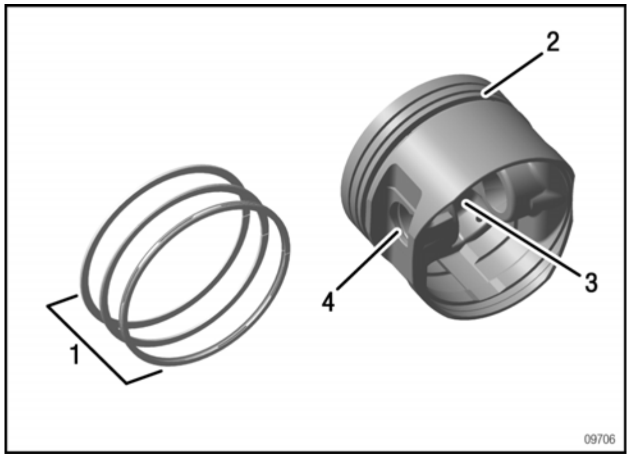

Figure 11.8

1	*Piston rings*	*2*	*Ring grooves*
3	*Piston crown*	*4*	*Piston pin circlip groove*

NOTE

Two sizes of pistons are available, red and green. The difference is 0.01 mm (0.00039 in.). The "red" piston is the smaller one. The nominal size of the piston is stamped on the piston crown. Oversized pistons are not available. The piston is only delivered with 3 rings installed.

Step	Procedure
4	Visually inspect and measure the piston. Measure the cylinder and determine the permissible installation clearance. See Chapter 72-30-10 section Wear limits.

NOTE

If the determined installation clearance is greater than the permissible installation clearance, the piston and/or cylinder must be replaced.

Step	Procedure
5	Determine the diameter of the piston pin bore. See Chapter 72-30-10 section Wear limits.

NOTE

The flank clearance can be measured on the installed rings using a feeler gauge. Multiple deposits in the spring of the oil scraper ring suggests that AVGAS 100LL has been used.

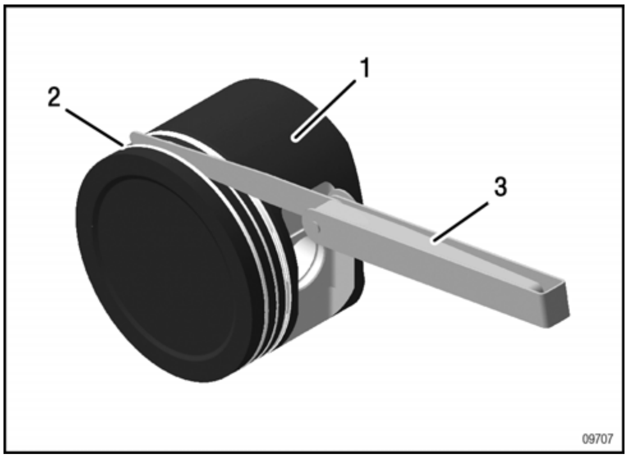

Figure 11.9

1 *Piston* 2 *Ring grooves*

3 *Feeler gauge*

PISTON RINGS — INSPECTION

Step	Procedure
1	Check the cleaned piston rings for piston ring joint clearance.

NOTE

To determine the piston ring joint clearance, remove the piston rings with piston ring pliers, clean them and place them in the cylinder. Aligned with a piston in the cylinder and pushed approx. 10 mm (0.3937 in.) from the upper edge into the cylinder.

Step	Procedure
2	Measure the piston ring joint clearance using a feeler gauge. See Chapter 72-30-10 section Wear limits (PI07).

NOTE

Examine the ring surface closely to identify the supporting part and thus also the wear which has already taken place.

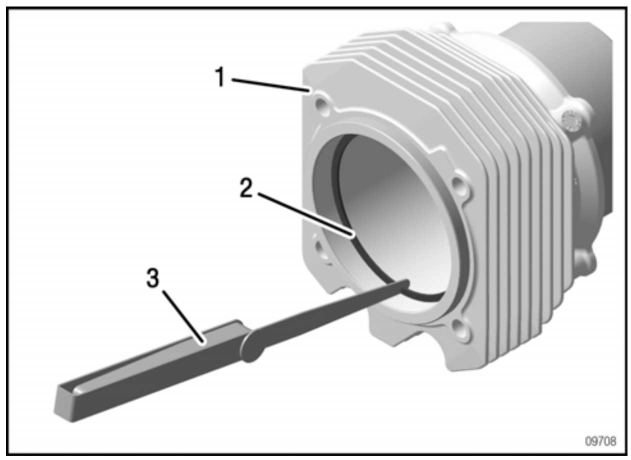

Figure 11.10

1 *Cylinders* 2 *Piston ring*

3 *Feeler gauge*

PISTON PIN — INSPECTION

NOTICE

The monohook circlips for the piston pin must only be used once and must therefore be replaced.

Step	Procedure
1	Check the piston pin for traces of wear in the region of the conrod bearing and in the region of the piston bearing and measure it.

NOTE

If perceptible traces of wear are found, even if the pistons are within tolerable dimensions, the piston pin must be replaced.

Step	Procedure
2	Measure dimension PI03. See Chapter 72-30-10 section Wear limits.

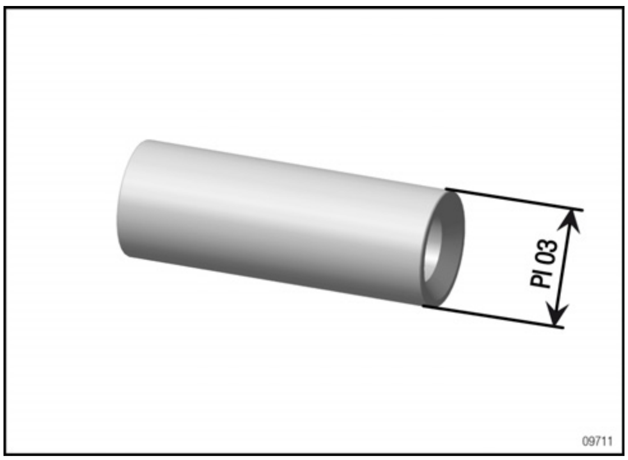

Figure 11.11

CYLINDER — INSPECTION

NOTE

If the sealing surface of the cylinder has slight carbon residues, this is a sign of leaking. The cylinder and/or cylinder head must be sent to an authorized overhaul facility for repairs.

Step	Procedure
1	Clean the cooling fins of the cylinder and remove carbon residues in the upper region of the cylinder bore.
2	Clean and check the sealing surfaces on the upper side and rear side.
3	Clean cylinder bore wall with very fine abrasive fleece and suitable cleaning fluid.

NOTICE

Damage to surface.
Honing, abrading and machining is not allowed.

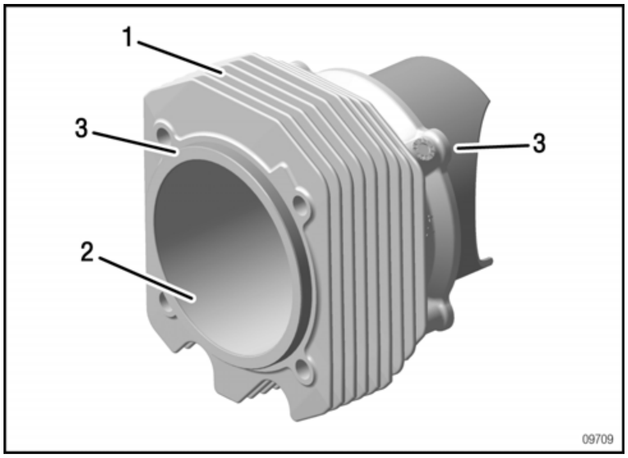

Figure 11.12

1 Cooling fins *2 Cylinder bore*
3 Sealing surface

Step	Procedure
4	Measure the cylinder and enter the measurement data (CY01/CY02/CY03). See Chapter 72-30-10 section Wear limits.
5	Determine the installation clearance. See Chapter 72-30-10 section Piston inspection.

NOTE

As long as the min. clearance is achieved, Cylinder B with red piston and/or Cylinder A with green piston can be paired.

HARDNESS TEST METHOD

NOTICE

If the engine has been overheated, a hardness test of the cylinder head is necessary.

See current Maintenance Manual Line (MML) for the respective engine type.

The hardness test takes place at measurement point CY04.

CY04: HB2.5/62.5 DIN EN ISO 6506-2

NOTICE

The result of the hardness test must be noted in Chapter 72-30-10, section Wear limits.

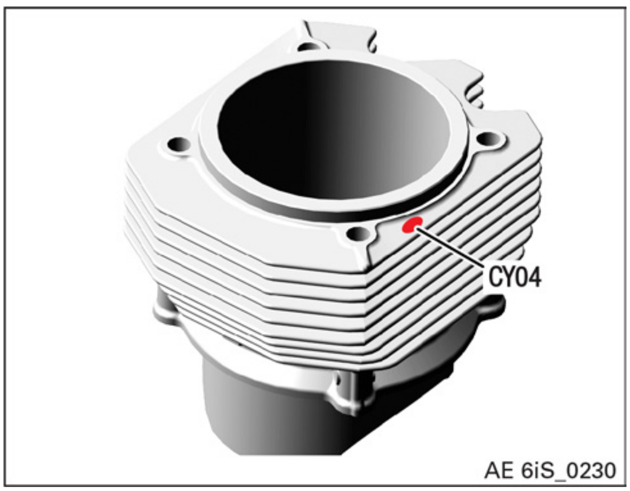

Figure 11.13

HYDRAULIC VALVE TAPPET — INSPECTION

Step	Procedure
1	Check visually for damage and wear.

NOTE

The hydraulic valve tappet rotates during operation, so there is a uniform, rotational symmetrical support pattern on the cam contact face.

NOTE

If the tappet does not rotate, uneven wear occurs on the contact face. If there are uneven smooth areas, corroded areas/pitting, the tappet must be replaced.

NOTICE

The hydraulic valve tappet must not be reground on the end!

NOTICE

Disassembly of the hydraulic valve tappet is neither permissible nor necessary.

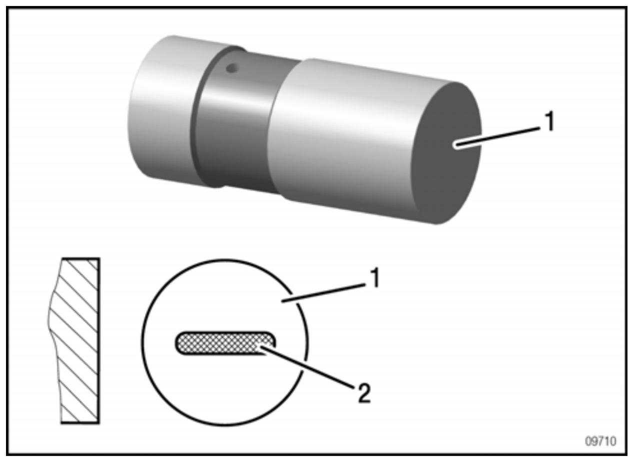

Figure 11.14

1 Cam contact face

2 Uneven wear

WEAR LIMITS

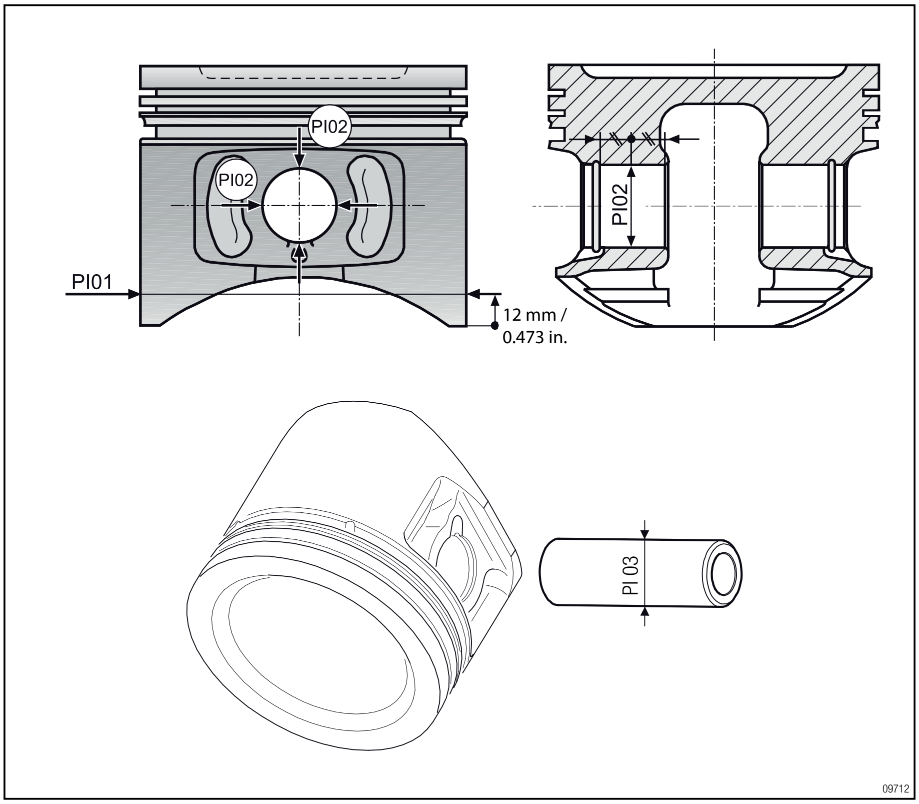

Figure 11.15

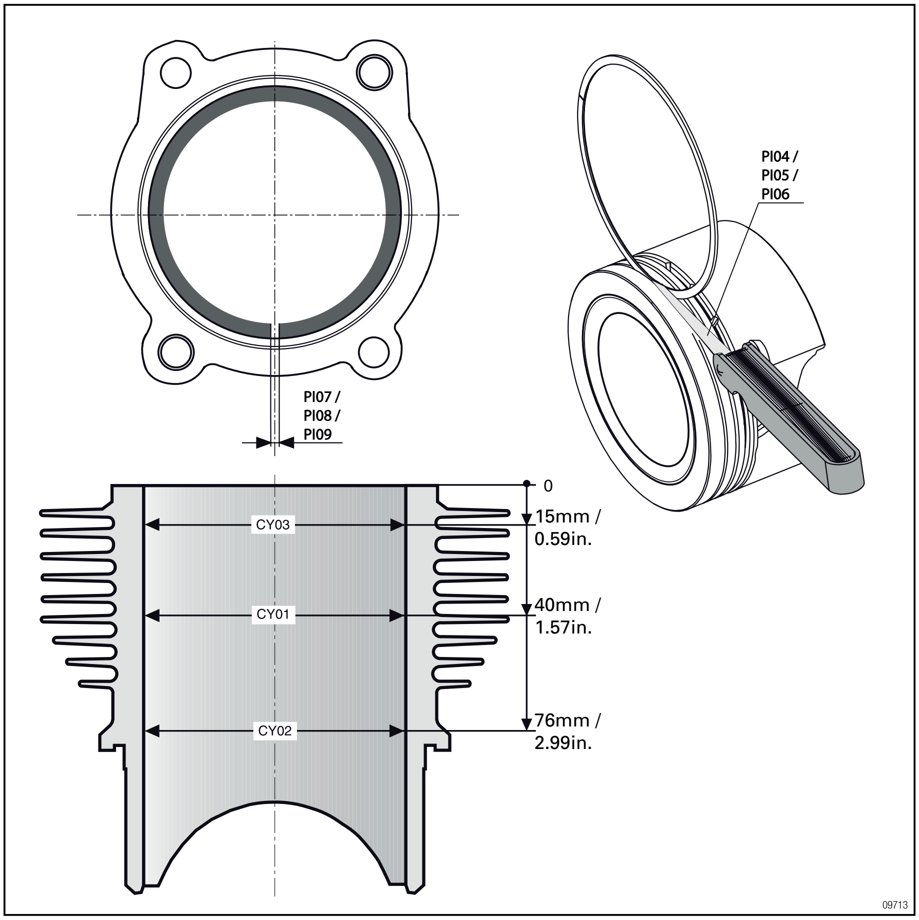
PI04 /
PI05 /
PI06
PI07 /
PI08 /
PI09
0
CY03
15mm /
0.59in.
CY01
40mm /
1.57in.
CY02
76mm /
2.99in.
09713

Figure 11.16

Description	Code	Reading new		Wear limit	Wear limit		Readings			
		min	max	100 %	50 %					
Piston							Cyl. 1	Cyl. 2	Cyl. 3	Cyl. 4
Piston A 84 mm / 3.3 in.	PI01	83.988 mm 3.3066 in.	84.002 mm 3.3072 in.	83.980 mm 3.3027 in.	83.939 mm 3.3047 in.	actual				
						re-newed				
Piston, B 84 mm / 3.3 in.	PI01	83.998 mm 3.3070 in.	84.012 mm 3.3075 in.	83.890 mm 3.3027 in.	83.944 mm 3.3049 in.	actual				
						re-newed				
Installation clearance cyl. "A" with "red" piston	CY01 /PI01	0.002 mm 0.000079 in.	0.024 mm 0.0009 in.	0.130 mm 0.0051 in.	0.077 mm 0.0030 in.	actual				
						re-newed				
Installation clearance cyl. "B" with "green" piston	CY01 /PI01	0.002 mm 0.000079 in.	0.026 mm 0.0010 in.	0.130 mm 0.0051 in.	0.078 mm 0.0031 in.	actual				
						re-newed				
Piston pin bore	PI02	20.001 mm 0.7874 in.	20.005 mm 0.7876 in.	20.040 mm 0.7890 in.	20.023 mm 0.7883 in.	actual				
						re-newed				
Piston pin	PI03	19.992 mm 0.7871 in.	19.995 mm 0.7872 in.	19.970 mm 0.7862 in.	19.981 mm 0.7867 in.	actual				
						re-newed				
Piston pin clearance in piston pin bore	PI01 / PI02	0.006 mm 0.0002 in.	0.013 mm 0.0005 in.	0.050 mm 0.0020 in.	0.032 mm 0.0012 in.	actual				
						re-newed				
Piston pin clearance in conrod	CS06 / PI03	0.015 mm 0.0006 in.	0.035 mm 0.0014 in.	0.050 mm 0.0020 in.	0.043 mm 0.0017 in.	actual				
						re-newed				
Piston ring clearance, groove clearance rectangular ring 1	PI04	0.03 mm 0.001 in.	0.07 mm 0.003 in.	0.10 mm 0.004 in.	0.085 mm 0.0033 in.	actual				
						re-newed				

Description	Code	Reading new		Wear limit	Wear limit		Readings			
		min	max	100 %	50 %					
Piston ring groove clearance compression ring 2	PI05	0.03 mm 0.001 in.	0.07 mm 0.003 in.	0.10 mm 0.004 in.	0.085 mm 0.0033 in.	actual				
						re-newed				
Piston ring groove clearance oil scraper ring 3	PI06	0.01 mm 0.0004 in.	0.18 mm 0.0006 in.	0.22 mm 0.0086 in.	0.20 mm 0.0078 in.	actual				
						re-newed				
Piston ring end gap, rectangular piston ring 1	PI07	0.25 mm 0.0098 in.	0.50 mm 0.02 in.	1.15 mm 0.05 in.	0.83 mm 0.0266 in	actual				
						re-newed				
Piston ring end gap, conical compres-sion ring 2	PI08	0.25 mm 0.0059 in.	0.50 mm 0.0138 in.	1.15 mm 0.05 in.	0.83 mm 0.0266 in.	actual				
						re-newed				
Piston ring end gap, oil scraper ring 3	PI09	0.2 mm 0.0078 in.	0.7 mm 0.003 in.	1.3 mm 0.05 in.	1.0 mm 0.039 in.	actual				
						re-newed				

Description		**Code**	**Reading new**		**Wear limit**	**Wear limit**		**Readings**			
			min	**max**	**100 %**	**50 %**					
Cylinder								Cyl. 1	Cyl. 2	Cyl. 3	Cyl. 4
Cylinder bore A 84 mm / 3.3 in.	D1	CY01	84.000 mm 3.3071 in.	84.012 mm 3.3075 in.	84.080 mm 3.3075 in.	84.080 mm 3.3102 in.	actual				
							re-newed				
	D2	CY02	CY01 +0.015 mm CY01 +0.0006 in.		CY01 +0.015/-0.008 mm CY01 +0.0006/-0.0003 in.		actual				
							re-newed				
	D3	CY03	CY01 +/- 0.008 mm CY01 +/- 0.0003 in.		CY01 +0.020/-0.008 mm CY01 +0.0008/-0.0003 in.		actual				
							re-newed				
Cylinder bore B 84 mm / 3.3 in.	D1	CY01	84.012 mm 3.3075 in.	84.024 mm 3.308 in.	84.090 mm 3.3106 in.	84.057 mm 3.3093 in.	actual				
							re-newed				
	D2	CY02	CY01 +0.015 mm CY01 +.0006 in.		CY01 +0.015/-0.008 mm CY01 +0.0006/-0.0003 in.		actual				
							re-newed				
	D3	CY03	CY01 +/- 0.008 mm CY01 +/- 0.0003 in.		CY01 +0.020/-0.008 mm CY01 +0.0008/ 0.0003 in.		actual				
							re-newed				
Cylinder ovality			0.0000 mm 0.0000 in.	0.007 mm 0.00003 in.	0.050 mm 0.0020 in.	0.029 mm 0.0011 in.	actual				
							re-newed				
Cylinder cone			0.0000 mm 0.0000 in.	0.030 mm 0.0012 in.	0.060 mm 0.0024 in.	0.045 mm 0.0018 in.	actual				
							re-newed				

Description	Code	Reading new		Wear limit	Wear limit		Readings			
		min	max	100 %	50 %					
NOTE *Surface cleaning of the sealing surfaces of cylinder and cylinder head with abrasive paste is allowed.*						actual				
						re-newed				
Hardness	CY04	90 HB								

INSTALLATION

CYLINDER AND PISTON — INSTALLATION

Preparation

- Clean all parts carefully.

HYDRAULIC VALVE TAPPET – INSTALLATION

NOTICE
If a hydraulic valve tappet has to be replaced, it must be ensured that a hydraulic valve tappet with a polished cam running surface is used.

NOTICE
If operating faults occur, such as operation with a non-purged hydraulic valve tappet, the internal components of the tappet will be permanently damaged and the hydraulic valve tappet must be replaced.

NOTE

New hydraulic valve tappets are partially emptied depending on the oil pressure and are pumped full of oil during the starting process. The oil passes through the oil bore into the hydraulic valve tappet. The retaining ring holds the piston in position when the hydraulic valve tappet is removed.

Step	Procedure
1	Lubricate the oil bore for the hydraulic valve tappet in the crankcase and contact faces with engine oil.
2	Install the lubricated hydraulic valve tappet in the corresponding place in the crankcase.

NOTE

The hydraulic valve tappet must rotate in the crankcase without resistance.

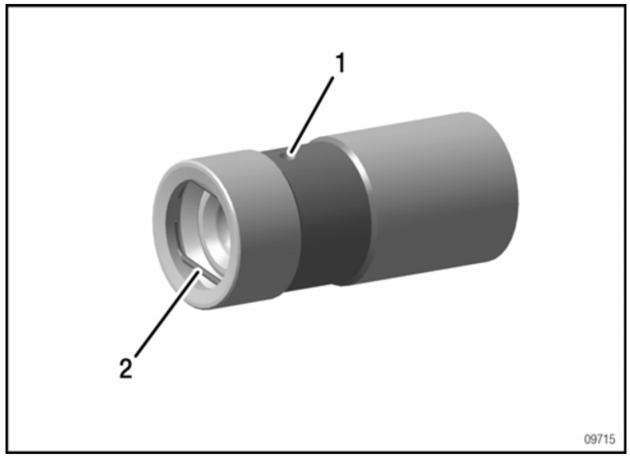

Figure 11.17

1	*Oil bore*	2	*Retaining ring*

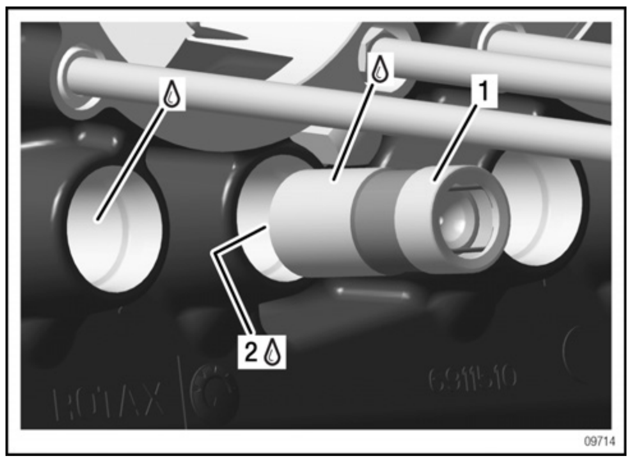

Figure 11.18

1	*Hydraulic valve tappet*	2	*Contact faces*

PISTON — INSTALLATION

NOTE

The pistons are axially offset. When the piston is installed, the arrow on the piston crown points towards the propeller shaft. This means with axial offset downwards for cylinders 1 and 3 and with axial offset upwards for cylinders 2 and 4.

Step	Procedure
1	Install the piston in accordance with the following figures.

NOTE

The eccentricity of the piston pin bore is 1 mm (0.039 in).

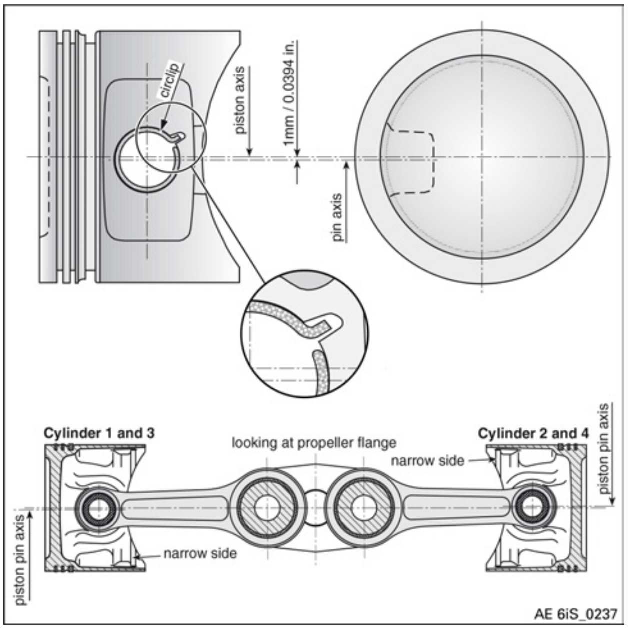

Figure 11.19

Step	Procedure
2	Lubricate the piston pin along with the conrod eye and the piston pin bore with LOCTITE ANTI SEIZE.

NOTE

Pull in the piston pin with the piston pin extractor part no. 877091. The following steps must be followed.

Step	Procedure
3	Push the piston pin to one side in the piston, insert the extractor spindle and mount the extracting nut part no. 877155.
4	Turn the spindle clockwise to pull in the piston pin entirely as far as the retaining ring.

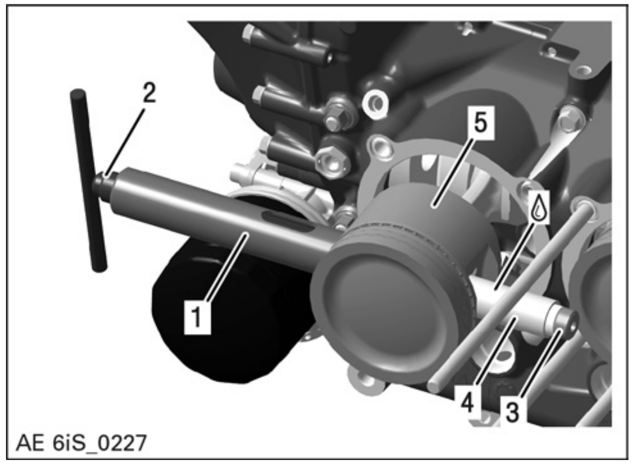

Figure 11.20: : TYPICAL

1	*Piston pin extractor part no. 877091*	2	*Extractor spindle*
3	*Extracting nut part no. 877155*	4	*Piston pin*
5	*Pistons*		

NOTICE

Damage to parts may occur.
When removing the piston pin extractor, make sure that the conrod and piston do not fall onto the crankcase.

NOTICE

Always use new monohook circlips.Circlips which are used or have already been installed have insufficient tangential tension, can twist and consequently abrade the groove in the piston.

NOTICE

The position of the monohook circlip is defined by the recess in the piston. The open side of the monohook circlip must be opposite the piston crown when installed.

Step	Procedure
5	Install the monohook circlip with installation tool part no. 877802. Press the monohook circlip into the groove of the installation sleeve and push the guide tool into the installation sleeve.
6	Push the installation sleeve onto the installation tool.
7	Push the installation tool into the position gauge and press the ring forwards as far as it will go.

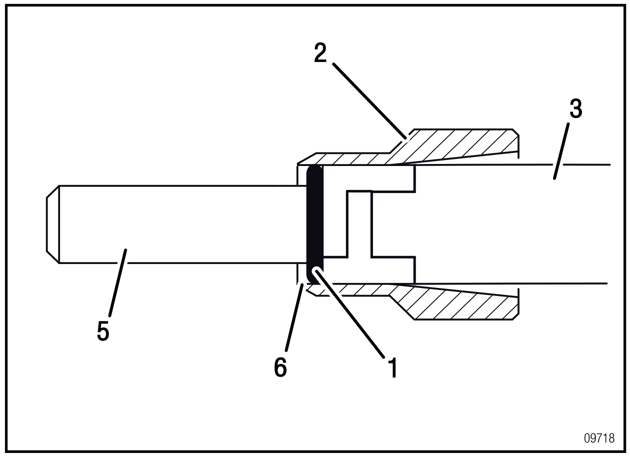

Figure 11.21

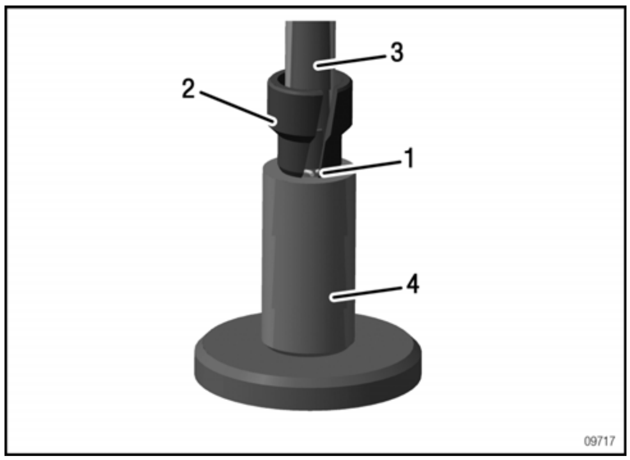

Figure 11.22

1	*Monohook circlip*	*2*	*Installation sleeve*
3	*Installation tool*	*4*	*Punch tool assy.*
5	*Guide tool*	*6*	*Groove*

Step	Procedure
8	Place the whole installation tool on the piston. Support the piston with your hand and push the monohook circlip into the retaining groove of the piston with a strong pressure on the installation tool.

⚠ WARNING

Wear eye protection. The monohook circlip is under tension!

NOTICE

When installing the monohook circlip, hold the piston firmly with your hand to avoid damaging the conrod while applying pressure on the installation tool.

NOTICE

When removing the installation tool, make sure the conrod and piston do not fall onto the crankcase as both can be damaged.

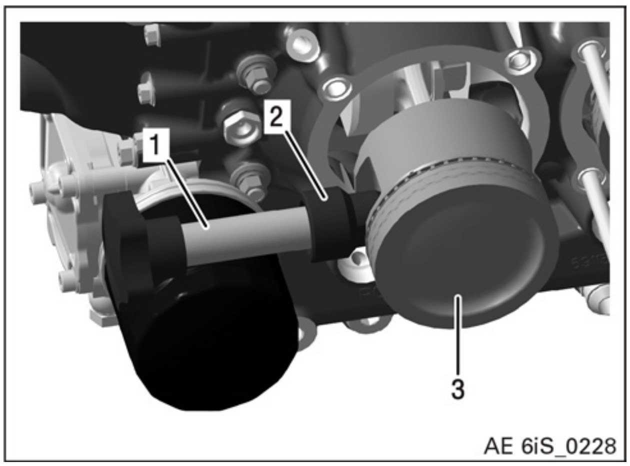

Figure 11.23: : TYPICAL

1	*Installation tool part no. 877802*	2	*Installation sleeve*
3	*Pistons*		

NOTE

Repeat this process on the other piston side.

STUDS – INSTALLATION

NOTICE

Studs (expansion screws) may only be used once.

Step	Procedure
1	Install 2 new studs M8x200 and 2 new studs M8x186. Tightening torque 3 Nm (27 in. lb.).

NOTICE

The studs must be screwed in as far as it will go. Check for correct position since the studs have two different lengths.

Step	Procedure
2	Install 2 new O-rings 10.82x1.78.

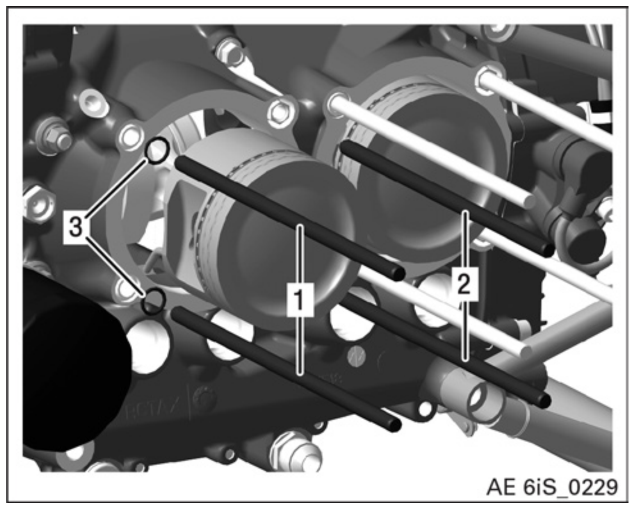

Figure 11.24

1	*Studs M8x200*	2	*Studs M8x186*
3	*O-rings 10.82x1.78*		

CYLINDER INSTALLATION

NOTICE

The suitable piston ring spanner part no. 876967 must be used to avoid ring breakages. Ensure that the piston ring joints are in the specified angle range.

Step	Procedure
1	Oil the piston rings and after installed onto the piston, the ring packs should be wobbled around twice per piston.
2	Adjust first piston ring and make sure that the opening of the 1st ring points downwards (in the direction of the pushrods). For piston ring no. 2, the piston ring joint must be turned to 12 o'clock up position. For piston ring no. 3, the piston ring joint must point downwards (6 o'clock in the direction of the pushrods)

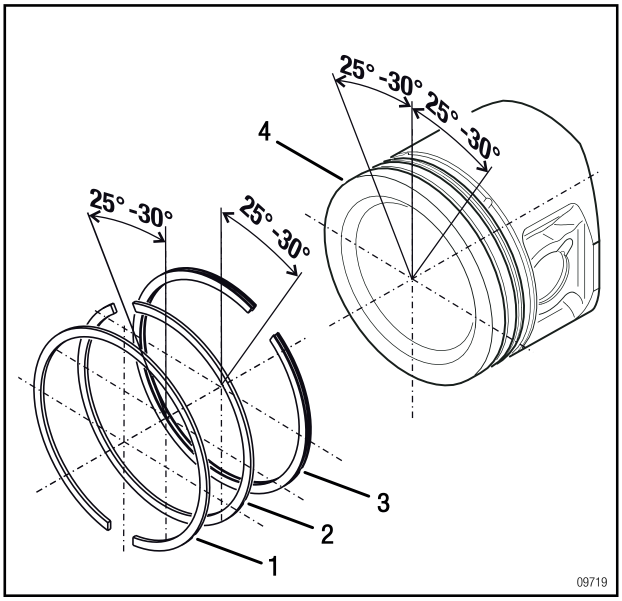

Figure 11.25

1	*Rectangular ring*	*2*	*Compression ring*
3	*Oil scraper ring*	*4*	*Pistons*

NOTICE

The ring gap should never come to lie in the region of the piston pin eye.

NOTICE

Double-check that monohook circlips are installed properly.

Step	Procedure
3	Install the 87x2 O-ring on the cylinder skirt and lubricate the cylinder running surface with engine oil.
4	Lubricate the piston with engine oil, compress the piston rings with piston ring spanner part no. 876967 and carefully install the corresponding cylinders.

NOTE

Repeat this process for the other cylinders.

FINISHING WORK

- Install the cylinder head. See Chapter 72-30-00.

NOTE

Before bringing into service, take note of Service Instruction SI-912-018 Purging of lubrication system.

Chapter: 73–00–00
FUEL SYSTEM

TOPICS IN THIS CHAPTER

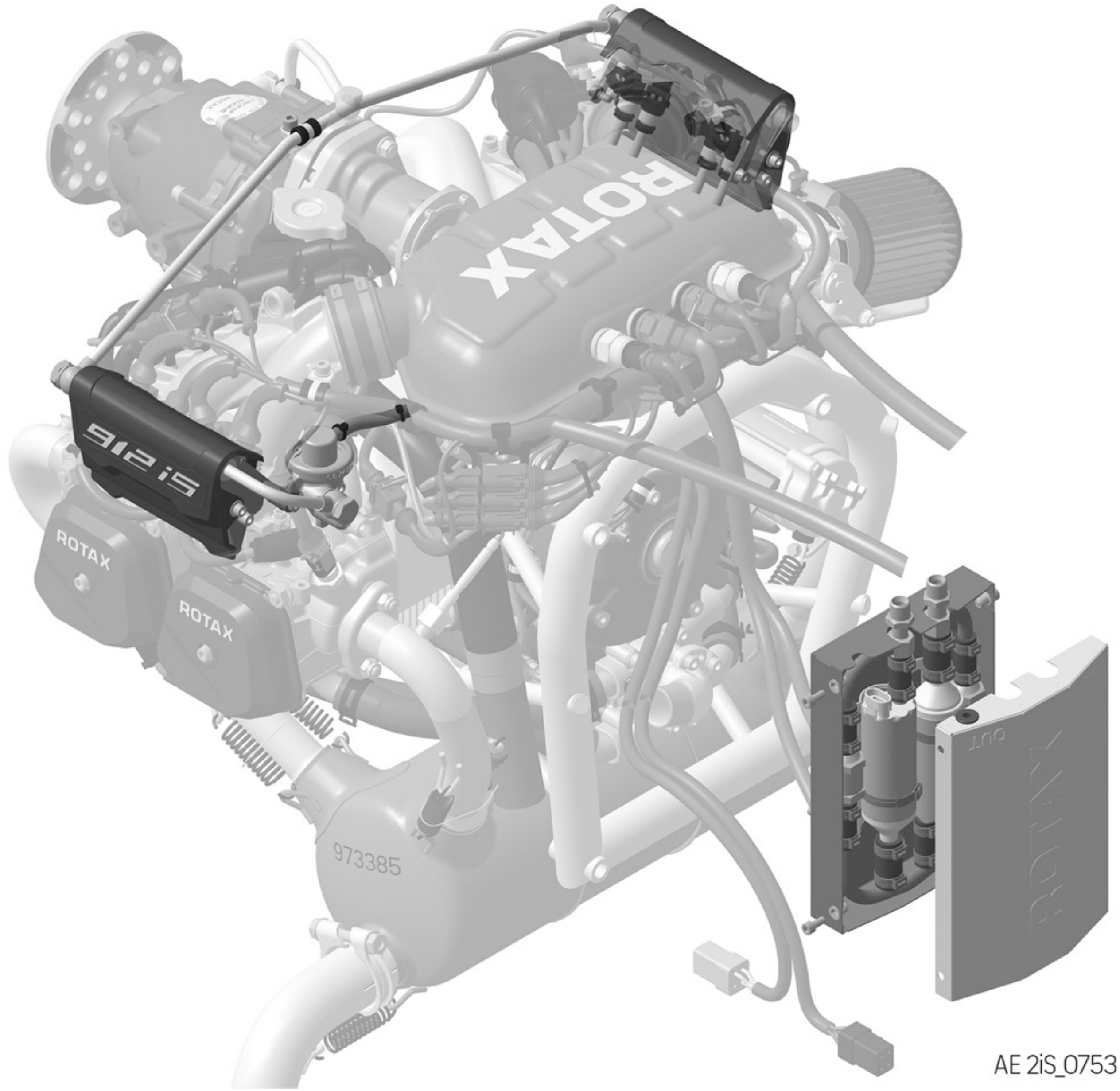

Figure 12.1: Fuel system

SYSTEM DESCRIPTION

The fuel passes from the tanks via the water trap to the series-connected electric fuel pumps, through fine filter from there to the fuel rails, the injection valves and the fuel pressure regulator.

The fuel pressure is measured with an absolute pressure sensor.

ECU

The pilot can switch on the second fuel pump with an additional switch if required, if no automatic detection is present.

FUEL FILTER

Coarse filter

The coarse filter is installed by the aircraft manufacturer and is not included in the ROTAX® delivery.

Fine Filter

The fine filter is installed by the aircraft manufacturer, see aircraft manufacturer manual.

SAFETY INSTRUCTION

⚠ WARNING

During work on the fuel system there is a risk of injury due to pressure and fuel!
Always wear safety goggles and gloves when working on the fuel system! Before starting repair work on the fuel system, ensure that it is no longer pressurised! Ensure that pressure cannot build up again by disconnecting the electric supply. At the workplace, ensure that drained fuel is handled according to the safety information.

⚠ 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

Please observe the disposal regulations applicable in your area.

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.

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Chapter: 73–10–00
FUEL SYSTEM AND DISTRIBUTION

TOPICS IN THIS CHAPTER

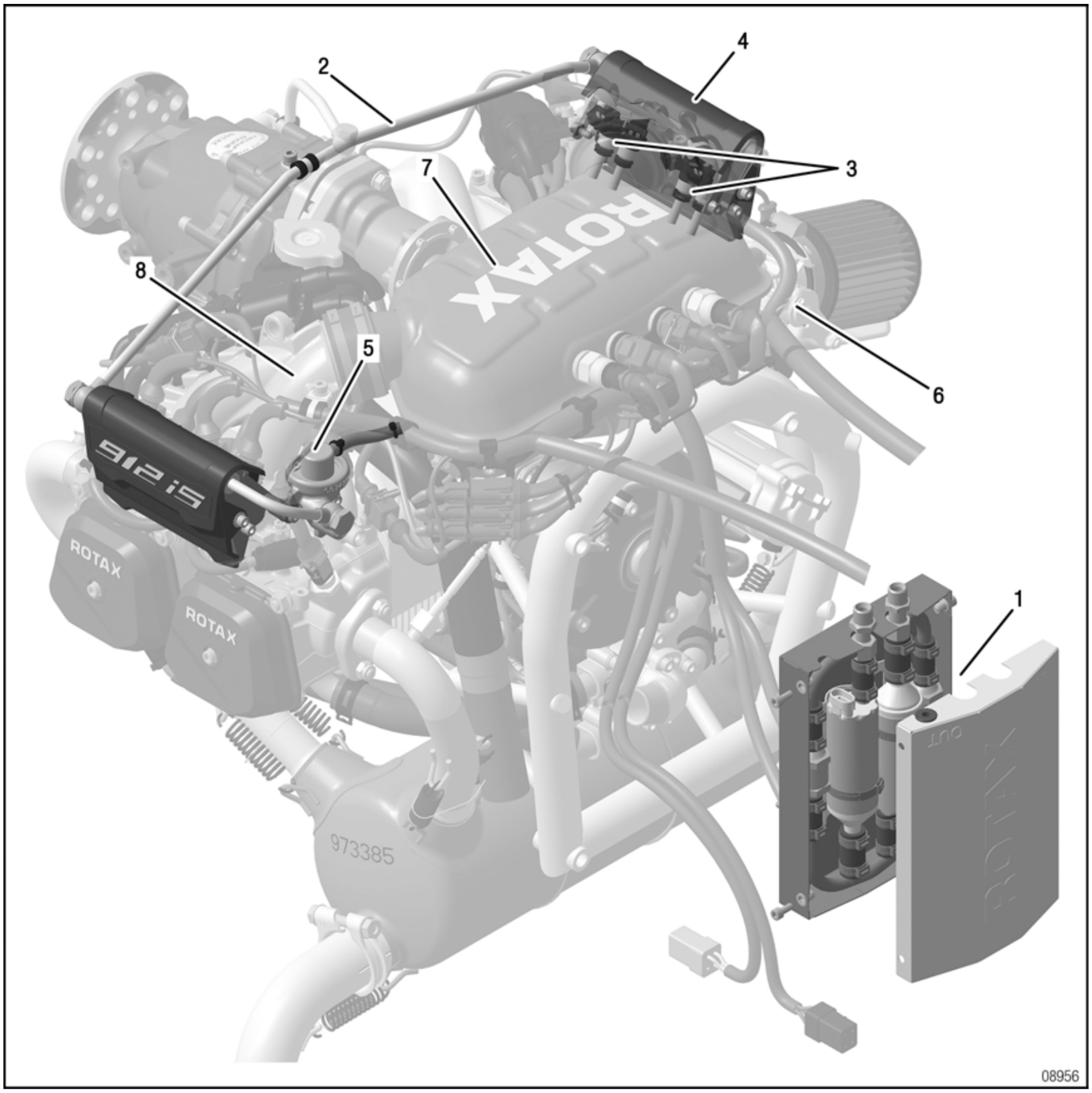

Figure 13.1: Fuel distribution

1	*Fuel pump assy.*	2	*Fuel line assy.*
3	*Injectors*	4	*Fuel rail 1/3*
5	*Fuel pressure regulator assy.*	6	*Throttle body*
7	*Airbox*	8	*Intake manifold*

SPECIAL TOOLS

Description	Part number
Snap ring pliers	n.a.
KNIPEX 1099 pliers (or similar OETIKER pliers)	889537
Socket driver T30	876180
Socket wrench 21	876075

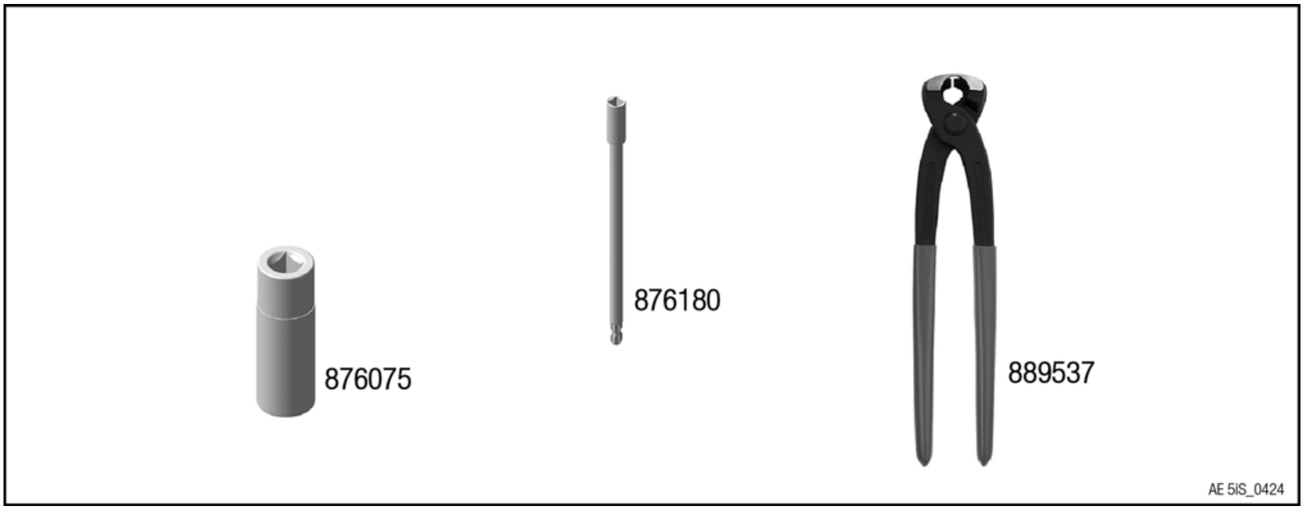

Figure 13.2: Special tools

SERVICE PRODUCTS

Description	Part number
LITHIUM BASE GREASE	897330
LOCTITE 243	897651
LOCTITE 648	899788

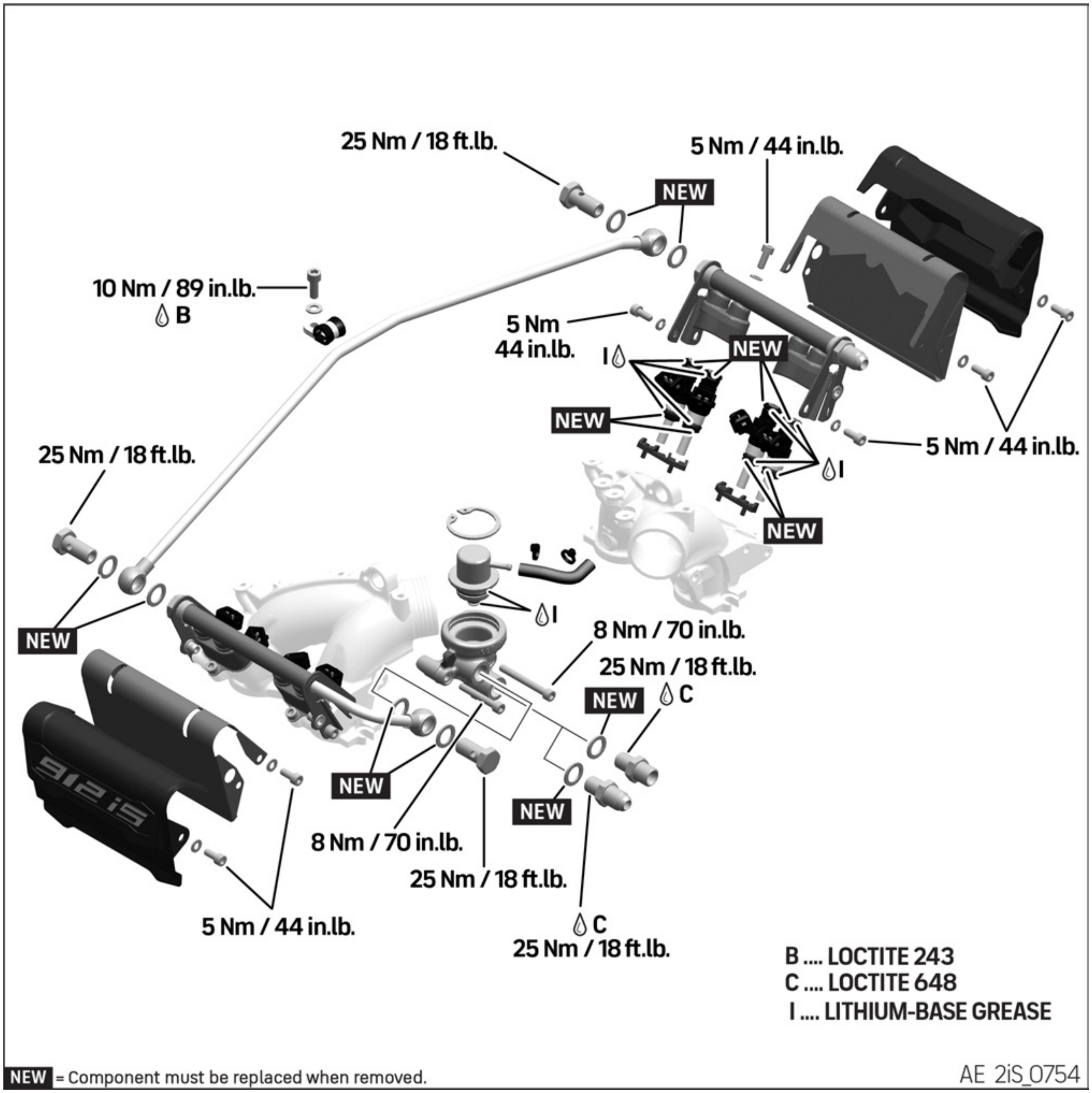

Figure 13.3: Fuel distribution

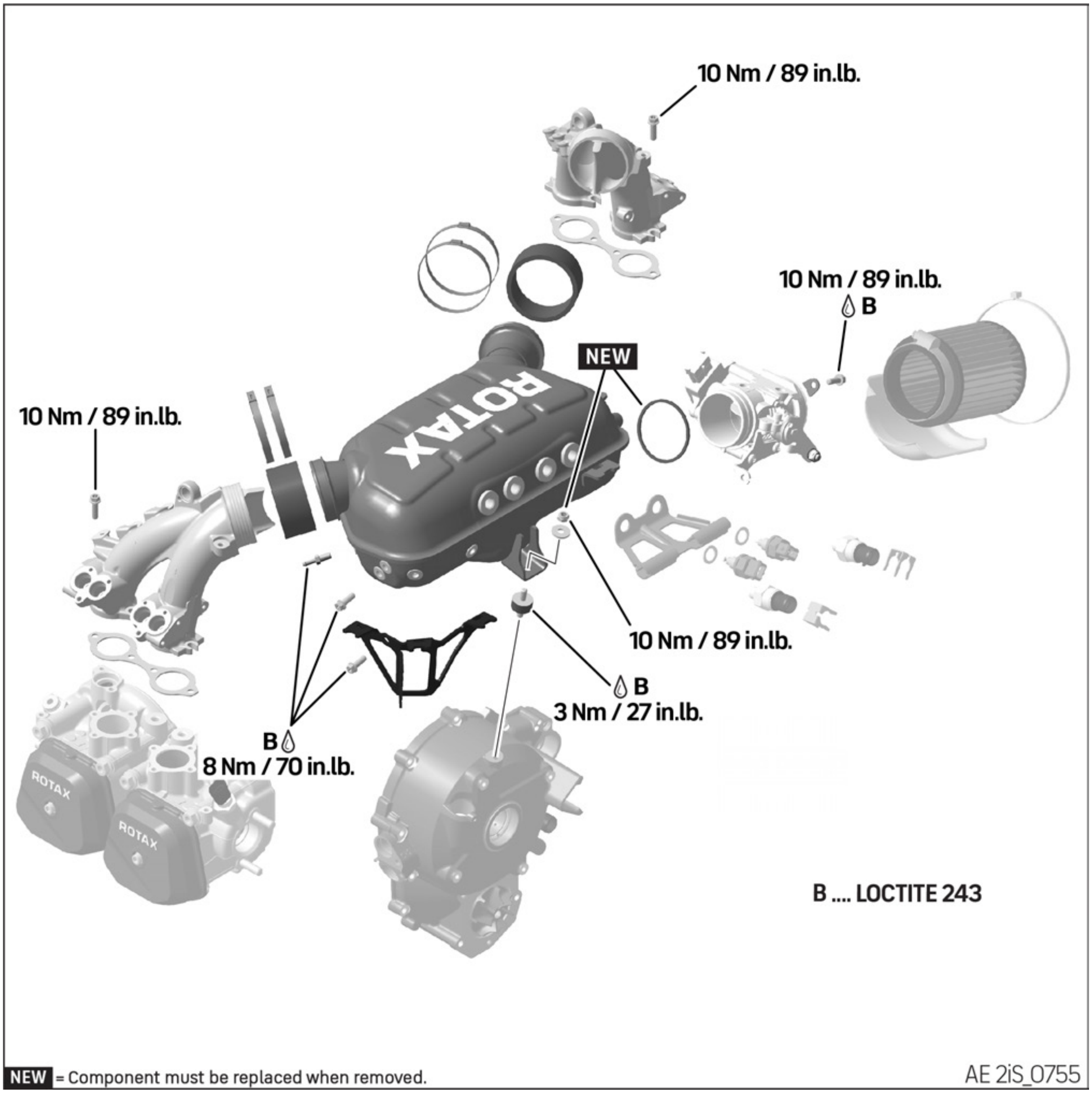
10 Nm / 89 in.lb.
10 Nm / 89 in.lb.
B
NEW
ROTAX
10 Nm / 89 in.lb.
10 Nm / 89 in.lb.
B
3 Nm / 27 in.lb.
B
8 Nm / 70 in.lb.
ROTAX
ROTAX
B .... LOCTITE 243
NEW = Component must be replaced when removed.
AE 2iS_0755

Figure 13.4

SYSTEM DESCRIPTION

FUEL PUMP MODULE

The fuel pump module consists of:
Main and auxiliary (AUX) pump
2 check valves
connecting lines, connecting hoses
sheet metal housing

The main fuel pump is always switched on during operation of the aircraft engine. The AUX fuel pump is switched on in the event of a failure of the main pump or for certain flight situations (e.g. take-off and landing). If a pump is blocked by contamination, the fuel is sucked in via the check valves and carried to the engine.

FUEL DISTRIBUTION

The main elements of the fuel distribution assembly are:

- Air filter
- Throttle body
- Airbox
- Injection system with fuel pressure regulator assy.

Throttle body
The throttle valve is actuated by using the throttle lever. The position of the throttle valve is detected by the throttle potentiometer and the signal is sent to the ECU. The ECU uses the sensors to determine the amount of fuel and the fuel is injected directly into the intake manifold through the injection valves.

NOTICE
The throttle valve is spring loaded to WOT, if no throttle cable is attached. Never start the engine without connecting a throttle cable.

Fuel pressure regulator
The fuel pressure regulator keeps the fuel system pressure upstream of the injection valves constant relative to the intake manifold pressure (differential fuel pressure). The injection quantity is therefore only dependent on the activation time of the injection valves and can be reproduced using the activation time in all operating conditions. Therefore, the same amount of fuel is injected per unit time at all pressure ratios. It is essentially a bypass valve, which opens a return duct to the tank for the fuel by means of a spring-loaded diaphragm when the set pressure is exceeded. The regulator has a hose connecting to the airbox (reference hose) so that the absolute fuel pressure can be changed proportionally to the airbox pressure.

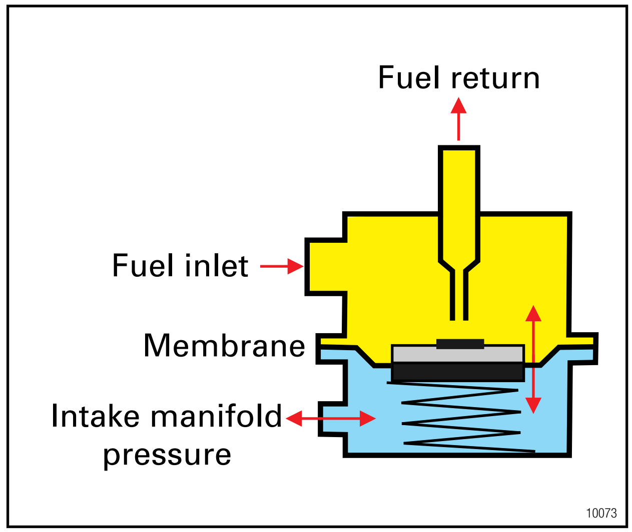

Figure 13.5

1 *Function principle*

NOTE

The fuel pressure is 3.00 bar (43.5 psi) +/-0.2 bar (+/- 2.9 psi).

Injection valve
The injection valves are laid out in a redundant manner and are activated by the control unit so that they inject alternately.
1-4-2-3 and in the next cycle 5-8-6-7.

Fuel lines.
Follow the instructions of the aircraft manufacturer.

Bubble trap.
Follow the instructions of the aircraft manufacturer.

Water trap.
Follow the instructions of the aircraft manufacturer.

Fuel cock.
Follow the instructions of the aircraft manufacturer.

SAFETY INSTRUCTION

⚠ WARNING

Danger of severe burns and scalds!
Always allow the engine to cool down to ambient temperature before starting any work.

⚠ WARNING

During work on the fuel distribution system/ fuel pump there is a risk of injury due to pressure and fuel!
Before starting repair work on the fuel system, ensure that it is no longer pressurised!

MAINTENANCE

As well as the maintenance and special checks, see current Maintenance Manual Line (MML) for the respective engine type.

REMOVAL

Preparation

Before the fuel distribution system/fuel pump is removed, the work described below must be carried out to identify any further faults in the fuel distribution system and rectify them as part of the repair work.

ENVIRONMENTAL NOTE
All the operating fluids and cleaning agents can damage the environment if not disposed of properly. Dispose of operating fluids in an eco-friendly manner!

NOTICE
If these checks are omitted, it may be necessary to dismantle the fuel distribution system again to rectify any faults after it has been repaired.

General visual inspection. See current Maintenance Manual Line (MML) for the respective engine type.

Carry out an engine test run. See current Maintenance Manual Line (MML) for the respective engine type.

- Functional check of the fuel distribution system assy.
- Check that the system has no leaks.
- Check the injection valves. Check the "spray pattern" using the map.
- Measure the resistance of the injection valves. See 76-70-00 Sensors and actuators.

Check that the fuel filter in the feed line is clean. Follow the instructions of the aircraft manufacturer.

Drain the fuel.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Planned maintenance.

Remove the feed line to fuel rail 1/3 and the return line to fuel rail 2/4 and fuel pressure regulator. Follow the instructions of the aircraft manufacturer.

FUEL PRESSURE REGULATOR – DISASSEMBLY

Step	Procedure
1	Remove the cable ties and pull out the hose.
2	Disconnect the plug connection to the Coolant Temperature Sensor (CTS).

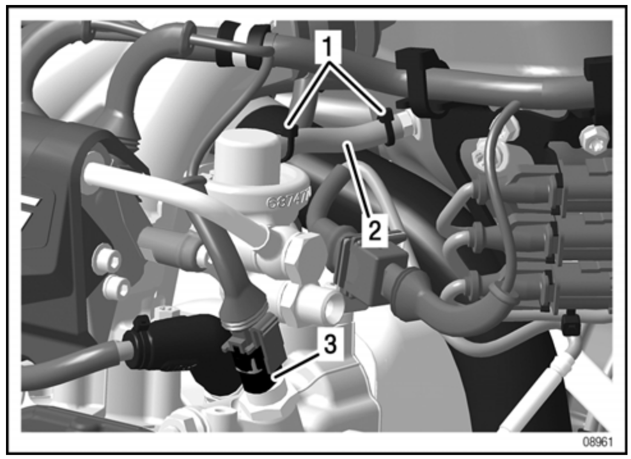

Figure 13.6: TYPICAL

1 Cable ties *2 Hose*
3 Coolant Temperature Sensor (CTS)

Step	Procedure
3	Remove the retaining ring using snap ring pliers.
4	Remove the fuel pressure regulator.

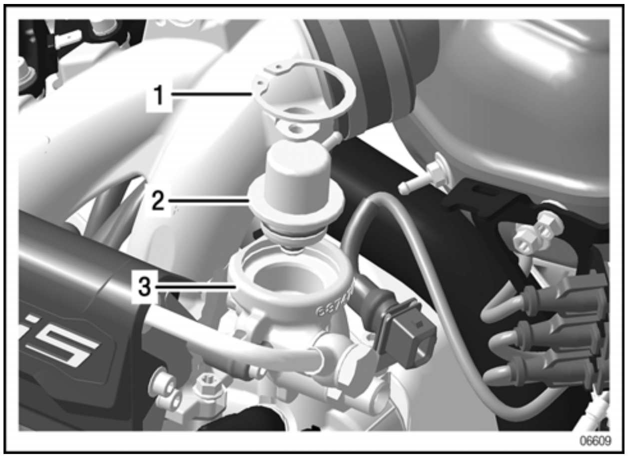

Figure 13.7

1 *Retaining ring*
2 *Fuel pressure regulator*
3 *Pressure regulator housing*

FUEL PRESSURE REGULATOR ASSY. — REMOVAL

Preparation

Carry out functional check (differential pressure to the intake manifold pressure or intake air pressure). See current Installation Manual (IM) for the respective engine type, Chapter 73–00–00 section hydraulic interfaces.

Step	Procedure
1	Remove the cable ties and pull out the hose.
2	Disconnect the plug connection to the Coolant Temperature Sensor (CTS).

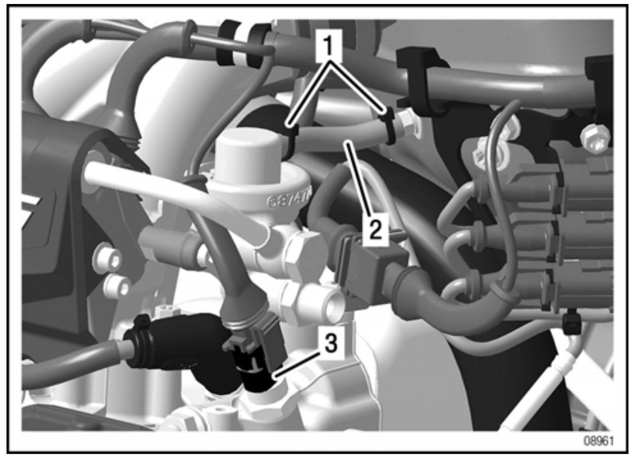

Figure 13.8

1 *Cable ties*
2 *Hose*
3 *Temperature sensor*

Step	Procedure
3	Loosen the banjo bolt with sealing rings.

NOTICE

Do not damage the Exhaust Gas Temperature sensor (EGT) on cylinder 4.

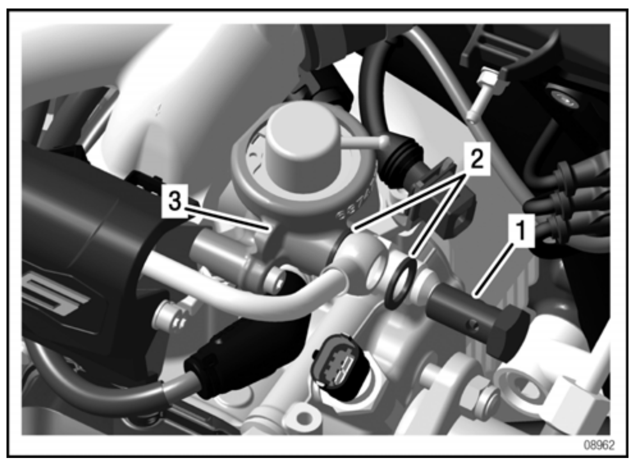

Figure 13.9

1 *Banjo bolt*
2 *Sealing rings*
3 *Pressure regulator housing*

Step	Procedure
6	Loosen the Allen screws. **NOTE** *1 M5x35 Allen screw. 1 M5x45 Allen screw.*
7	Remove the fuel pressure regulator and housing.

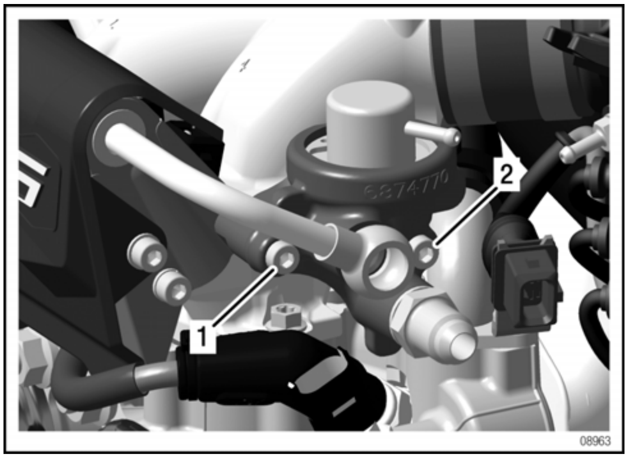

Figure 13.10: TYPICAL

1 Allen screw M5x35
2 Allen screw M5x45

FUEL LINE ASSY. — REMOVAL

Step	Procedure
1	Loosen the Allen screw with lock washer from the fuel line assy.

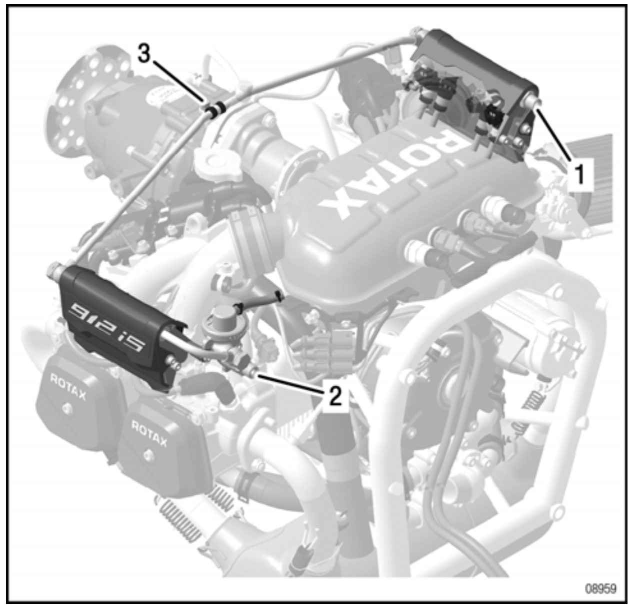

Figure 13.11

1 Fuel rail 1/3 feed line
2 Fuel rail 2/4 outlet line
3 Allen screw with lock washer

Step	Procedure
2	Loosen 2 banjo bolts with sealing rings.
3	Remove the fuel line assy.

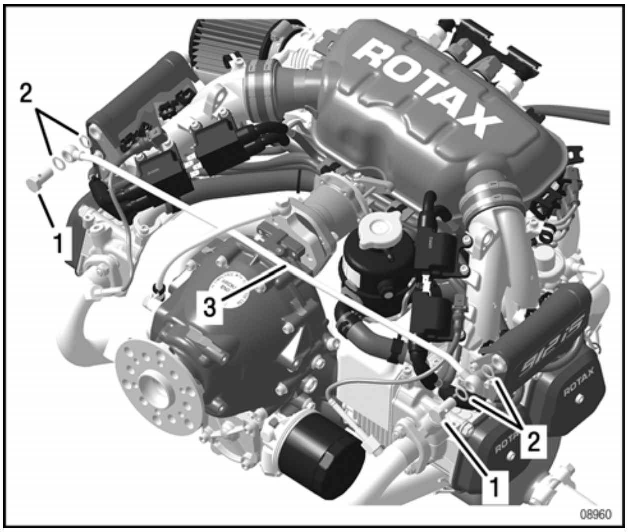

Figure 13.12

1 Banjo bolt *2 Sealing rings*

3 Fuel line assy.

FUEL RAIL — REMOVAL

Preparation

NOTICE
Do not damage the Exhaust Gas Temperature sensor (EGT).

- Remove the fuel line assy. See fuel line assy. – removal

Step	Procedure
1	Remove 2 Allen screws with spring washers from the fuel rail cover.
2	Lift off the fuel rail cover from the heat shield.

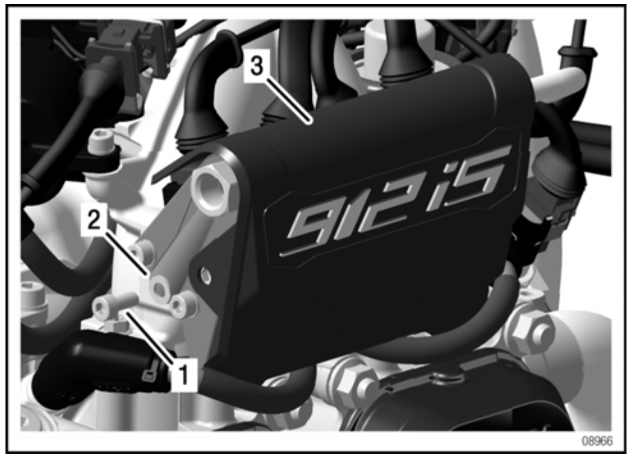

Figure 13.13

1 Allen screw *2 Spring washer*

3 Fuel rail cover

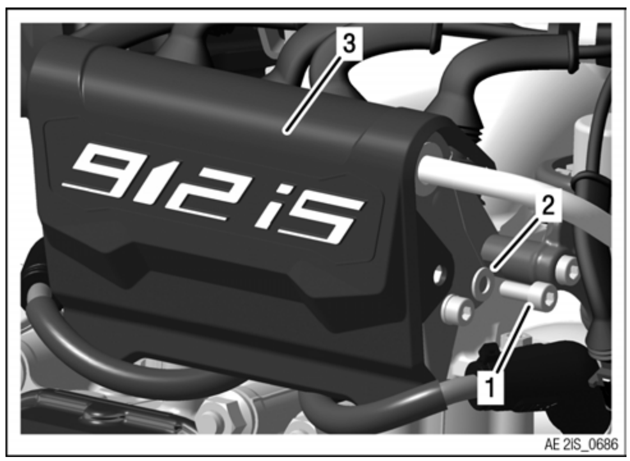

Figure 13.14

1 Allen screw *2 Spring washer*

3 Fuel rail cover

Step	Procedure
3	Loosen 4 Allen screws with lock washers and remove from the heat shield.

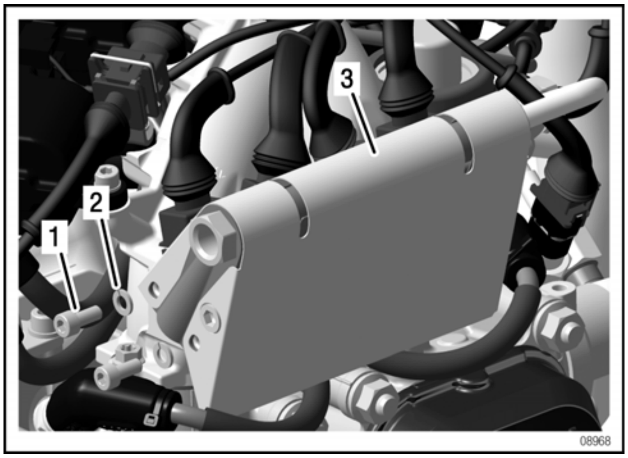

Figure 13.15

1	*Allen screw*	2	*Lock washer*
3	*Heat shield*		

Step	Procedure
4	Remove Allen screw M5x35 from the fuel pressure regulator (only on cylinder 4).
5	Lift off the heat shield on both sides in the region of the rivet nut.

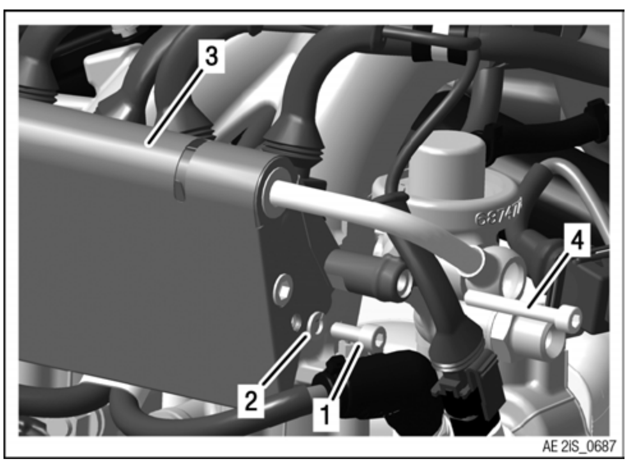

Figure 13.16

1	*Allen screw M5x12*	2	*Lock washer*
3	*Heat shield*	4	*Allen screw M5x35*

Step	Procedure
6	Press the metal spring and pull off the connector from the fuel injector.

NOTE

The cables are labelled INJ_ 1 to INJ_8.

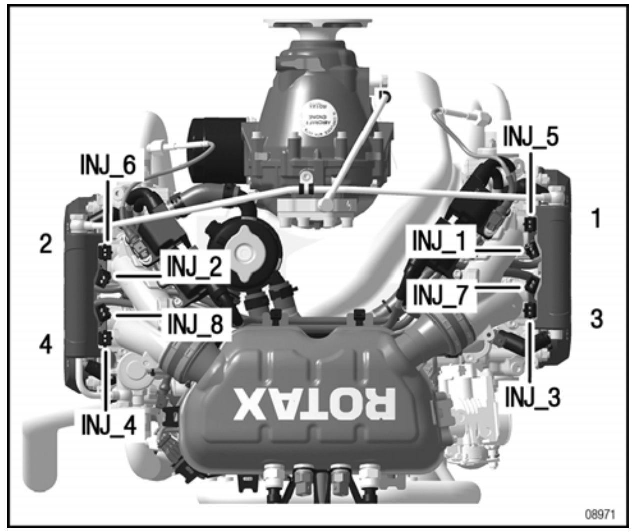

Figure 13.17: Labelling diagram

NOTE

Let the wire clip snap back in after the connector has been disconnected so that it does not get lost.

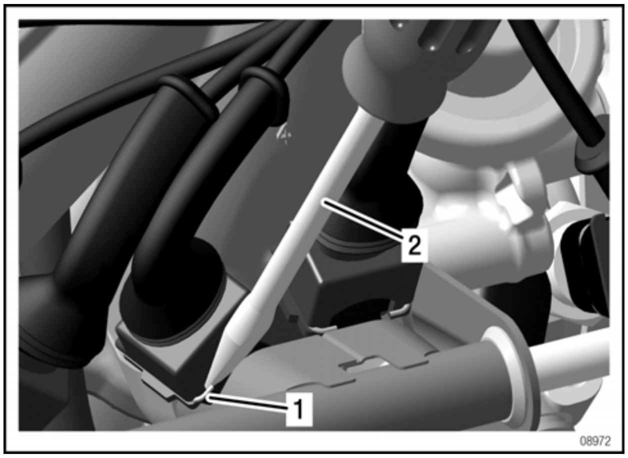

Figure 13.18

1 Injector connectors *2 Screwdriver*

Step	Procedure
7	Loosen the Allen screws of the fuel rail attachment with the lock washers on both sides.
8	Remove both fuel rails from the intake manifold.
9	Remove left and right damper from the intake manifold.

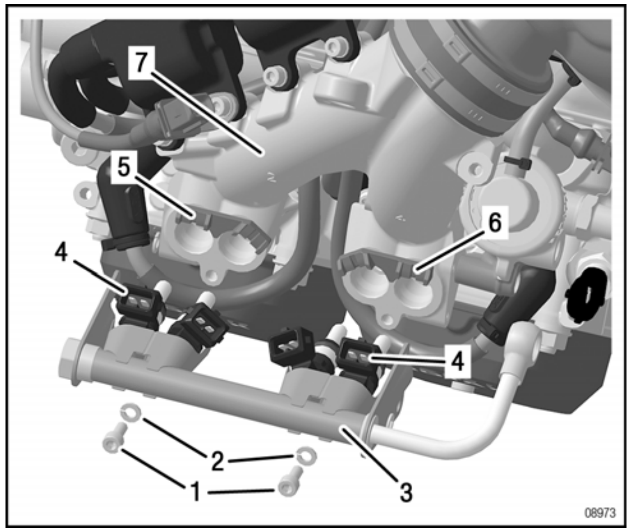

Figure 13.19

1 Allen screw *2 Lock washer*
3 Fuel rail (2/4) *4 Injectors*
5 Left damper *6 Right damper*
7 Intake manifold

FUEL RAIL — DISASSEMBLY

Step	Procedure
1	Remove the injectors individually from the fuel rail.

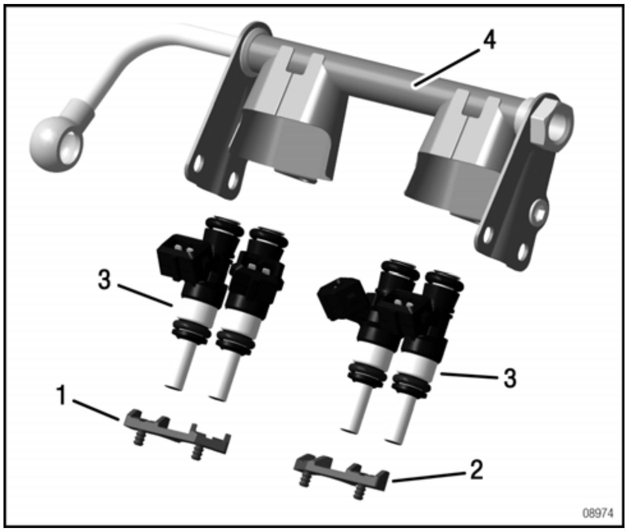

Figure 13.20

1	*Left damper*	2	*Right damper*
3	*Injectors*	4	*Fuel rail*

THROTTLE BODY ASSY. — REMOVAL

Preparation

General visual inspection. See current Maintenance Manual Line (MML) for the respective engine type.

Remove the Bowden cable from the throttle body assy.
Follow the instructions of the aircraft manufacturer.

Step	Procedure
1	Unplug the connector from the Throttle Position Sensor (TPS). See Chapter 76-50-00 section Throttle Position Sensor (TPS) — disconnection.
2	Remove the air filter from the throttle body assy, follow the instructions by the aircraft manufacturer.

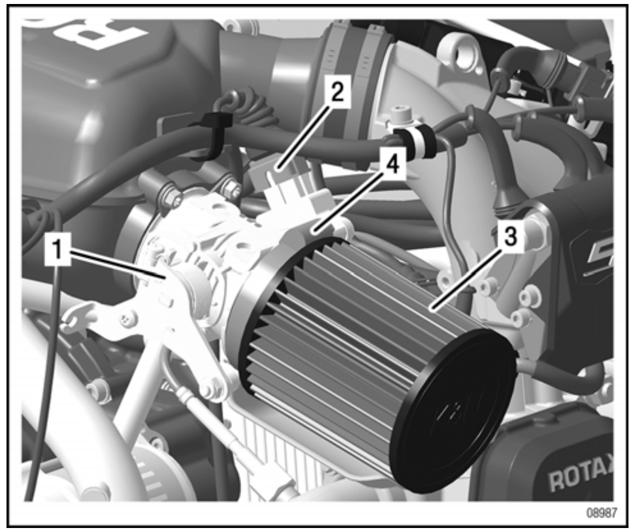

Figure 13.21

1	*Throttle body assy.*	2	*Connector*
3	*Air filter*	4	*Screw hose clamp*

Step	Procedure
3	Loosen 3 hex./torx collar screws with the separating plate.

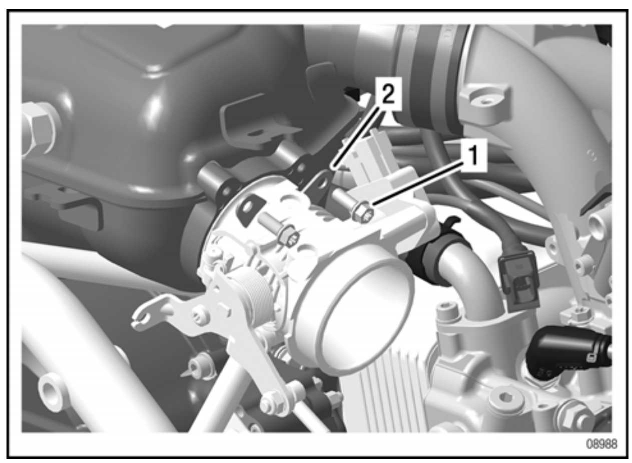

Figure 13.22

1	*Hex./torx collar screws*	2	*Separating plate*

NOTICE
Do not lose the rubber ring and ensure that it does not remain in the airbox.

Step	Procedure
4	Remove the throttle body and the rubber ring.

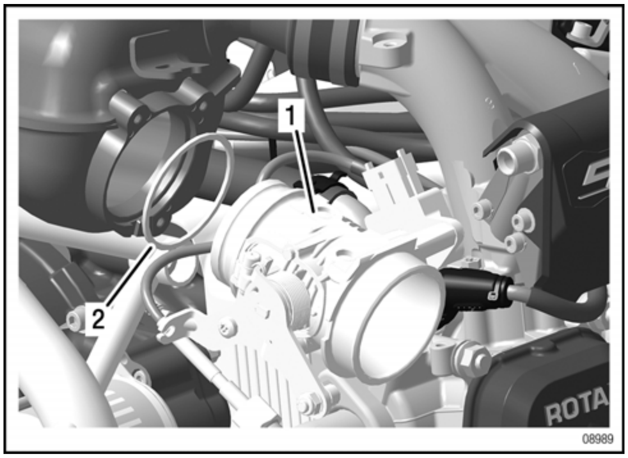

Figure 13.23

1 *Throttle body* 2 *Rubber ring*

INTAKE MANIFOLD — REMOVAL

Preparation

- Remove fuel line assy. and fuel rails.
- Remove the fuel pressure regulator assy.
- Loosen and detach the wiring harness. See Chapter 76–50–00 .
- Remove double ignition coils, see Chapter 74-20-00, section Double ignition coil – removal.

Step	Procedure
1	Remove the 1-ear clamps.

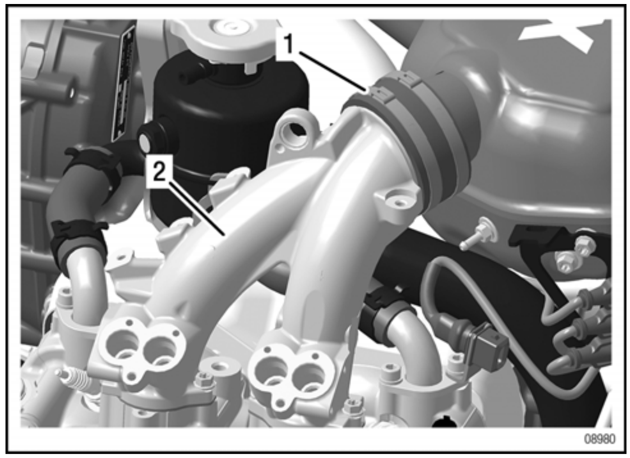

Figure 13.24

1 *1-ear clamps* 2 *Intake manifolds*

Step	Procedure
2	Loosen 4 hex./torx collar screws for attachment to the cylinder heads 2/4. Use the special tool part no. 876180.
3	Remove the intake manifold 2/4.

NOTICE

Screws cannot be completely unscrewed. To remove the screws, the intake manifold must be lifted after loosening all 4 hex./torx collar screws.

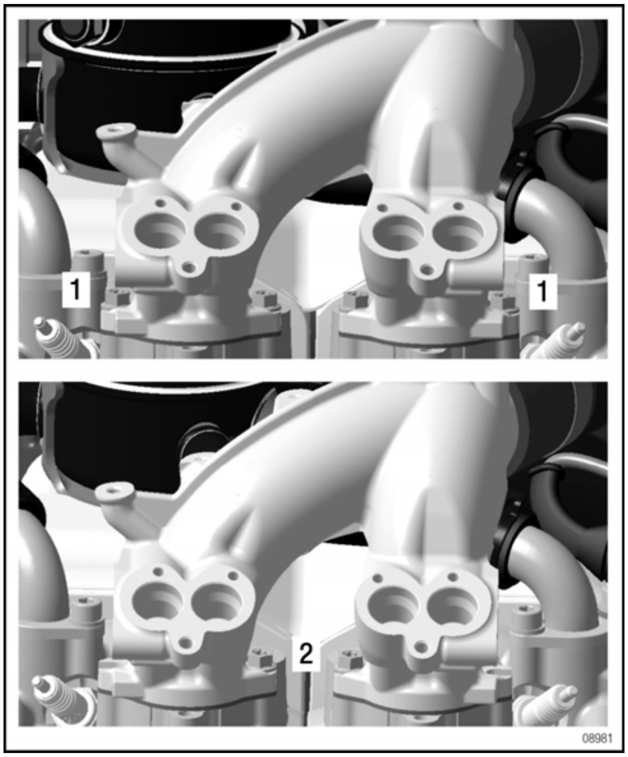

Figure 13.25: TYPICAL

1 *Outer screw-fastening* 2 *Inner screw-fastening*

Step	Procedure
4	Remove the isolating flange from the cyl-inders 2/4.
5	Close the intake duct using a plug (part no. 860397).

NOTICE

Close the intake duct immediately so that no debris particles can get into the combustion chamber!

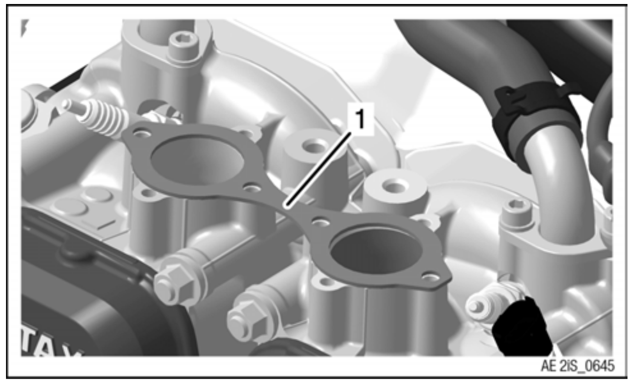

Figure 13.26

1 *Isolating flange*

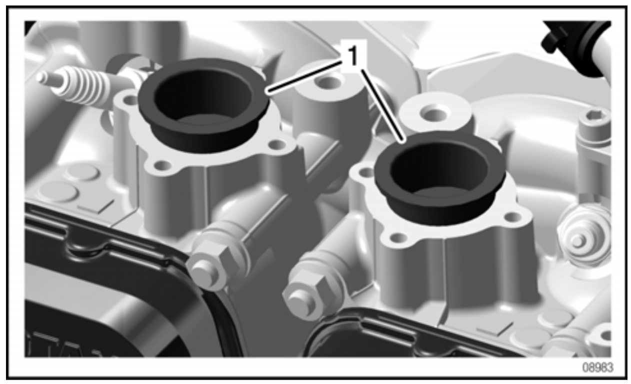

Figure 13.27

1 *Plug part no. 860397*

NOTE

Remove the intake manifold 1/3 in the same way as the intake manifold 2/4.

AIRBOX — REMOVAL

Preparation

- Unplug Manifold Air Pressure Sensors (MAPS) and Manifold Air Temperature Sensors (MATS). See 76-50-00 Wiring harness.
- Remove Knock Sensor (KNOCK) and Crankshaft Position Sensors (CPS_1/2) from the connector bracket, see 76-70-00 Sensors and actuators.
- Loosen and detach the wiring harness from all fastenings (cable ties, retaining fixtures) on the engine. See 76-50-00 Wiring harness.
- Remove intake manifolds.

Step	Procedure
1	Remove the lock nut attaching the airbox to the ignition housing along with the washer.

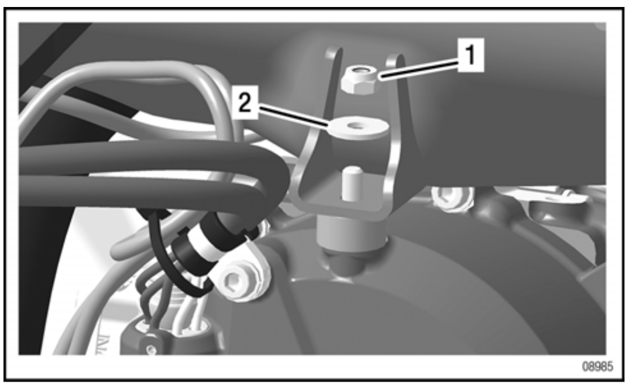

Figure 13.28

1 Lock nut *2 Washer*

Step	Procedure
2	Remove the airbox.
3	Remove the two 1-ear clamps and connecting sockets.

NOTE

The Manifold Air Pressure Sensors (MAPS) and Manifold Air Temperature Sensors (MATS) must only be removed, if absolutely necessary!
For removal and installation, see 76-70-00 Sensors and actuators.

NOTE

Remove the nipple, hex./torx-flange screw M6x16 and connector bracket only if absolutely necessary!

Step	Procedure
4	Loosen the nipple and hex./torx-flange screw M6x16.
5	Loosen 3 hex./torx-flange screws and remove connector bracket.

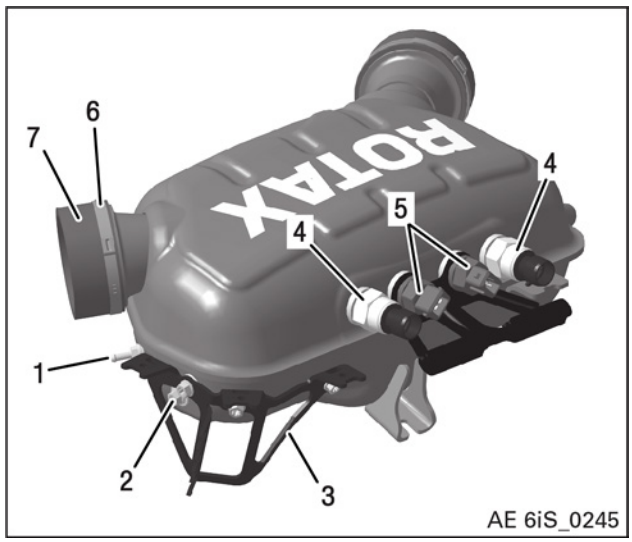

Figure 13.29

1 Nipple
2 Hex./Torx-flange screw
3 Connector bracket
4 Manifold Air Pressure Sensors (MAPS)
5 Manifold Air Temperature Sensors (MATS)
6 1–ear clamps
7 Connecting socket

FUEL PUMP ASSY. — REMOVAL

NOTE

The position and type of positioning and attachment of the fuel pump depends on the aircraft type. See aircraft manufacturer documentation.

ENVIRONMENTAL NOTE

All the operating fluids and cleaning agents can damage the environment if not disposed of properly.
Dispose of operating fluids in an eco-friendly manner!

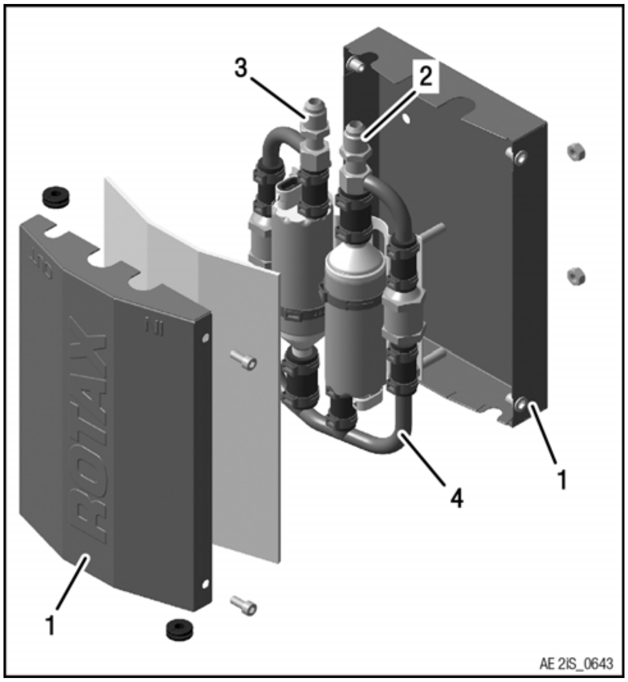

Figure 13.30: Overview

1	*Housing*	2	*Intake system*
3	*Pressure line*	4	*Fuel pump assy.*

Step	Procedure
1	Loosen 4 Allen screws from the cover.
2	Disconnect the fuel pumps (main, aux): • Lift the latches. • Unplug the connectors.
3	Disconnect the fuel inlet and outlet.

NOTE

Drain the fuel from the fuel pump and close it with appropriate plug caps.

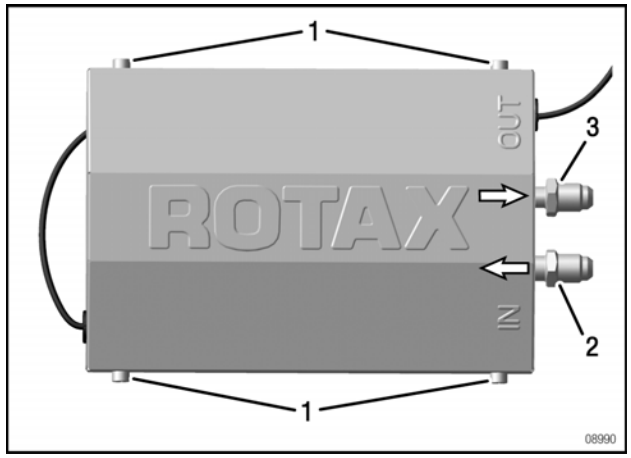

Figure 13.31

1	*Allen screws*	2	*Fuel inlet*
3	*Fuel outlet*		

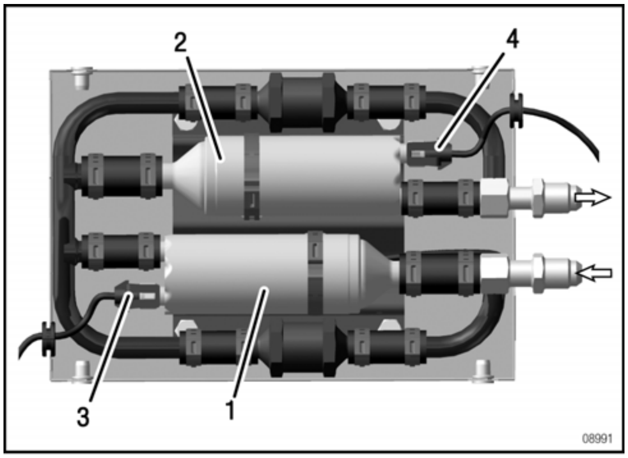

Figure 13.32

1	*Main pump (main)*	2	*Additional pump (aux)*
3	*Connector (Fuel pump 1)*	4	*Connector (Fuel pump 2)*

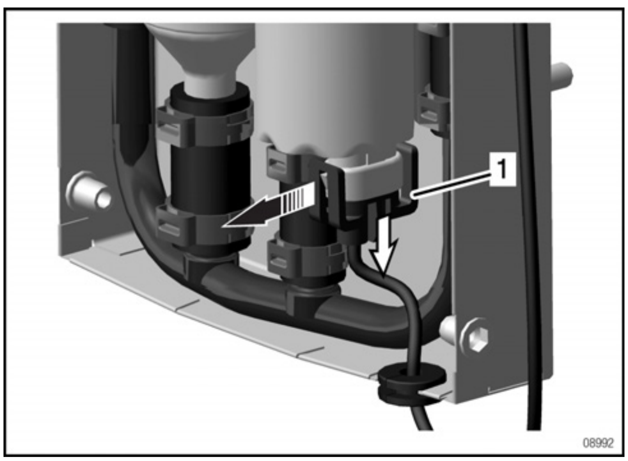

Figure 13.33

1 *Connector*

Step	Procedure
4	Remove the fuel pump module from the aircraft according to the aircraft manufacturer's manual.
5	Loosen the 4 hex. nuts and take the fuel pump unit out of the housing.

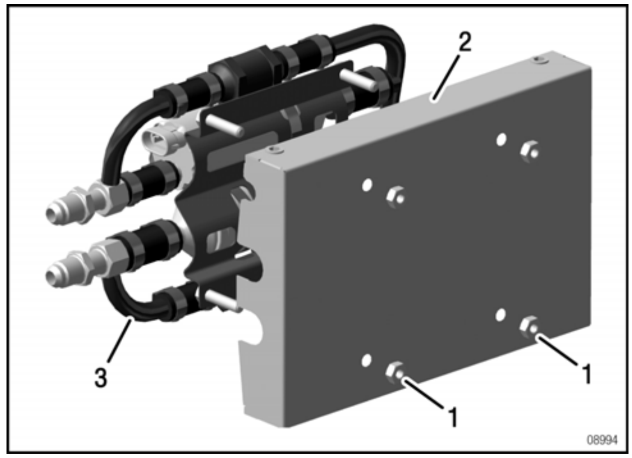

Figure 13.34

1	*Hex. nuts*	2	*Housing*
3	*Fuel pump unit*		

INSPECTION

Preparation

Clean all parts carefully.
See current Maintenance Manual Line (MML) of the respective engine type, Chapter 05-00-00 section Procedure.

FUEL LINE ASSY. — INSPECTION

Step	Procedure
1	Check the fuel line assy. for cracks, scuffing marks and kinks.

NOTICE

Cracks in the fuel distribution system, its components and hoses are not permissible!
If in doubt, check the affected parts for cracks with a florescent penetrant method.

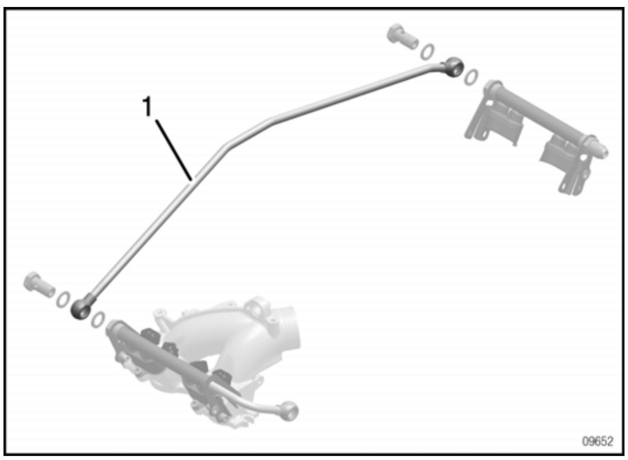

Figure 13.35

1 *Fuel hose assy.*

FUEL PRESSURE REGULATOR ASSY. — INSPECTION

Step	Procedure
1	Check all the O-rings.

NOTE

If an O-ring is damaged, the entire fuel pressure regulator must be replaced. O-rings are not available as spare parts.

Step	Procedure
2	Check the screen for dirt.

NOTE

If the screen is dirty, all the aircraft filters must be checked for function and dirt.

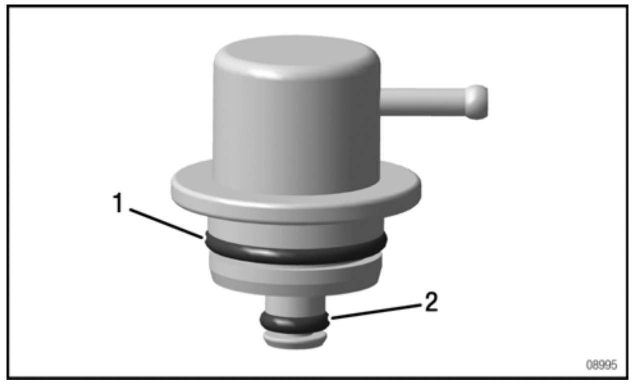

Figure 13.36

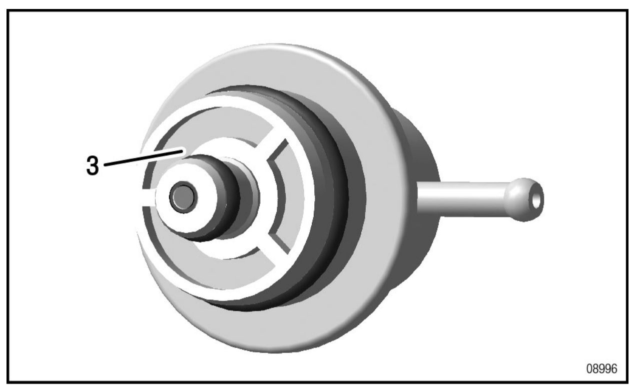

Figure 13.37

1 *20x2.5 O-ring*
2 *5x2.5 O-ring*
3 *Screen*

PRESSURE REGULATOR HOUSING — INSPECTION

Step	Procedure
1	Check the sealing surfaces of the O-rings for striations.
2	Check the recess of the retaining ring for sharp edges and burrs.

NOTE

The depressions must not have sharp edges! Sharp edges can be carefully reworked with a sharpening stone. The surface roughness must not be changed!

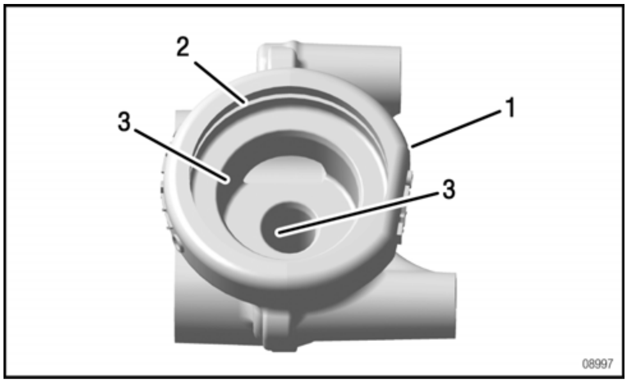

Figure 13.38

1	*Pressure regulator housing*	*2*	*Recess for retaining ring*
3	*Sealing surface for O-rings*		

FUEL RAIL — INSPECTION

Step	Procedure
1	Check the sealing surfaces for the O-rings of the injectors for scratches and burrs.
2	Visual inspection for dents, kinks and cracks.

NOTICE

The fuel rail must be replaced if damaged!

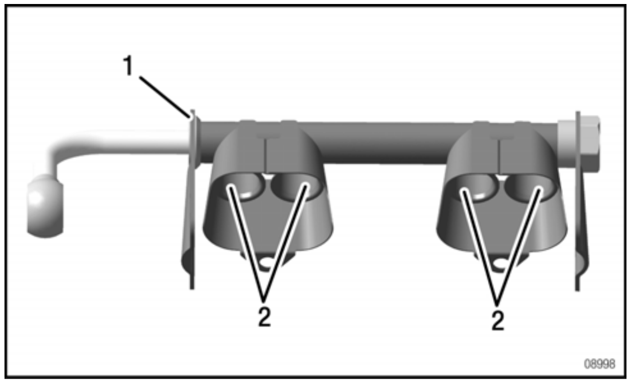

Figure 13.39

1	*Fuel rail*	*2*	*Sealing surface for O-rings*

FUEL INJECTOR — INSPECTION

NOTE

All O-rings must be replaced if the injectors have been removed.

Step	Procedure
1	Check the injectors for damage. • Scuffing marks (including scratches) on the valves are permissible up to a maximum depth of 0.2 mm (0.0079 in.).

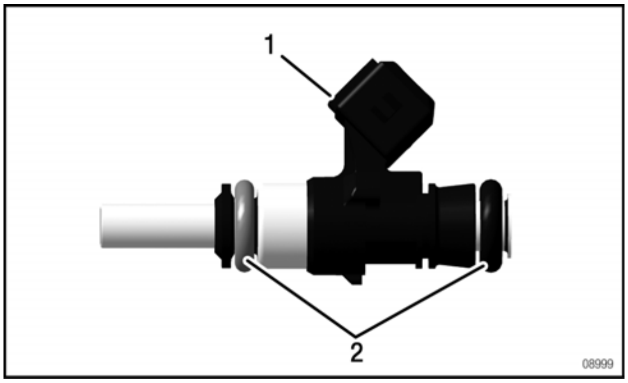

Figure 13.40

1	*Injector*	2	*O-rings*

INTAKE MANIFOLD — INSPECTION

NOTE

For intake manifold inspection, dye penetrant or similar method must be used.

Step	Procedure
1	Check the intake manifold for cracks and scuffing marks.
2	Check threaded bores for damage.
3	Check bores for injectors for scuffing marks. Scuffing marks (including scratches) on the valves are permissible up to a maximum depth of 0.2 mm (0.0079 in.).
4	Check contact faces for double ignition coil. Indentations up to a max. of 0.5 mm (0.0197 in.). Bumps up to a max. of 0.5 mm (0.0197 in.).

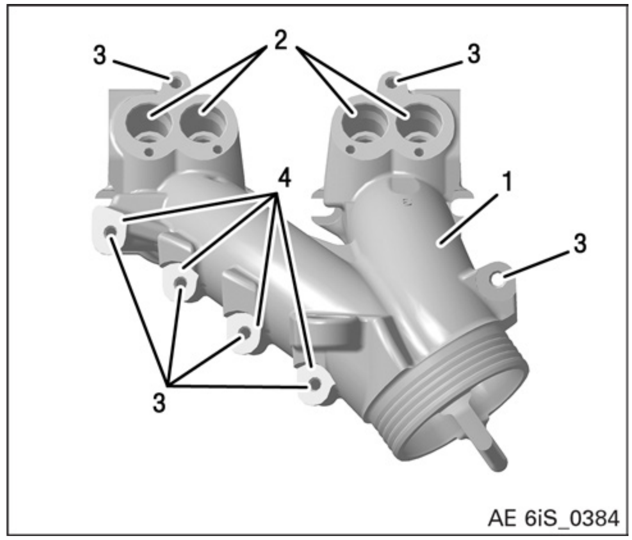

Figure 13.41

1	*Intake manifold*	2	*Injection valve bore*
3	*Threaded bores*	4	*Contact faces (double ignition coil)*

Step	Procedure
5	Check contact and flat surfaces for Allen/ hex. screws, nuts and sensors. • Indentations up to a maximum of 0.1 mm (0.0039 in.) are permissible. • Bumps up to a maximum of 0.1 mm (0.0039 in.) are permissible.

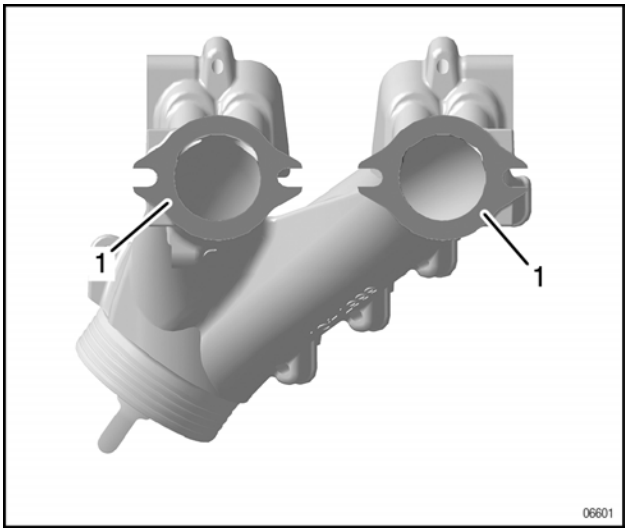

Figure 13.42

1 Contact face

CONNECTING SOCKET — INSPECTION

Step	Procedure
1	Inspect connecting socket for damage and wear.

AIRBOX — INSPECTION

Step	Procedure
1	Check the airbox for damage and wear.
2	Check the support plates for damage.
3	Check the connecting pieces for brittleness.
4	Check threaded bores for damage.

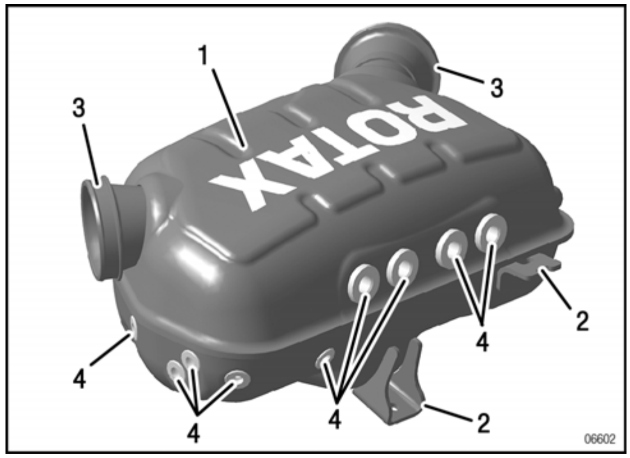

Figure 13.43

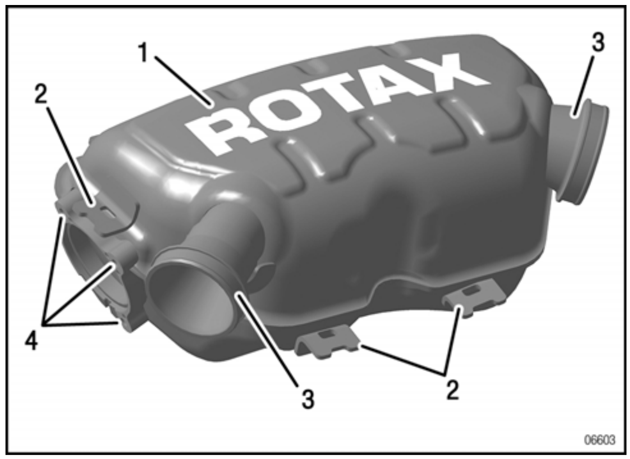

Figure 13.44

1 Airbox *2 Support plate*
3 Connecting piece *4 Threaded bores*

THROTTLE BODY — INSPECTION

NOTICE

Danger of consequent damage to engine!
The throttle body must not be re-machined! If the throttle body is damaged or worn, it must be replaced with a new part.

Step	Procedure
1	Check the throttle body for damage and wear.
2	Check the bearing of the throttle shaft for damage.

NOTE

Wear of more than 0.1 mm (0.0039 in.) is not permissible.

Step	Procedure
3	Check the throttle flap for damage.

NOTE

Traces of wear up to a maximum of 0.05 mm (0.0020 in.) in depth are permissible.

Step	Procedure
4	Check the evenness of the flat and contact surfaces of the throttle body and bent socket with respect to each other.

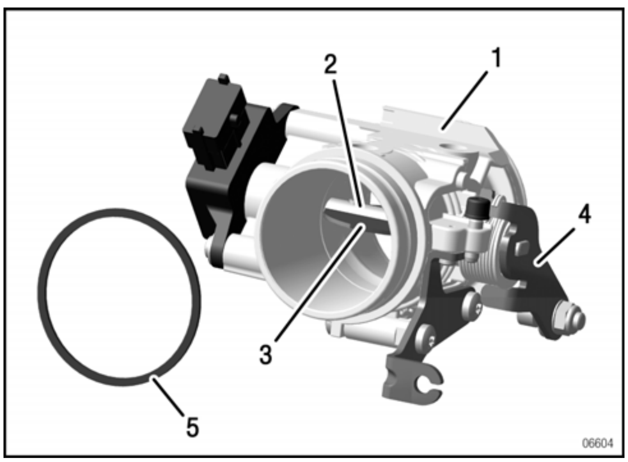

Figure 13.45

1 *Throttle body assy.*	2 *Throttle shaft*
3 *Throttle valve*	4 *Throttle cable*
5 *Rubber gasket ring*	

Step	Procedure
5	Ensure that the throttle valve and the Bowden cable can move freely.
6	Check that the fastening and securing elements are secure.

FUEL PUMP ASSY. SINGLE PARTS — CHECK

Preparation

Clean all parts carefully.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 05-00-00 section Procedures

Carry out a visual inspection.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 05-20-00 section Maintenance.

FUEL PUMP — INSPECTION

NOTE

Carry out in accordance with the latest SI-912 i-025R1, "Fuel pump Assy. for ROTAX Engine Type 912i Series".

Step	Procedure
1	Check the fuel pumps for damage and wear.
2	Check the check valves for damage and wear.
3	Check the lines and hoses for damage and wear.

NOTICE
No longitudinal scratches are allowed on the connections!

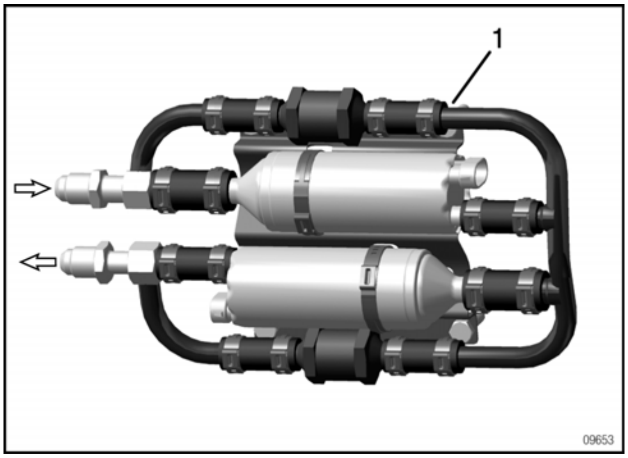

Figure 13.46

1 *Fuel pump assy.*

AIR FILTER — INSPECTION

Check the air filter according to the aircraft manufacturer's instructions. See also current Maintenance Manual Line (MML) of the respective engine type, Chapter 12-20-00.

FUEL FILTER — INSPECTION

Check the fine fuel filter according to the aircraft manufacturer's instructions. See also current Maintenance Manual Line (MML) of the respective engine type, Chapter 12-20-00.

ASSEMBLY

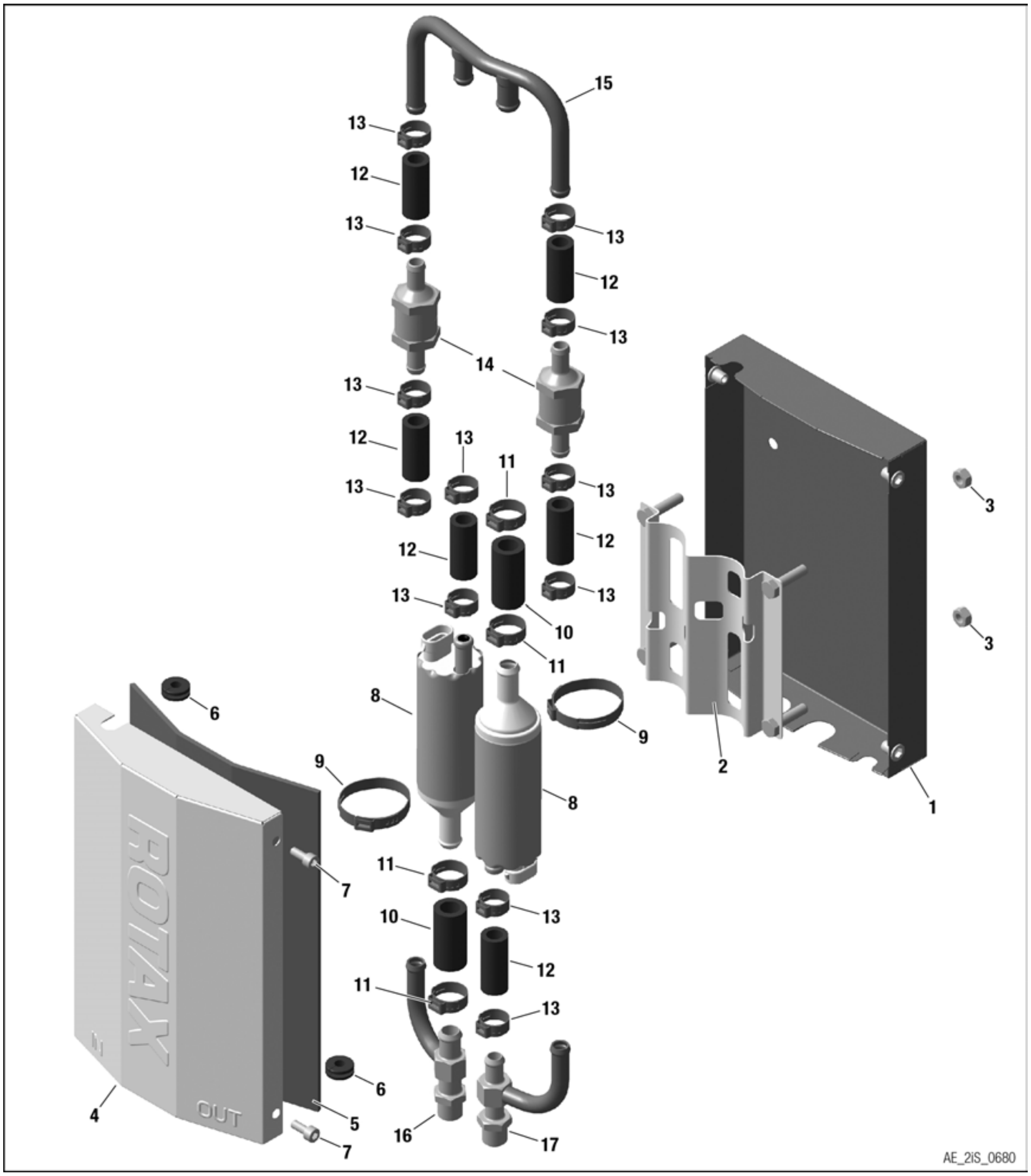

Figure 13.47: Fuel pump single parts

1	*Fuel pump housing*	2	*Fuel pump bracket assy.*
3	*Hex. nut M6*	4	*Fuel pump cover*
5	*Heat protection mat*	6	*Rubber grommet*
7	*Allen screw M5x12*	8	*Main and Aux. fuel pump*

9	*1-ear clamp*	10	*Hoses*
11	*1-ear clamp*	12	*Hoses*
13	*1-ear clamp*	14	*Check valves*
15	*Connection line*	16	*Suction line*
17	*Pressure line*		

FUEL PUMP ASSY. SINGLE PARTS — ASSEMBLY

NOTICE

Always use new parts for assembly. Only use ROTAX genuine parts for part replacement!

NOTE

Assemble with clean parts only in a clean environment!

NOTE

Ensure that check valves and fuel pumps remain in original reinitiation.

NOTE

See also SI-912 i-015 and SI-912 i-019.

For understanding the position numbers see illustration “fuel pump single parts” at the beginning of this chapter.

Step	Procedure
1	Position new hoses (pos. 12) on connection line (pos. 15).
2	Slip on new 1-ear clamps (pos. 11, 13).
3	Install the check valves (pos. 14) and the fuel pumps (pos. 8).
4	Position new hoses (pos. 10, 12) on check valves (pos. 14) and the fuel pumps (pos. 8).
5	Install new 1-ear clamp (pos. 9) on the fuel pump bracket assy. (pos. 2).
6	Slide in the check valves and fuel pumps accordingly.
7	Slip on new 1-ear clamps (pos. 11, 13).
8	Install suction line (pos. 16).
9	Install pressure line (pos. 17).

Step	Procedure
10	Temporarily position complete fuel pump module assy. (pump bracket assy. pos. 2 with fuel pumps pos. 8 etc.) in the fuel pump housing (pos. 1).
11	Arrange the position of the fuel pumps, check valves, hoses etc. accordingly to fit within the fuel pump housing.

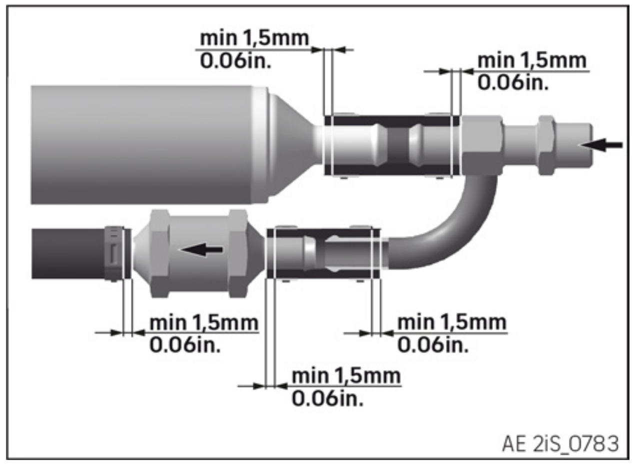

Figure 13.48

NOTICE

Do not overtighten the 1-ear clamps, otherwise the fuel pump rotor may stick and pump does not work.

Step	Procedure
12	Mount and crimp the two fuel pump 1-ear-clamps (pos. 9). **NOTE** *Use e.g. ear clamp pliers KNIPEX 1099 part no. 889537.*
13	For easier work on the consequent job tasks, remove the complete fuel pump module assy. from the fuel pump housing without relocating hoses, check valves, fuel pumps etc.

Step	Procedure
14	Mount and crimp 1-ear-clamps (pos. 11, 13). **NOTE** *Use e.g. ear clamp pliers KNIPEX 1099 part no. 889537.*
15	Place complete fuel pump module assy. (pump bracket assy. (pos. 2) with fuel pumps (pos. 8) etc.) in the fuel pump housing.
16	Install hex. nuts M6 (pos. 3) with LOCTITE 243. Tightening torque 10 Nm (89 in. lb.).
17	Before installing the fuel pump cover, perform a leakage check. See section Leakage check.
18	Install the wiring and rubber grommets (pos. 6) into fuel pump housing (pos. 1).
19	Connect electrical connectors to MAIN and AUX fuel pump (pos. 8). See Chapter 76-50-00 Wiring harness.
20	If still installed in aircraft: Connect the fuel lines from aircraft system. **NOTE** *The position and type of positioning and attachment of the fuel pump depends on the aircraft type. See aircraft manufacturer's documentation.*
21	If there is enough fuel in the tank, switch on the fuel pumps. **NOTE** *Engine is still turned off.*
22	Let the fuel pumps run for a minute.
23	Check if fuel is leaking out of the system. If a leakage occurs, fix that problem before going on.
24	Install fuel pump cover (pos. 4) using 4 Allen screws M5x12 (pos. 7). Tightening torque 6 Nm (53 in. lb.).

Leakage check

NOTICE

Make sure not to mix up IN (-LET and OUT (-LET) of fuel pump assembly in the following tasks.

Step	Procedure
1	Block the OUTLET of the fuel pump assembly with suitable connector.
2	Connect the INLET of the fuel pump assembly to a differential pressure gauge.
3	Apply 6 bar (87 psi) to the fuel pump assembly.
4	NO pressure loss is allowed on the differential pressure gauge.
5	Submerge the pressurized fuel pump assembly in a suitable fluid, e.g. fuel, universal solvent. **NOTE** *Follow leak detector solution manufacturer's instructions for its use, clean up and safety information.*
6	If any air bubbles are present at rubber hose connections, replace the clamp and ensure proper crimp. An extra clamp of each size is provided in the service kit.

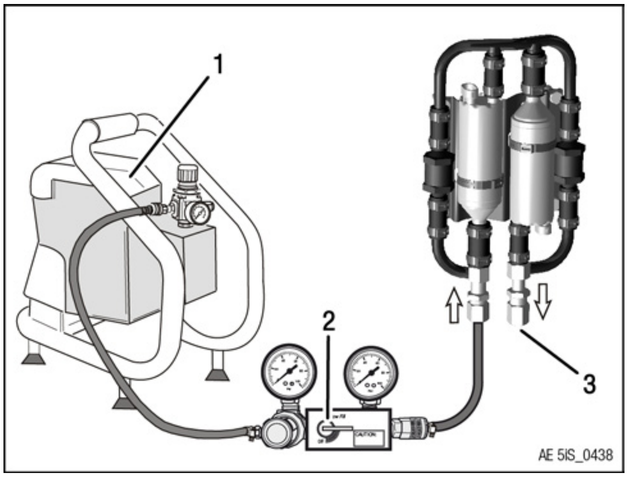

Figure 13.49: Leakage check

1 Air compressor *2 Differential pressure tester*
3 Outlet (to engine)

FUEL PUMP ASSY. — ASSEMBLY

Step	Procedure
1	Fix the fuel pump unit in the housing with 4 hex. nuts M6 with LOCTITE 243. Tightening torque 10 Nm (89 in. lb.)

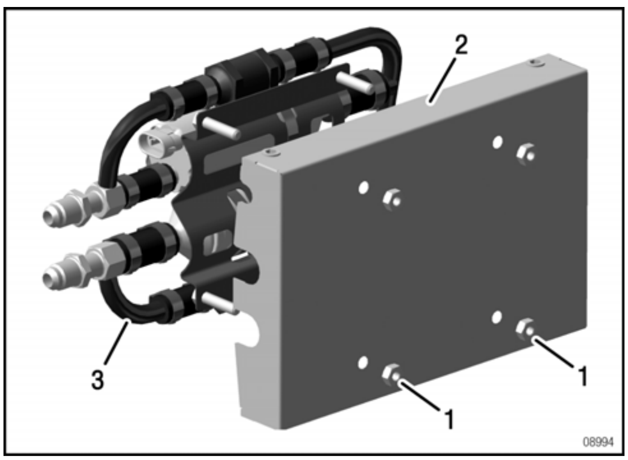

Figure 13.50

1 Hex. nut M6 *2 Housing*
3 Fuel pump unit

Step	Procedure
2	Connect the wiring harness connector appropriately. See Chapter 76-50-00 Wiring harness.
3	Fix the cover with 4 Allen screws M5x12. Tightening torque 6 Nm (53 in. lb.)
4	Install the fuel line assy. **NOTE** *The position and type of positioning and attachment of the fuel pump depends on the aircraft type. See aircraft manufacturer's documentation.*

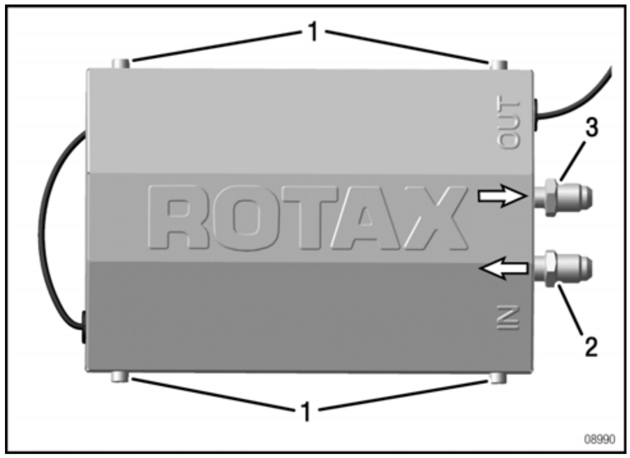

Figure 13.51

1 Allen screws M5x12 *2 Intake system*
3 Pressure line

FUEL PRESSURE REGULATOR — ASSEMBLY

Step	Procedure
1	Lubricate the O-rings lightly with Lithium-base grease.

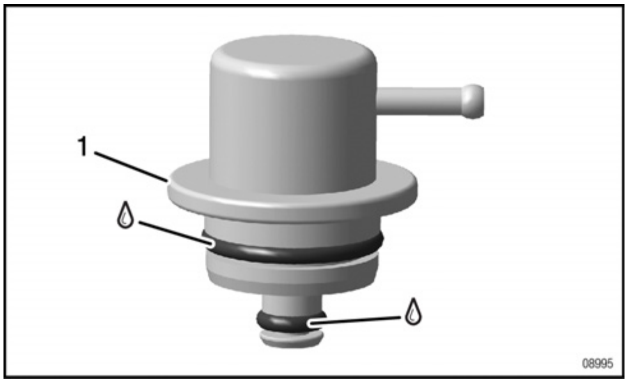

Figure 13.52

1 Fuel pressure regulator

Step	Procedure
2	Install the fuel pressure regulator in the pressure regulator housing until it stops.
3	Install the retaining ring 36x1.5 with the sharp edge to the top.

NOTE

When the retaining ring is mounted, it must be possible to rotate the fuel pressure regulator manually.

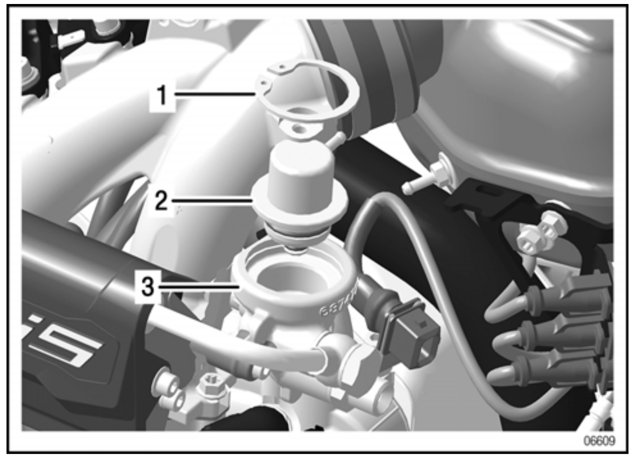

Figure 13.53

1 Retaining ring 36x1.5 *2 Fuel pressure regulator*

3 Pressure regulator housing

Step	Procedure
4	Slide the hose 60 mm (2.36 in.) onto the nipples and fasten with new cable ties.

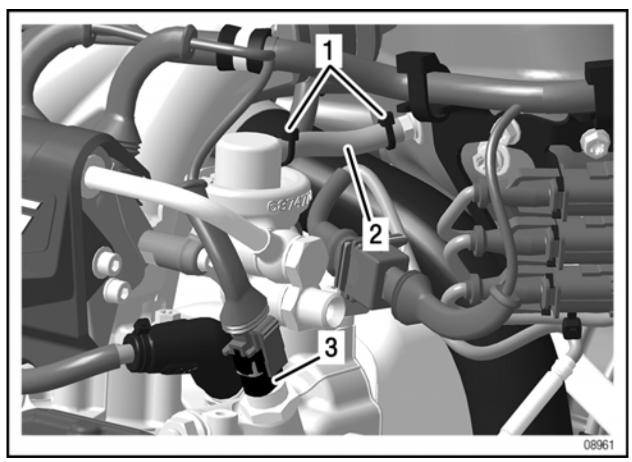

Figure 13.54

1 Cable ties *2 Hose*

3 Coolant temperature sensor (CTS)

AIRBOX — ASSEMBLY

Step	Procedure
1	Secure the nipple with LOCTITE 243. Tightening torque 8 Nm (70 in. lb.)
2	Secure the hex./torx.-flange screw M6x12 and with LOCTITE 243. Tightening torque 8 Nm (70 in. lb.)
3	Install connector bracket with 3 hex./torx.-flange screws M6x16 secured with LOCTITE 243. Tightening torque 8 Nm (70 in. lb).
4	Install 2 connecting sockets with new 1–ear clamps on the airbox.

NOTICE

1-ear clamps may only be used once!

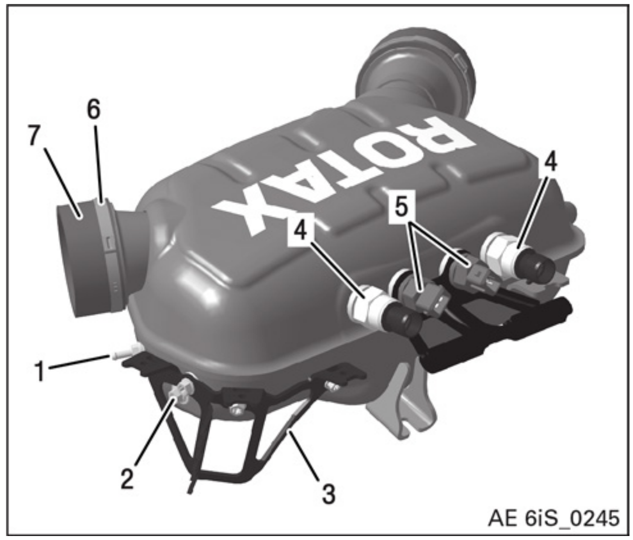

Figure 13.55

1	*Nipple*	2	*Hex./ torx-flange screw M6x12*
3	*Connector bracket*	4	*Manifold Air Pressure Sensors (MAPS)*
5	*Manifold Air Temperature Sensors (MATS)*	6	*1– ear clamps*
7	*Connecting socket*		

Step	Procedure
5	For Manifold Air Pressure Sensors (MAPS) and Manifold Air Temperature Sensors (MATS), see Chapter 76-70-00 Sensors and actuators, Installation.

INSTALLATION

For fuel pump installation see SI-PAC-016.

FUEL PUMP – INSTALLATION

AIRBOX — INSTALLATION

NOTE

Check the rubber buffer on the ignition housing for damage.

Step	Procedure
1	If necessary, install the lubricated rubber buffer 20x10xM6 on the ignition housing with LOCTITE 243. Tightening torque 4 Nm (27 in. lb.).
2	Fix the airbox with a new lock nut M6 and washer 6.4 on the ignition housing. Tightening torque 10 Nm (89 in. lb.).

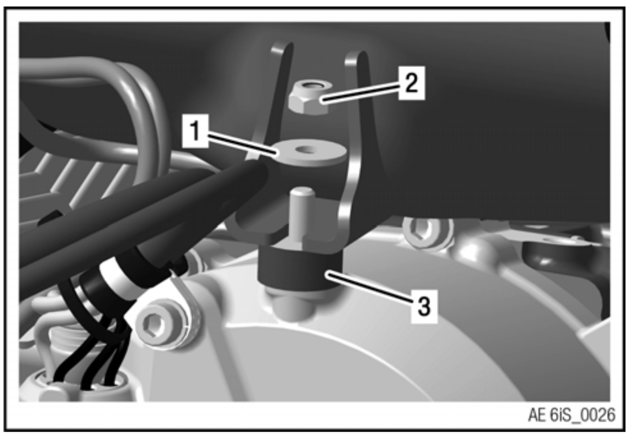

Figure 13.56

1 *Lock nut M6*
2 *Washer 6.4*
3 *Rubber buffer 20x10xM6*

INTAKE MANIFOLD — INSTALLATION

Preparation

- Open the intake duct remove plug (part no. 860397)

NOTE

Airbox must be installed.

Step	Procedure
1	Place new isolating flange on the cylinder heads.

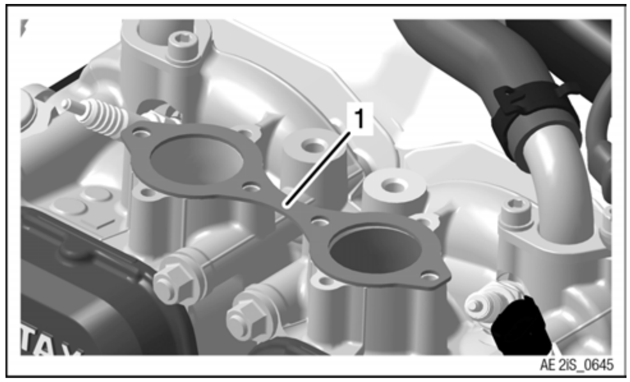

Figure 13.57

1 *Isolating flange*

NOTICE

1-ear clamps may only be used once!

Step	Procedure
2	Place intake manifolds on the cylinders and install it into the connecting socket. **NOTE** *Before install the new 1– ear clamps on the connecting socket.*
3	Fix the 2/4, 1/3 intake manifolds with 8 hex./torx collar screws M6x20 from the in-side outwards, using special tool part no. 876180. Tightening torque 10 Nm (89 in. lb.). **NOTE** *Check tightening torque after engine test run once more.*
4	Install new 1 -ear clamps with the pliers.

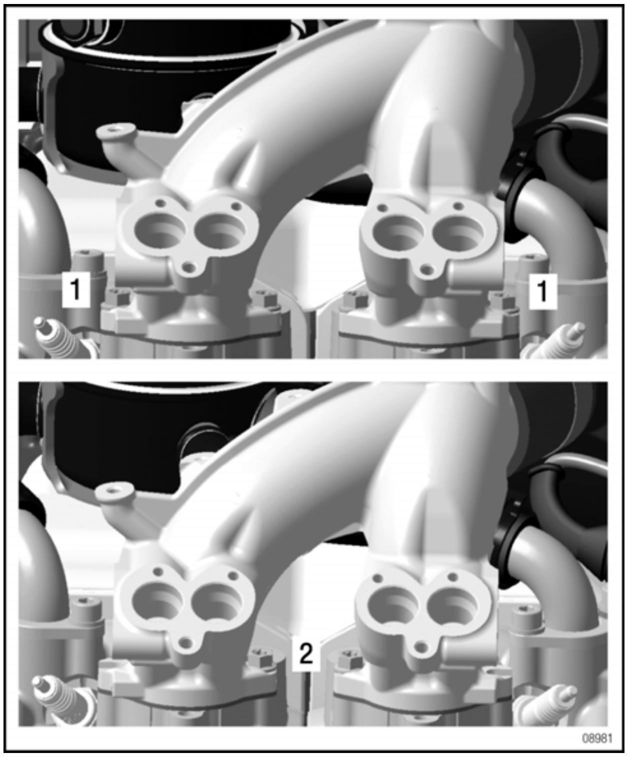

Figure 13.58: TYPICAL

1	*Outer screw-fastening*	2	*Inner screw-fastening*

Image Tag Expected within Figure Tag

1	*1-ear clamp*	2	*Intake manifold*

FUEL RAIL – INSTALLATION

Step	Procedure
1	Lubricate the O-rings of the injectors lightly with Lithium-base grease.

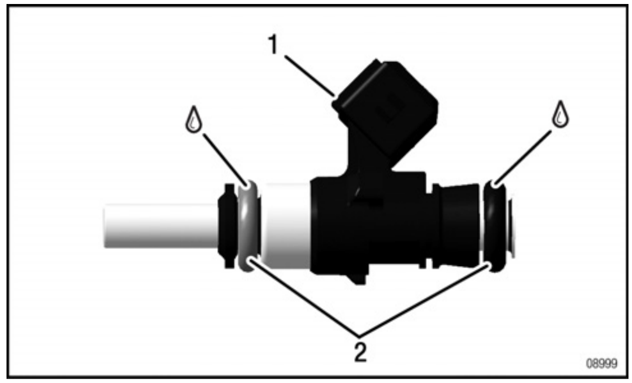

Figure 13.59

1	*Injector*	2	*O-rings*

NOTE

When a used injector is reinstalled, new O-rings must be installed.

Step	Procedure
2	Install dampers and injectors.

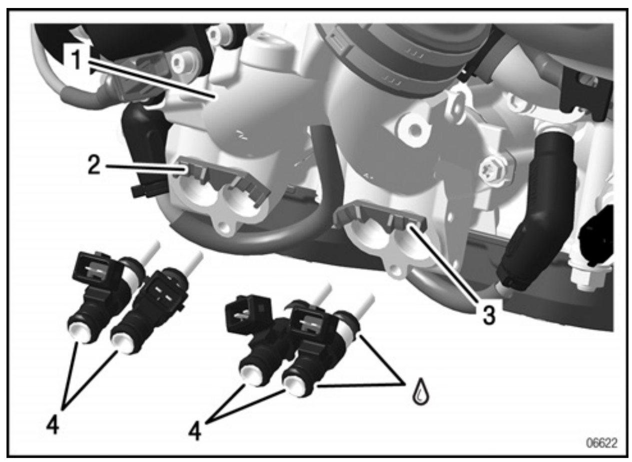

Figure 13.60

1	*Intake manifold*	2	*Left damper*
3	*Right damper*	4	*Injectors*

NOTE

The left and right damper are different and are used to position and fix the injectors.

Step	Procedure
3	Fix the fuel rail on the left and right of the intake manifold with Allen screws M5x12 and lock washers A5. Tightening torque 5 Nm (44 in. lb.)

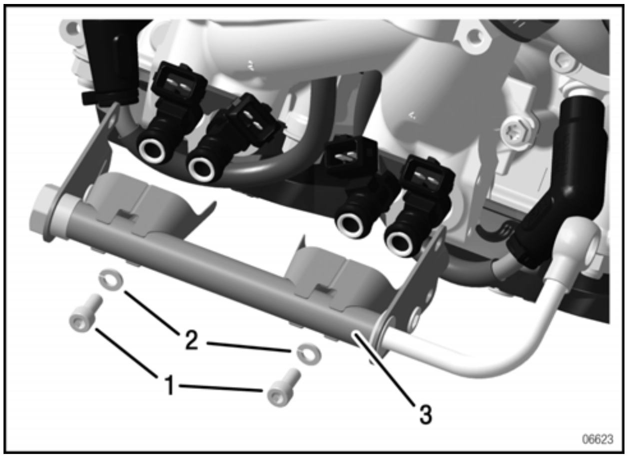

Figure 13.61

1 Allen screws M5x12
2 Lock washers A5
3 Fuel rail

Step	Procedure
4	Plug the connectors (labeled INJ_1 to INJ_8) into the correct fuel injector. Positioning of the connectors must be as shown in following figure “Connection overview”.

NOTE

The cables are labelled INJ_1 to INJ_8.

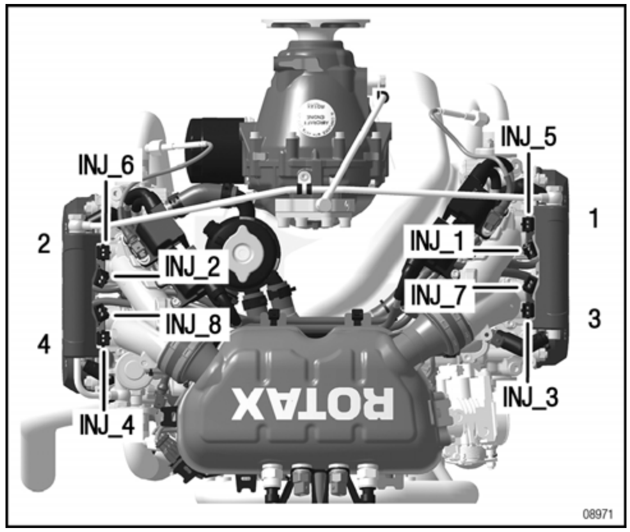

Figure 13.62

NOTICE

Do not damage the Exhaust Gas Temperature Sensor (EGT).

Step	Procedure
5	Fasten the heat shield with 4 Allen screws M5x12 and lock washers A5. Tightening torque 5 Nm (44 in. lb.)

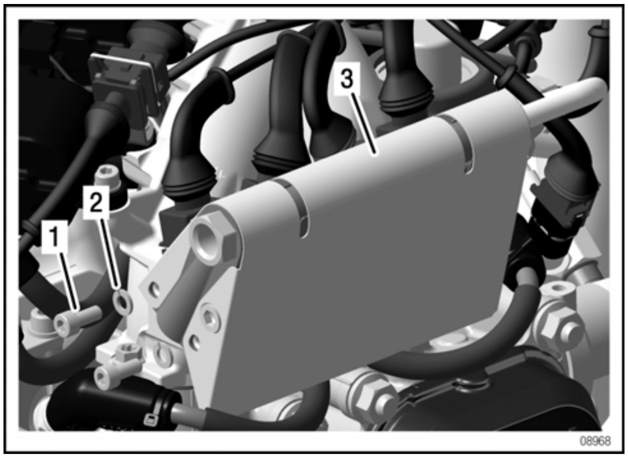

Figure 13.63

1	*Allen screw M5x12*	2	*Lock washer A5*
3	*Heat shield*		

Step	Procedure
6	Fix the fuel pressure regulator with Allen screw M5x35 (only cylinder 4). Tightening torque 8 Nm (70 in. lb.).

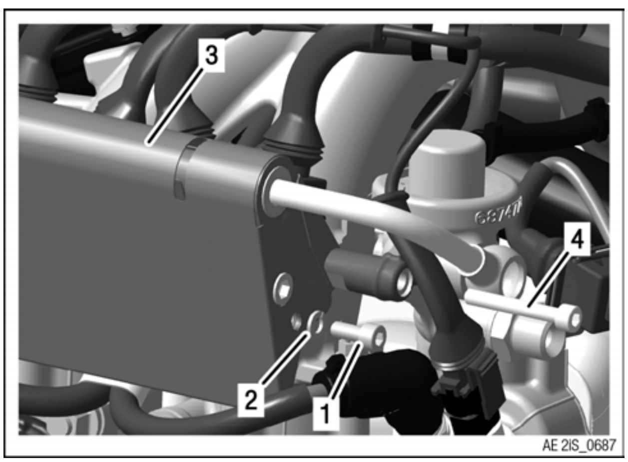

Figure 13.64

1	*Allen screw M5x12*	2	*Lock washer A5*
3	*Cover*	4	*Allen screw M5x35*

Step	Procedure
7	Install the fuel rail cover with Allen screws M5x12 and spring washers 12x5.2x0.5. Tightening torque 5 Nm (44 in. lb.)

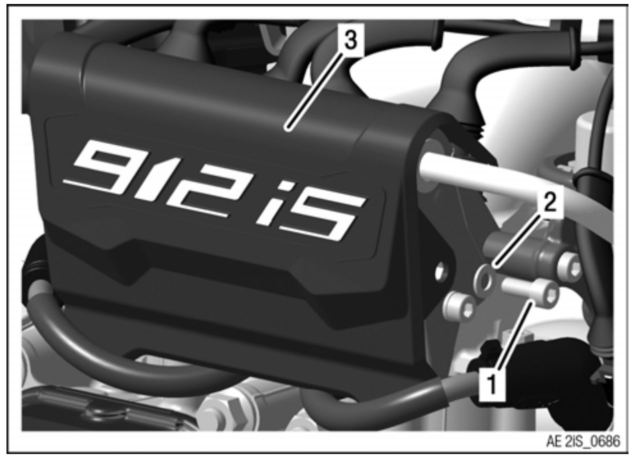

Figure 13.65

1	*Allen screw M5x12*	2	*Spring washer 12x5.2x0.5*
3	*Fuel rail cover*		

FUEL PRESSURE REGULATOR ASSY. — INSTALLATION

NOTICE

Do not damage the Exhaust Gas Temperature Sensor (EGT) on cylinder 4.

Step	Procedure
1	Fix the fuel pressure regulator assy. with an Allen screw M5x35 and an Allen screw M5x45. Tightening torque 8 Nm (70 in. lb.).

NOTE

Tighten the Allen screw M5x45 first. The heat shield is screwed on along with the front Allen screw M5x35.

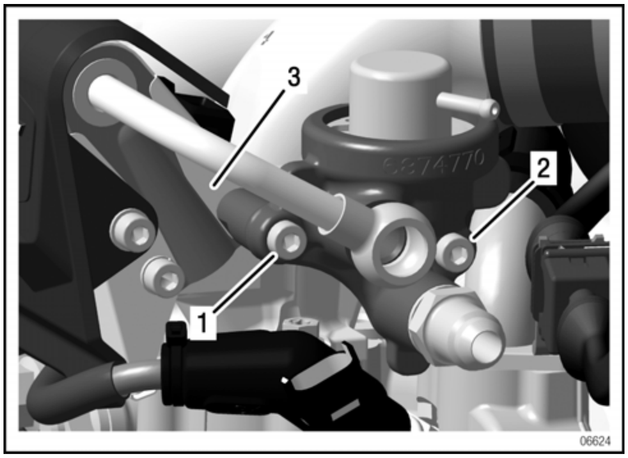

Figure 13.66

1 *Allen screw M5x35*
2 *Allen screw M5x45*
3 *Heat shield*

Step	Procedure
2	Install the banjo bolt M12x1.5x24 with new sealing rings A12x18. Tightening torque 25 Nm (18 ft. lb.).

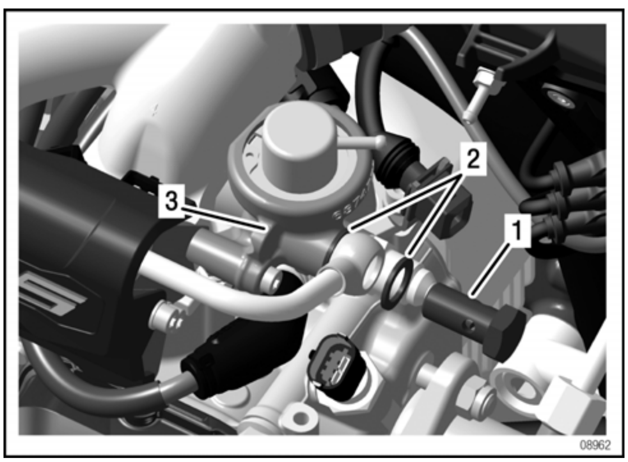

Figure 13.67

1 *Banjo bolt M12x1.5x24*
2 *Sealing rings A12x18*
3 *Fuel pressure regulator assy.*

Step	Procedure
3	Fix hose 60 (regulator/airbox) with 2 cable ties.
4	Plug in the coolant temperature sensor (CTS), see Chapter 76-70-00 Sensors and actuators.

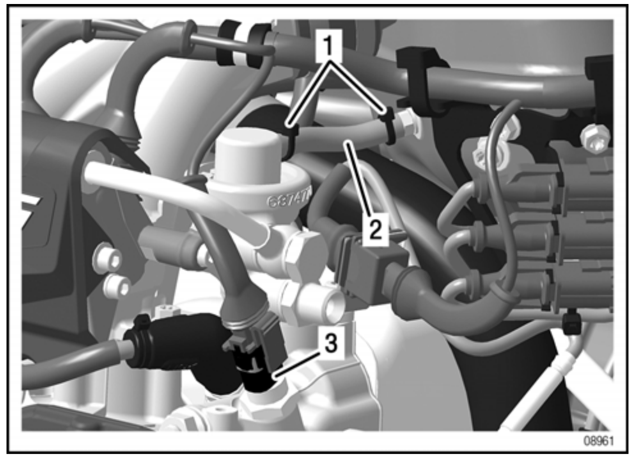

Figure 13.68

1 *Cable ties 94x2.5 mm*
2 *Hose 60 +/-3mm*
3 *Temperature sensor CTS*

NOTE

If necessary install adapter metric or UNF and a new sealing ring A12x18 lubricated with LOCTITE 648. Tightening torque 25 Nm (18 ft. lb.).

FUEL LINE ASSY. — INSTALLATION

NOTICE

Install the fuel line assy. in a tension-free manner. If the line is too far away from the fuel rail, the fuel line must be adjusted. The sealing surfaces must be parallel.To be sure: The banjo bolts must fit without twisting (fuel line) and must be able to be hand tightened.

Step	Procedure
1	Fix the fuel line assy. on the left and right fuel rails with banjo bolts M12x1.5x24 with 2 new sealing rings A 12x8. Tightening torque 25 Nm (18 ft. lb.).

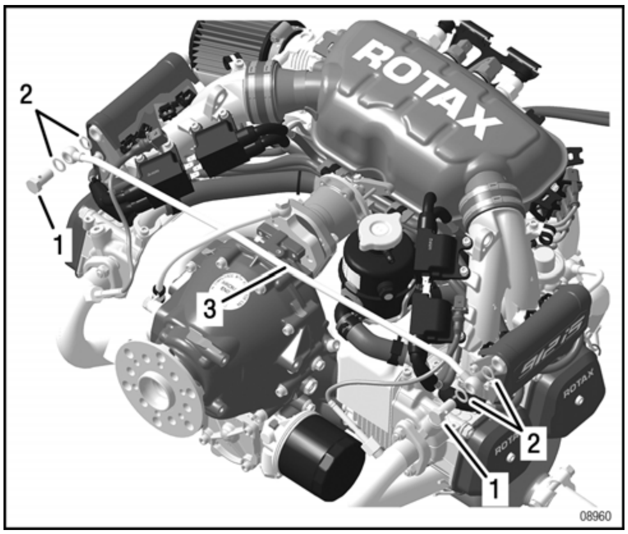

Figure 13.69

1 *Banjo bolt M12x1.5*
2 *Sealing ring A12x18*
3 *Fuel line assy.*

Step	Procedure
2	Secure the cable clamp 8/M6 with an Allen screw M6x16 and lock washer A6 on the propeller gearbox with LOCTITE 243. Tightening torque 10 Nm (89 in. lb.).

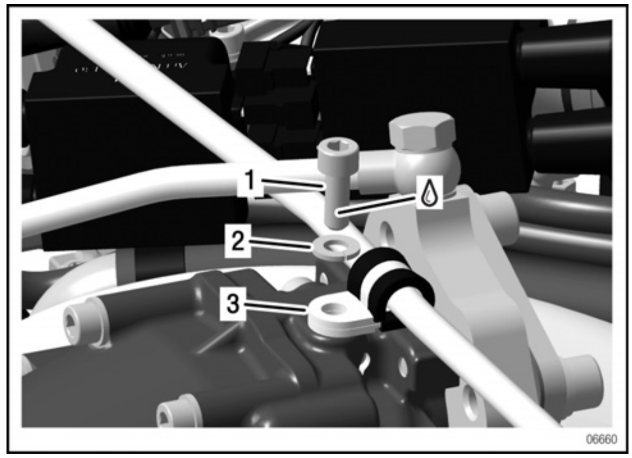

Figure 13.70

1 *Allen screw M6x16*
2 *Lock washer A6*
3 *Cable clamp 8/M6*

THROTTLE BODY ASSY. — INSTALLATION

NOTE

When the throttle body is installed, a new rubber gasket ring must be used!

Step	Procedure
1	Install the rubber gasket ring.

NOTE

The rubber gasket ring is installed dry!

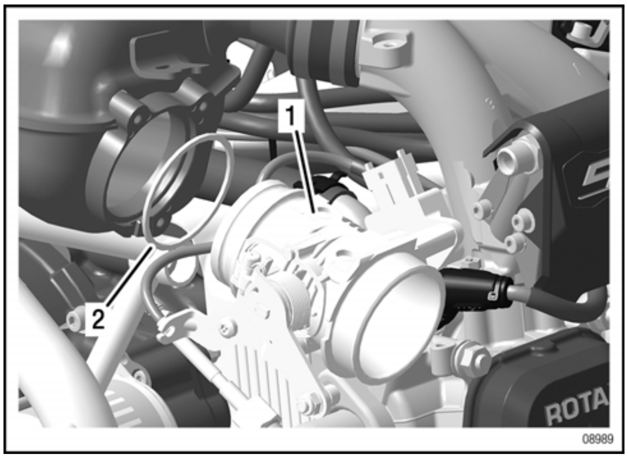

Figure 13.71

1 *Throttle body assy.* 2 *Rubber gasket ring*

Step	Procedure
2	Push the throttle body into the airbox. Secure 3 hex./torx collar screws and fixation latch with LOCTITE 243. Tightening torque 10 Nm (89 in. lb.).

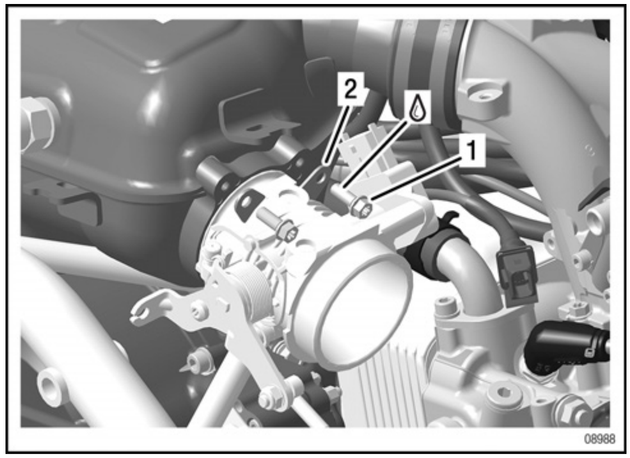

Figure 13.72

1 *Hex./torx collar screws M6x12* 2 *Fixation latch*

Step	Procedure
3	Install the air filter, follow the instructions by the aircraft manufacturer.
4	Connect the Throttle Position Sensor (TPS), see Chapter 76–50–00 Wiring Harness - installation.

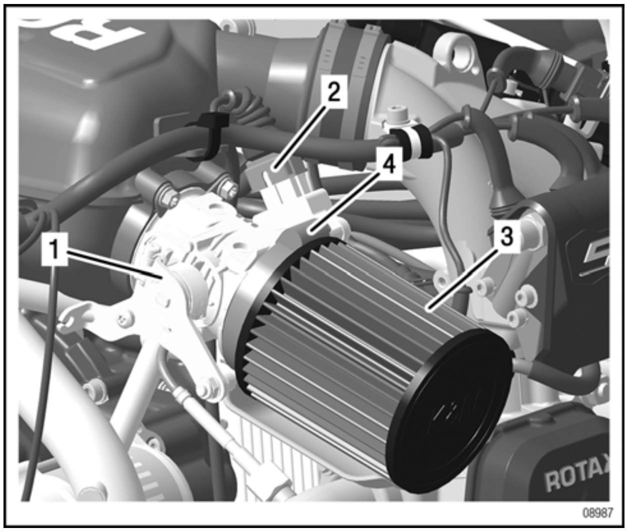

Figure 13.73

1	*Throttle body assy.*	*2*	*TPS connector*
3	*Air filter*	*4*	*Screw hose clamp*

FINISHING WORK

- Install double ignition coil, see 74-20-00, section
- Install Knock sensor (KNOCK) and Crankshaft Position Sensor (CPS_1/2) into the connector bracket, see 76-70-00 section Sensors and actuators.
- Connect the Manifold Air Pressure Sensors (MAPS) and Manifold Air Temperature Sensors (MATS) see, 76-50-00 Wiring harness
- Tighten the wiring harness on all fastenings (cable ties, retaining fixtures) of the engine, see 76-50-00 Wiring harness

Install the Bowden cable on throttle body assy.
Follow the instructions of the aircraft manufacturer.

Install the feed line to fuel rail 1/3 and the return line to fuel rail 2/4 and fuel pressure regulator.
Follow the instructions of the aircraft manufacturer.

Fill with operating fluids or check filling levels.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-10-00 section Adding operating fluids.

Carry out an engine test run.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Planned maintenance

NOTE

After engine test run, check tightening torque from intake manifold attachment screws again.

INTENTIONALLY LEFT
BLANK

Chapter: 74–00–00
IGNITION UNIT

TOPICS IN THIS CHAPTER

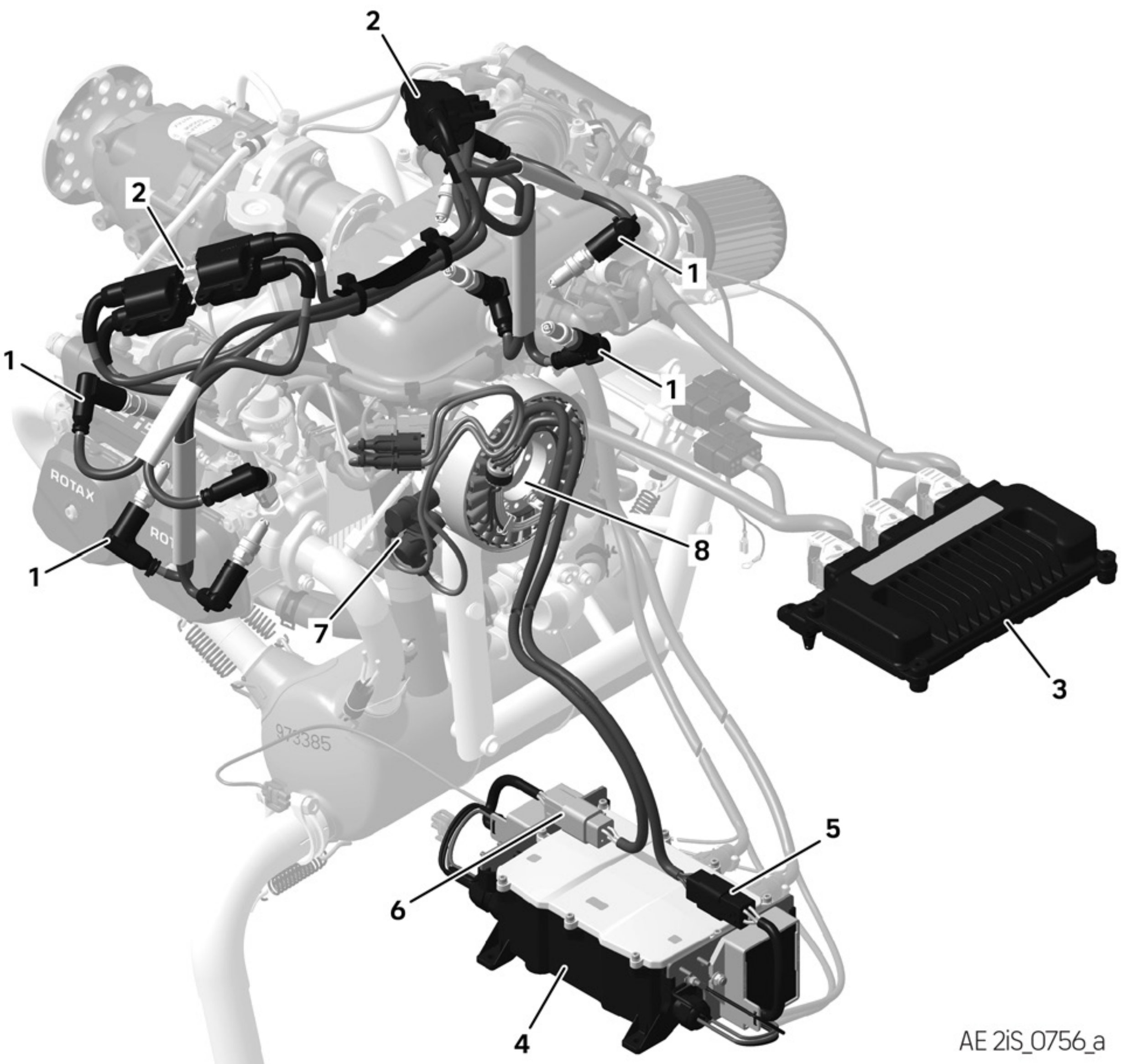

Figure 14.1: Ignition unit

1	*Spark plug connector*	2	*Double ignition coil*
3	*Engine control unit (ECU)*	4	*Fuse box assy.*
5	*Connector generator A*	6	*Connector generator B*
7	*Crankshaft position sensor (CPS 1/2)*	8	*Generator A and B*

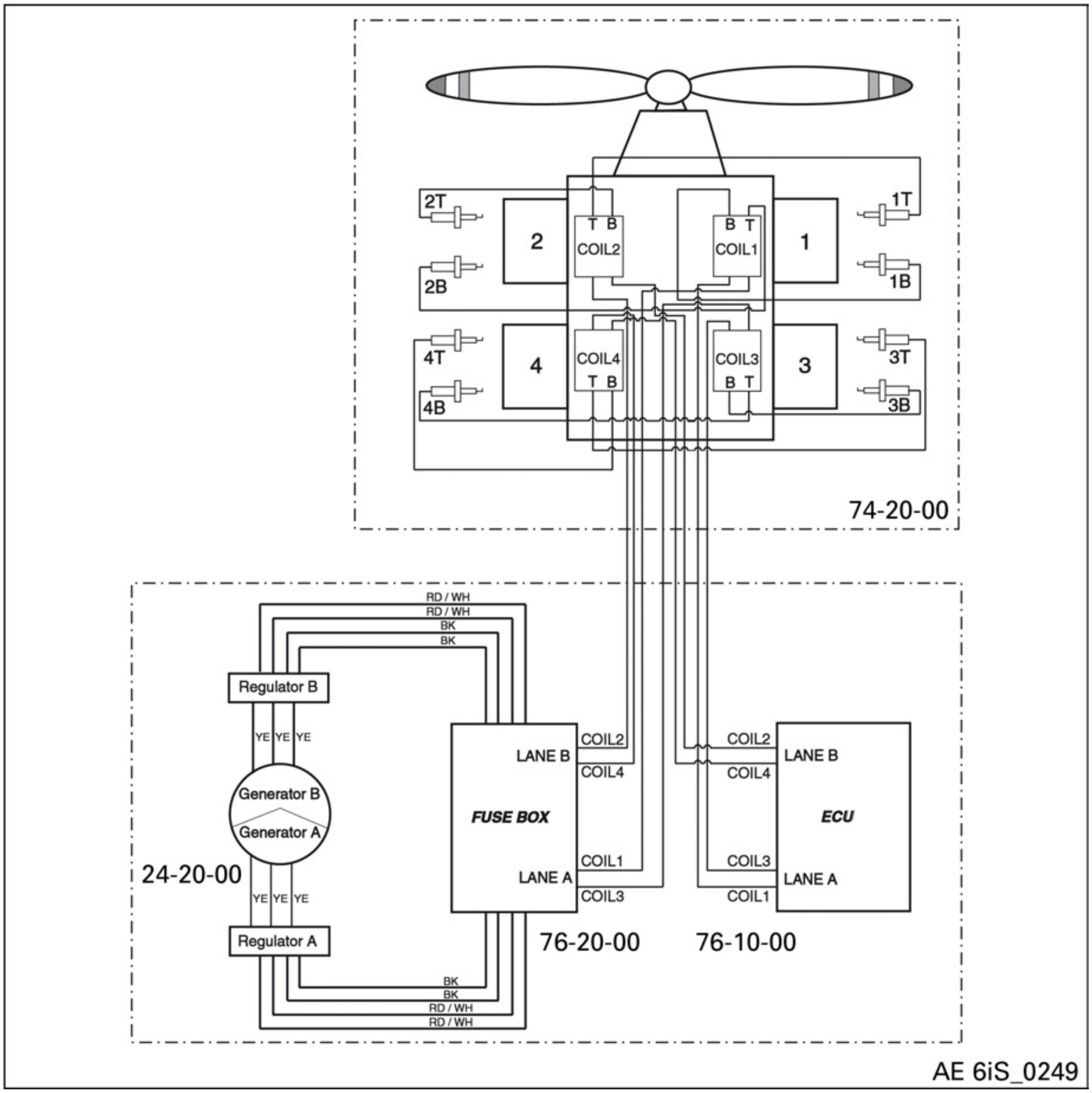

Figure 14.2: Layout plan allocation (cylinder/LANE)

SYSTEM DESCRIPTION

The ignition unit operates with four double ignition coils with double ignition. If the LANE selector switchs are both ON, the active LANE controls all four double ignition coils which are connected to the eight spark plugs. In normal Dual LANE Mode (both ON), both spark plugs ignite each cylinder at the same time. In LANE A or LANE B Mode, only one spark plug ignites per cylinder (one LANE switched OFF).

The ignition unit does not require an external power supply.

FIRING ORDER

1–4–2–3

INTERNAL GENERATORS A AND B

In normal operation generator A is supplying the double ignition coils via the fuse box. Generator B charges the battery via the fuse box.
When engine is started at first generator B supplies the double ignition coils. If throttle is opened and engine revs more than 2700 rpm for a few seconds, the fuse box switches to generator A to supply the double ignition coils and generator B charges the battery.
If more electric energy for the non-engine consumers of the aircraft is needed, an external generator (optional available) can be used.

SAFETY INSTRUCTION

⚠ WARNING

Follow the general safety instructions during all work on the engine and the assemblies around it. See section Introduction.

CONNECTIONS FOR DISPLAY SYSTEMS

NOTICE

Follow the instructions in the Installation Manual (IM) for respective engine type regarding connections for instrumentation.

KNOCK SENSOR

The knock sensor is situated directly on the cylinder head and helps to prevent any uncontrolled combustion (engine knocking).

Chapter: 74–20–00
DISTRIBUTION

TOPICS IN THIS CHAPTER

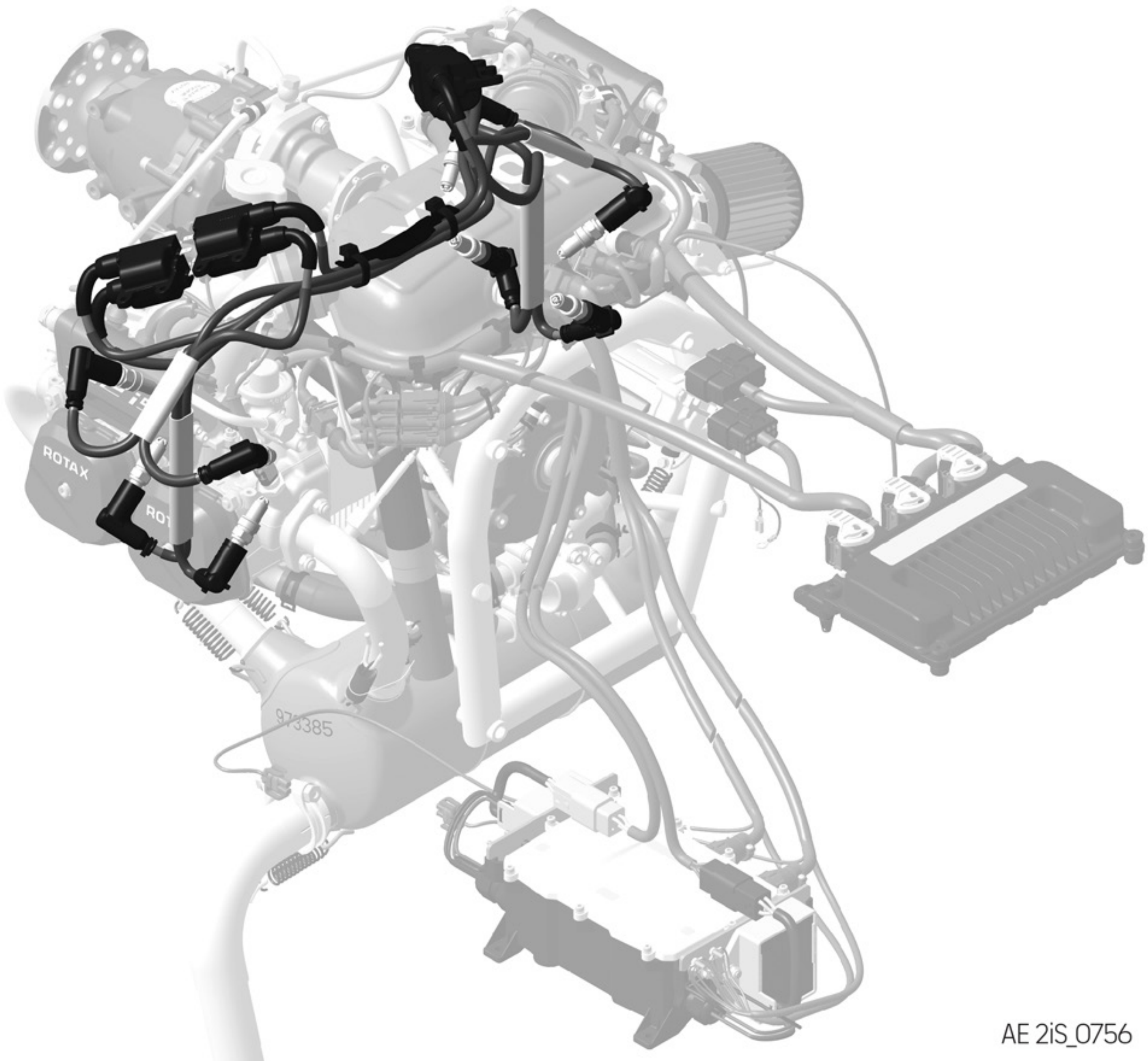

Figure 15.1: Location on the engine

SERVICE PRODUCTS

Description	Part number
Silicon heat compound WACKER P12	897186

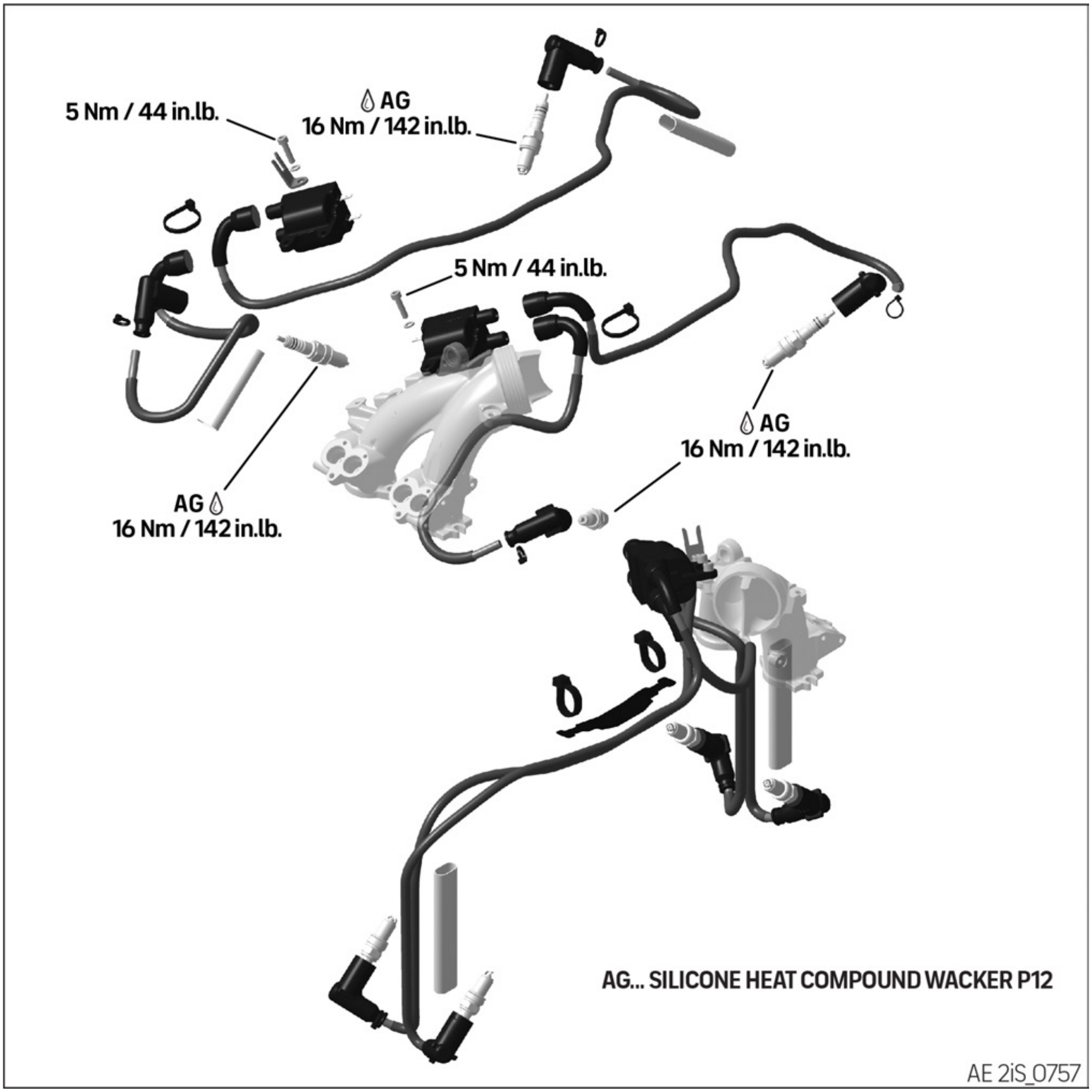

Figure 15.2: Double ignition coils with blade receptacle (male) connectors

SYSTEM DESCRIPTION

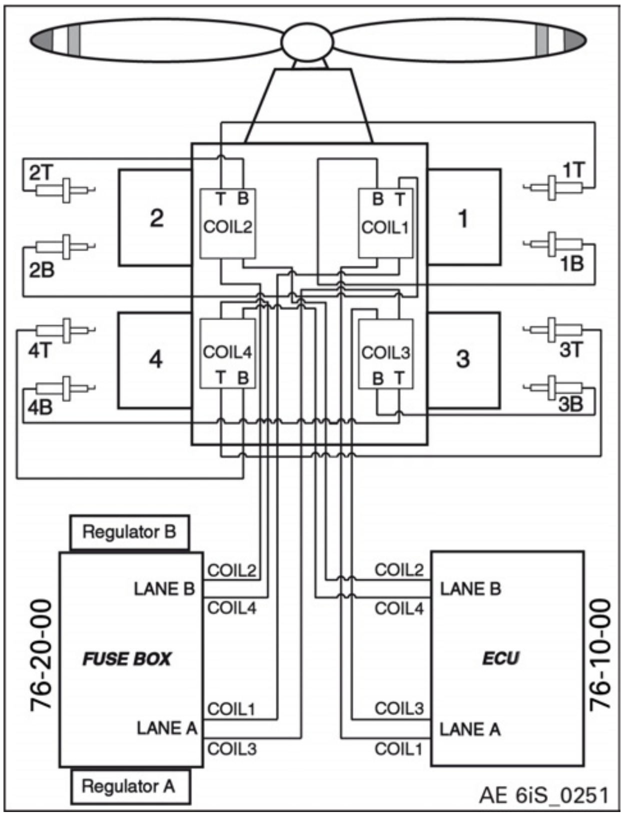

Figure 15.3: Layout plan allocation

The ignition voltage is distributed directly to the cylinders by stationary, electronically controlled components.
The ignition voltage is generated by four double ignition coils which are situated above the spark plugs.
The ignition unit is synchronised by the signals of the position sensors (see Chapter 76- 70-00 section Sensors and actuators) of the crankshaft, which are sent to the control unit (ECU) (see Chapter 76- 10-00 section Control unit (ECU)). To determine the optimal ignition point, the ECU uses its programmed ignition map to adapt to the different operating states, taking into account the signals of the knock sensor.

INTERNAL GENERATORS

See Chapter 24-20-00 section Internal generator.

DOUBLE IGNITION COILS

The four double ignition coils are fastened to the intake manifolds.

NOTE

The connections are labelled according to the closest cylinder designation.

IGNITION CABLE ASSY.

The high voltage ignition cable consist of copper alloys for applications at high ignition temperatures.

Protection hose identification

The protection hoses of the ignition cables are labelled on both ends:

- On the spark plug connector side the hose is labelled with a number/Letter combination (1 T, 1. B...)
- On the coil end the label marks the position of the ignition cable on the ignition coil and on the cylinder head.

1, 2, 3 and 4 = cylinder
T, B = Top, Bottom

NOTE

The cables are only available as complete set (ignition cable, protection hose, ignition coil side connector).

SPARK PLUGS

The spark plugs are not shielded but use a resistance type suppressor to prevent interference.

The connecting bolt for the high-voltage ignition cables complies with ISO/DIN standard guidelines.

WIRING HARNESS

All the electrical components necessary for the engine are connected to the wiring harness. See 76-50-00 Wiring harness.

FUSE BOX

The fuse box contains the capacitors and all the fuses. See Chapter 76–20–00 Fuse box.

CRANKSHAFT POSITION SENSOR (CPS)

The crankshaft position sensor sends information to the control unit about the rotation speed and crankshaft position.

SAFETY INFORMATION

⚠ WARNING

Danger of electric shock! Switch off the ignition and pull out the ignition key! Disconnect the negative terminal of the battery.

⚠ WARNING

Danger of death due to high voltage!
Only carry out work on the ignition unit with the appropriate protective measures and devices!

⚠ WARNING

Follow the general safety instructions during all work on the engine and the assemblies around it. See Chapter 00-00-00, section Safety Information.

REMOVAL

Preparation

- Switch the ignition off

Engine cleaning.
See current Maintenance Manual Line (MML) for the respective engine type.

General visual inspection.
See current Maintenance Manual Line (MML) for the respective engine type.

INTERNAL GENERATOR — REMOVAL

See Chapter 24-20-00 section Internal generator.

SPARK PLUG CONNECTOR AND IGNITION CABLE ASSY. — REMOVAL

NOTICE

Do not damage the cables.
Always cut cable ties on the side of the support plate facing away from the cables.

Step	Procedure
1	Remove cable ties.
2	Detach spark plug connector from the spark plug and unscrew the spark plug connector. **NOTE** *To remove the ignition cables it is only necessary to remove the lower spark plug connectors.*
3	Remove ignition cable from double ignition coils if necessary. **NOTE** *Ignition coil connectors are plugged (uncommon) or screwed (most common) with the ignition coil plugs.*

NOTE

The rubber seal may need to be pulled back off the coil in order to unscrew the cable.

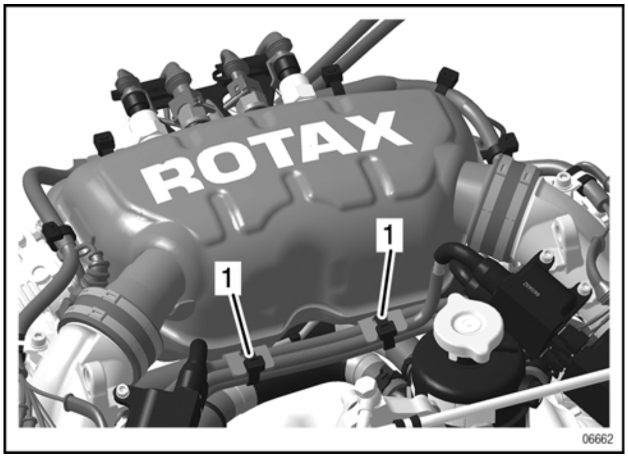

Figure 15.4: TYPICAL

1 *Cable ties*

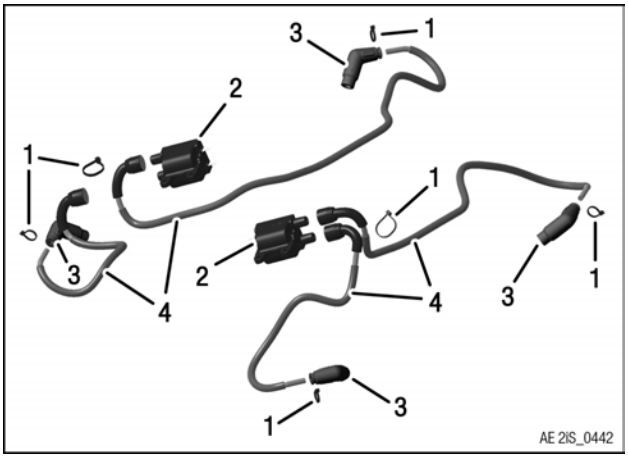

Figure 15.5: Screwed version (most common)

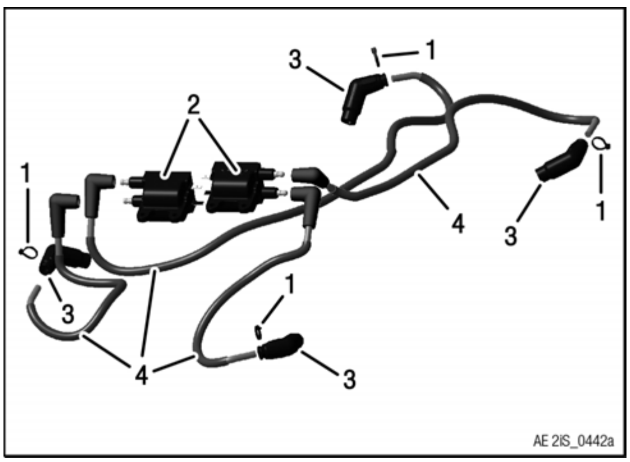

Figure 15.6: Plugged version (uncommon)

1 Cable ties	*2 Ignition coils*
3 Spark plug connector	*4 Ignition cable assy.*

DOUBLE IGNITION COIL – REMOVAL

NOTE

Cable ties around the ignition cable connectors have to be removed before disassembly.

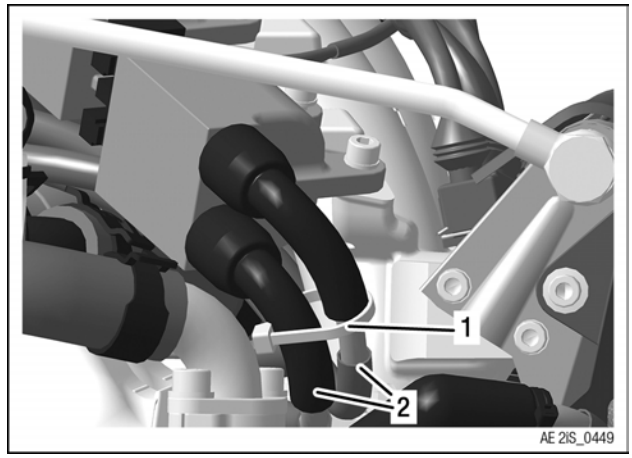

Figure 15.7: TYPICAL

1 Cable ties	*2 Ignition coil connectors*

Step	Procedure
1	Remove the cable clamps from the wiring harness.

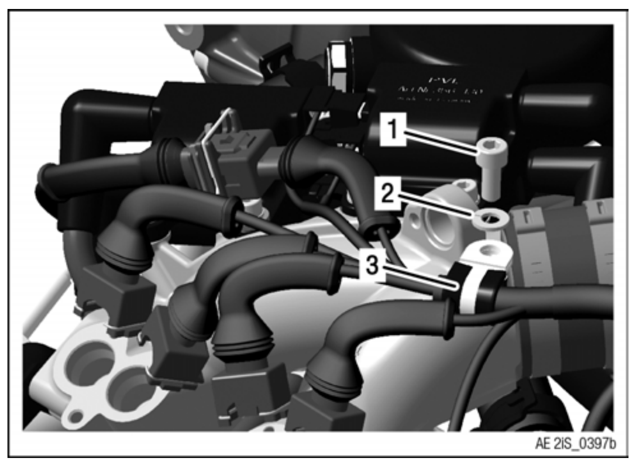

Figure 15.8

1 Allen screw M6x14	*2 Lock washer*
3 Cable clamp	

Step	Procedure
2	Carefully pull EGT 1 and EGT 2 (cylinders 1 and 2) out of the connector plate.
3	Press the metal spring and pull off the connector to the Exhaust Gas Temperature Sensor (EGT). See also Chapter 76-50-00 Wiring harness.

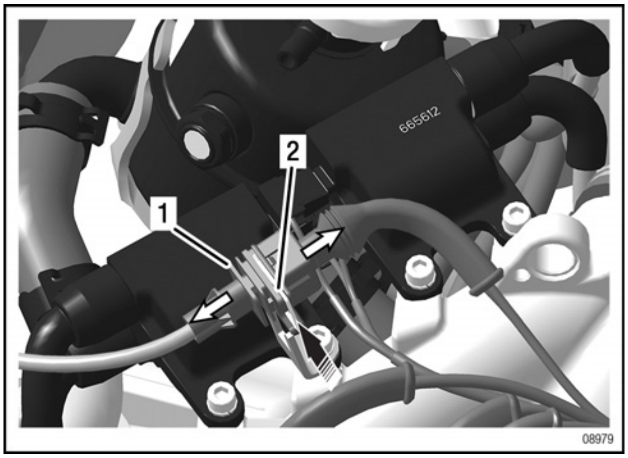

Figure 15.9

1 EGT connector *2 Connector bracket*

Step	Procedure
4	Loosen Allen screws with lock washers and remove connector bracket and clamp. **NOTE** *Clamp only double ignition coils with MCON 1.2 (male) connectors*

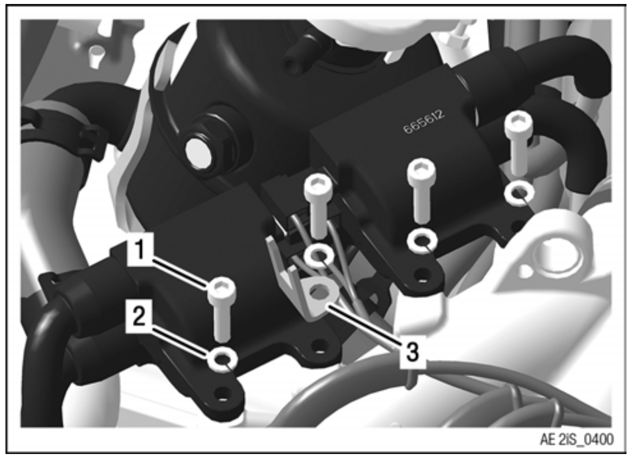

Figure 15.10

1 Allen screw *2 Lock washer*

3 Connector bracket

Step	Procedure
5	Unplug the connectors to the double ignition coils. See 76-50-00 Wiring harness.
6	Remove the double ignition coils.

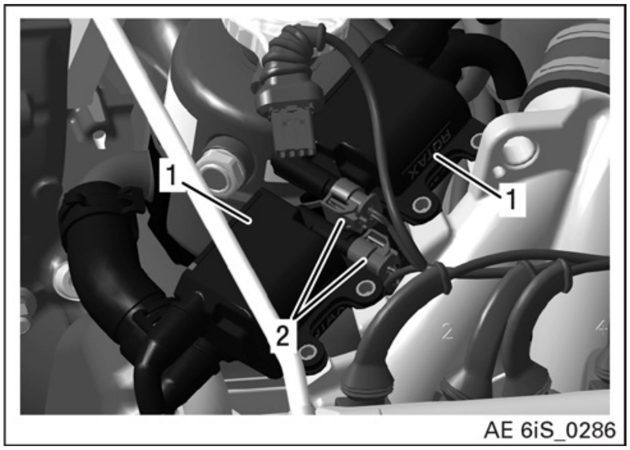

Figure 15.11: TYPICAL, for MCON 1.2 (male) connectors

1	*Double ignition coils*	2	*Ignition coil connector*

Figure 15.12: TYPICAL, for blade receptacle (male) connectors

1	*Double ignition coils*	2	*Ignition coil connector (coil 1, coil 2, coil 3, coil 4)*

NOTE

The red cable is positive (+), the red cable with the black dash is negative (-). Double ignition coils are labeled + and -!

SPARK PLUG — REMOVAL

See current Maintenance Manual Line (MML) for the respective engine type. Chapter 12–20–00 Installation of spark plug.

KNOCK SENSOR — REMOVAL

See Chapter 76-70-00 section Sensors and actuators and Chapter 76-50-00 section Wiring harness.

NOTE

The knock sensor must only be removed if necessary!

INSPECTION

Components can only be replaced, not repaired. If the ignition spark fails, search systematically for the possible cause of the fault. The B.U.D.S. Aircraft diagnostic tool can be used for this.

DOUBLE IGNITION COIL ASSY. AND IGNITION CABLE ASSY. — INSPECTION

Preparation

General visual inspection.
See current Maintenance Manual Line (MML) for the respective engine type.

- Carry out a voltage and resistance test. To do this, see Chapter 76-70-00 section Sensors and actuators.
- Carry out continuity test on ignition cable assy., see Chapter 76-70-00 section Sensors and actuators.

NOTICE
Cracking and other obvious damage to the ignition cable is not permitted! If in doubt, always replace the cable and connectors in question.

Step	Procedure
1	Check fastening elements (screws, washers and connector bracket) for damage, corrosion and deformation.

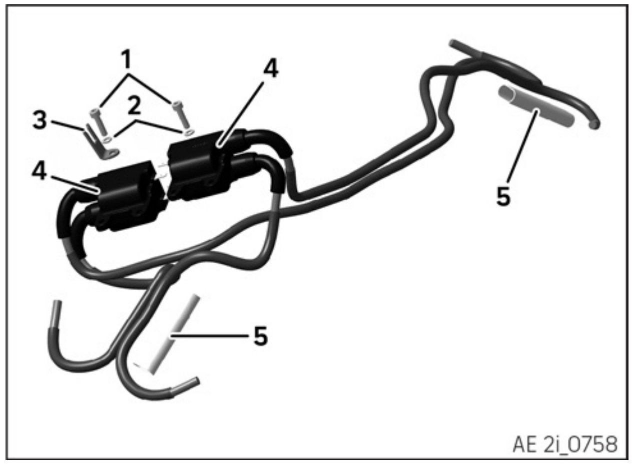

Figure 15.13: Double ignition coils (screwed connection, most common - new)

1	*Allen screw*	*2*	*Lock washer*
3	*Connector bracket*	*4*	*Double ignition coils with cables*
5	*Silicone coated glass-fibre sleeves*		

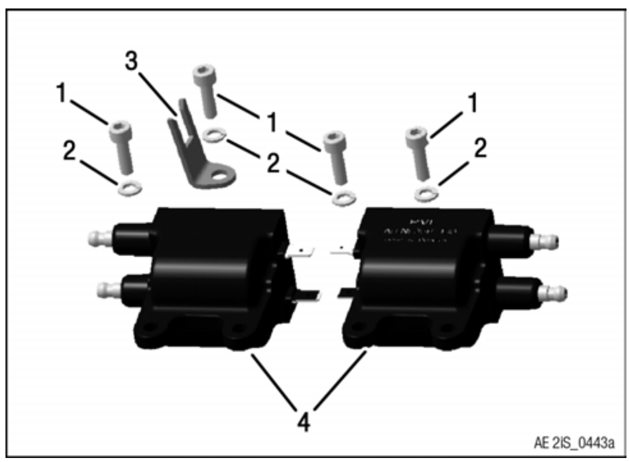

Figure 15.14: Double ignition coils (uncommon - old, plugged connection)

1	*Allen screw*	*2*	*Lock washer*
3	*Plug holder*	*4*	*Double ignition coils*

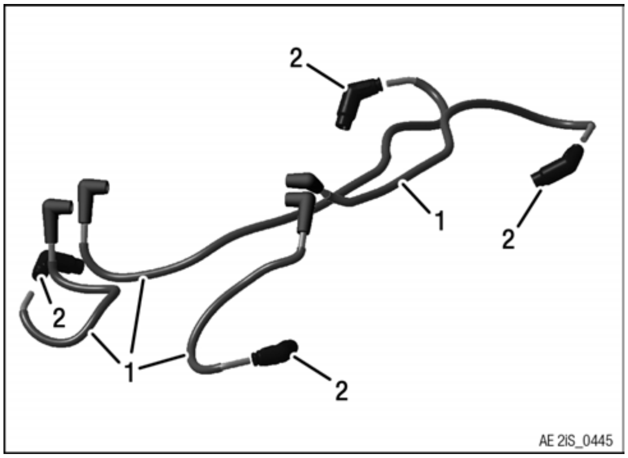

Figure 15.15: Ignition cables (uncommon - old, plugged version)

1 Ignition cable assy. *2 Spark plug connector*

Step	Procedure
2	Check double ignition coils for damage, corrosion and deformation.
3	Check contact faces: Indentations up to a max. of 0.5 mm (0.02 in.). Bumps up to a max. of 0.5 mm (0.02 in.).

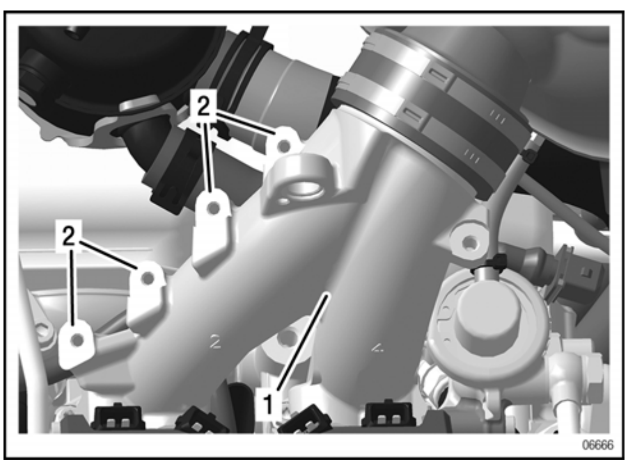

Figure 15.16

1 Intake manifold *2 Contact face*

SPARK PLUG CONNECTOR — INSPECTION

Carry out resistance test on ignition cable assy. To do this, see Chapter 76-70-00 section Sensors and actuators.

Step	Procedure
1	Check spark plug connectors for corrosion and damage.

SPARK PLUG — INSPECTION

See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12–20–00 section Inspection of spark plugs.

KNOCK SENSOR (KNOCK) — INSPECTION

To do this, see Chapter 76-70-00 section Sensors and actuators.

INSTALLATION

KNOCK SENSOR — INSTALLATION

See Chapter 76-70-00 section Sensors and actuators and Chapter 76-50-00 section Wiring harness.

SPARK PLUG — INSTALLATION

See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12–20–00 section Inspection of spark plugs.

SPARK PLUG CONNECTOR AND IGNITION CABLE ASSY. — INSTALLATION

NOTICE

Risk of damage to spark plug connector!
The spark plug connectors must only be installed by hand or using an equivalent tool, that has no pointed or sharp edges.

Step	Procedure
1	Screw the ignition cables into the terminals of the double ignition coil. **NOTE** *If new double ignition coils are used the ignition cables are already mounted.*
2	Pull silicon coated glass-fibre sleeves on the ignition cables Top and Bottom.
3	Route the ignition cable assy. correctly.

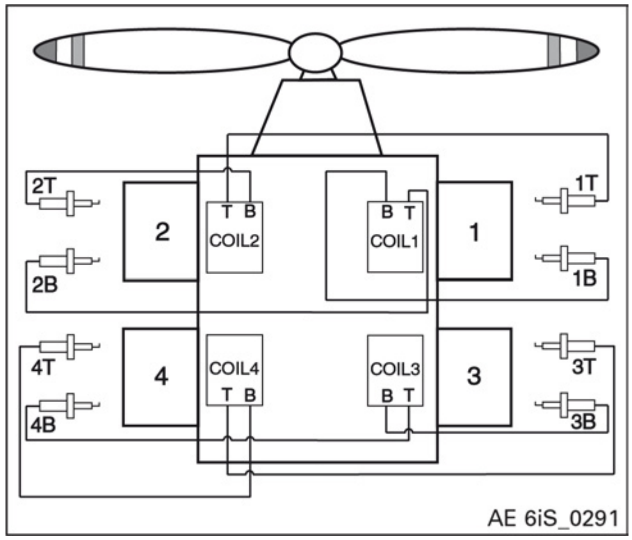

Figure 15.17

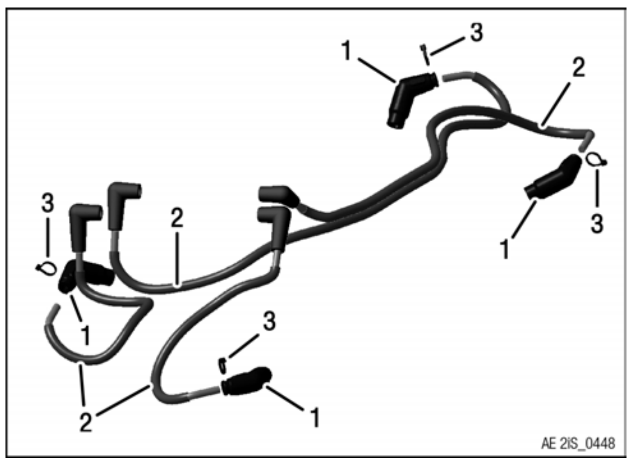

Figure 15.18: Plugged, uncommon/old version

1	*Spark plug connectors*	2	*Ignition cable assy.*
3	*Cable ties 94x2.5*		

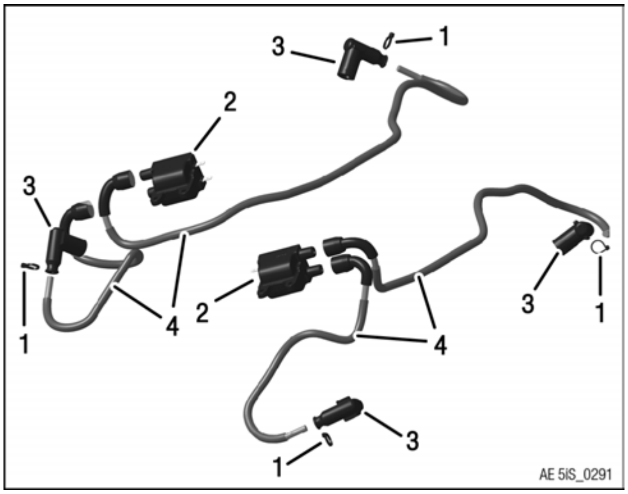

Figure 15.19: Screwed, common/new version

1	*Cable ties 94x2.5*	2	*Ignition coils*
3	*Spark plug connectors*	4	*Ignition cable assy.*

Step	Procedure
4	Screw the spark plug connector on the ignition cable assy. and secure it with a cable tie 94x2.5.
5	Put the spark plug connector onto the spark plug.
6	Install double ignition coil, see section .
7	Install ignition cable assy. with cable ties 203x7.6 on the airbox.

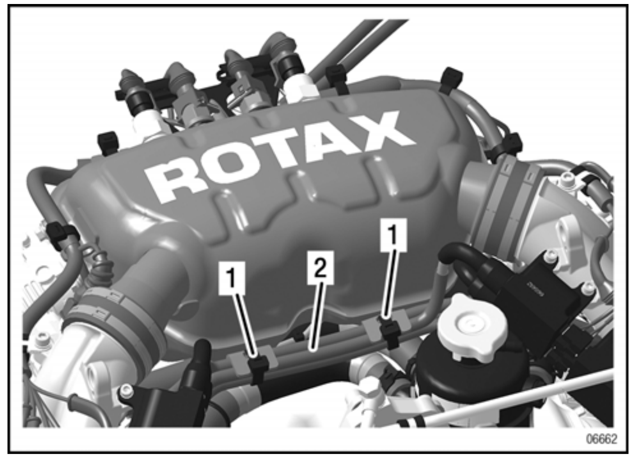

Figure 15.20

1	*Cable ties 203x7.6*	2	*Ignition cable assy.*

DOUBLE IGNITION COIL (SCREWED CONNECTION) — INSTALLATION

For double ignition coils with blade receptacle (male) connectors on primary side.

Step	Procedure
1a	Plug in the double ignition coil connectors.

NOTE

The red cable is positive (+), the black cable is negative (-). Double ignition coils are labelled + and -!

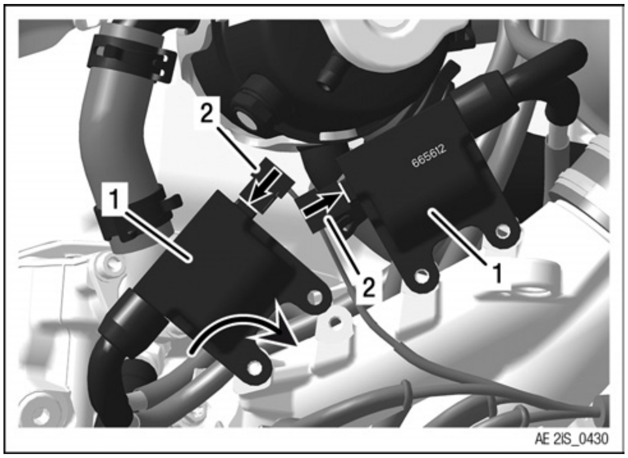

Figure 15.21: With blade receptacle (male) connectors

1 Double ignition coils *2 Ignition coil connector (coil 1, coil 2, coil 3, coil 4)*

For double ignition coils with MCON 1.2 (male) connectors on primary side.

Step	Procedure
1b	Plug in the double ignition coil connectors and install cable clamp 8/M5.

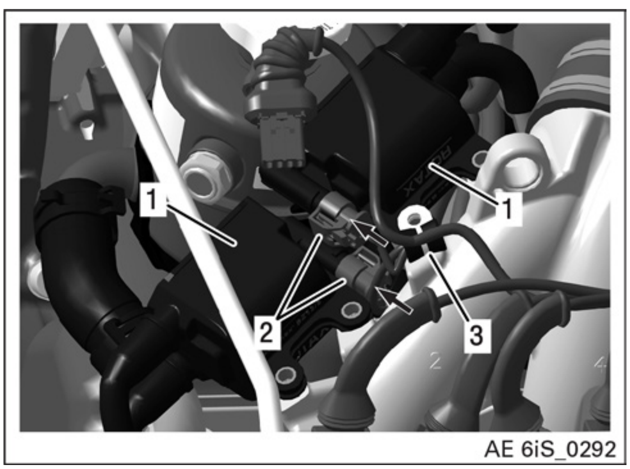

Figure 15.22: TYPICAL – With MCON 1.2 (male) connectors

1 Double ignition coils *2 Ignition coil connector*

3 Cable clamp 8/M5

Step	Procedure
2	Fix the double ignition coils with M5x16 Allen screws with connector brackets and A5 lock washers. Tightening torque 5 Nm (44 in. lb.).

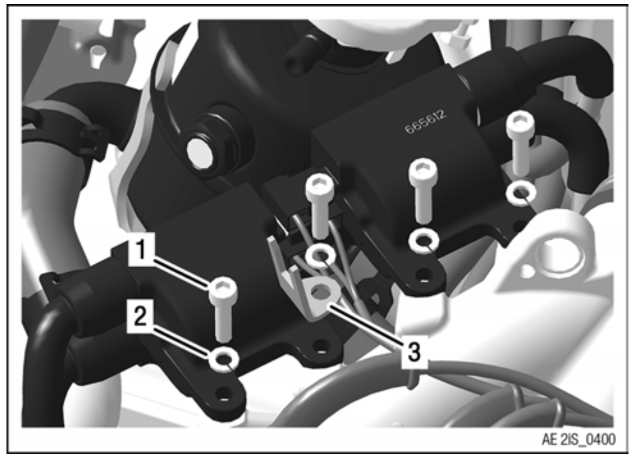

Figure 15.23

1 Allen screw M5x16 *2 Lock washer A5*

3 Connector bracket

Step	Procedure
3	Connect the Exhaust Gas Temperature sensors. See Chapter 76-50-00, section Exhaust Gas Temperature Sensor (EGT) – connection.

NOTE

Compress the connector with the EGT connector so that the spring clip latches in.

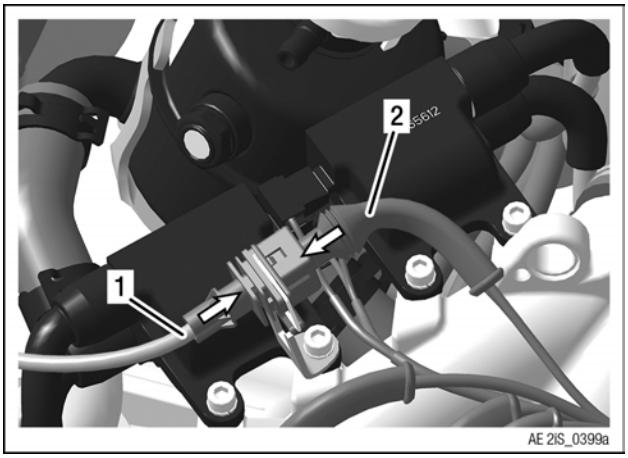

Figure 15.24: TYPICAL

1 *EGT connector*	2 *Connector*

Step	Procedure
4	Press the EGT connector into the connector bracket.
5	Secure the cable clamp 12/M6 with an Allen screw M6x14 and washer with LOCTITE 243. Tightening torque 10 Nm (89 in. lb.)

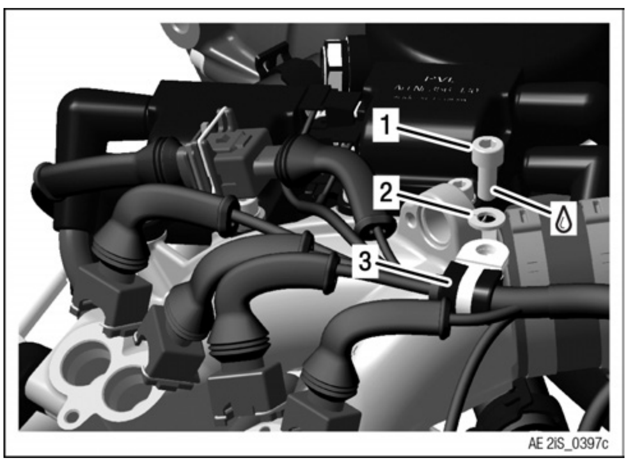

Figure 15.25: TYPICAL

1 *Allen screw M6x14*	2 *Lock washer A6*
3 *Cable clamp 12/M6*	

NOTICE

Push on 90° ignition coil connectors should be attached with cable ties to reduce vibration. Pull the cable tie tight so it does not allow movement/chafing.

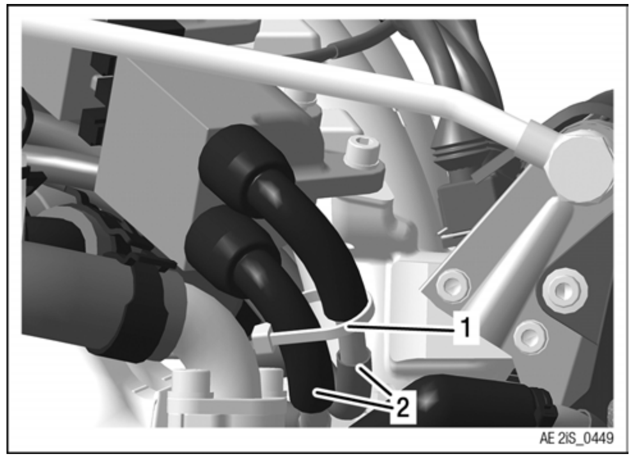

Figure 15.26

1 *Cable tie*	2 *Ignition coil connectors*

DOUBLE IGNITION COIL (PLUGGED CONNECTION) — INSTALLATION

NOTE

The red cable is positive (+), the red cable with the black dash or the black one is negative (-). Double ignition coils are labelled + and -!

Step	Procedure
1	Plug in the double ignition coil connectors.

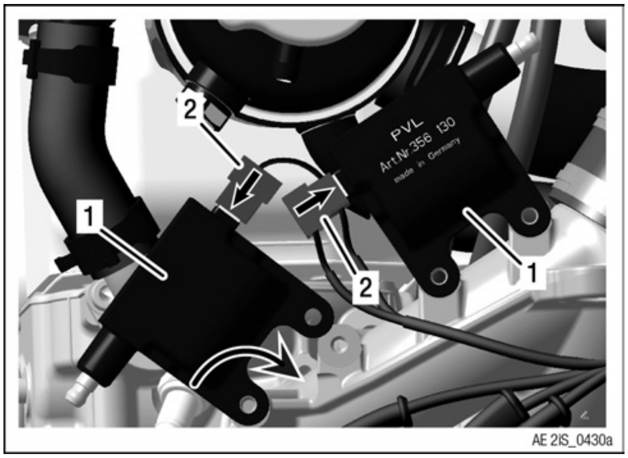

Figure 15.27

1	*Double ignition coils*	2	*Ignition coil connector (coil 1, coil 2, coil 3, coil 4)*

Step	Procedure
2	Fix the double ignition coils with M5x16 Allen screws with plug holders and A5 lock washers. Tightening torque 5 Nm (44 in. lb.).

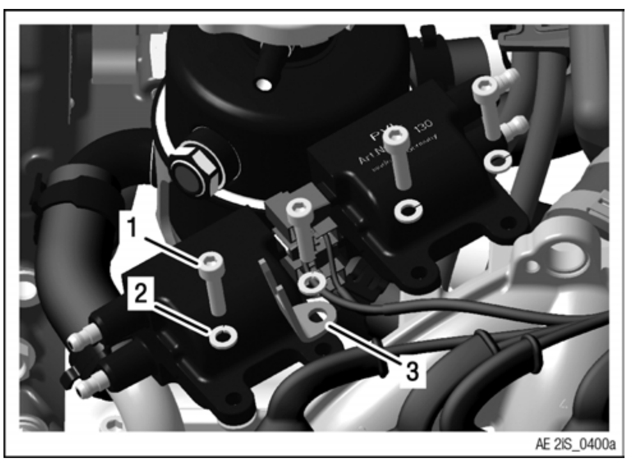

Figure 15.28

1	*Allen screw M5x16*	2	*Lock washer A5*
3	*Plug holder*		

Step	Procedure
3	Plug in the connector to the EGT connector.

NOTE

Compress the connector with the EGT connector so that the spring clip latches in.

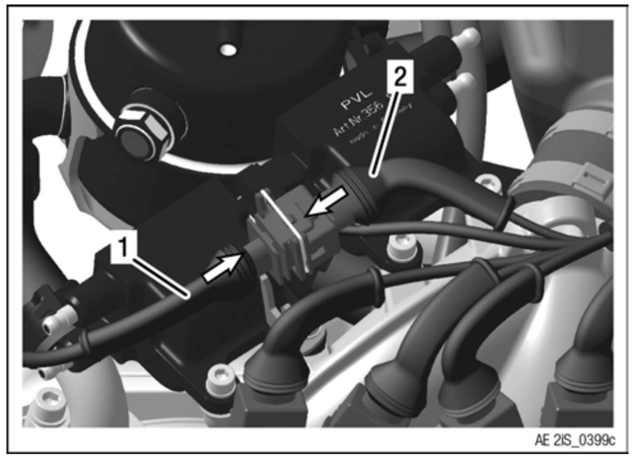

Figure 15.29

1	*EGT connector*	2	*Connector*

Step	Procedure
4	Push the ignition coil connectors on the double ignition coils.
5	Press the EGT connector into the plug holder.

NOTE

Check for secure connection.

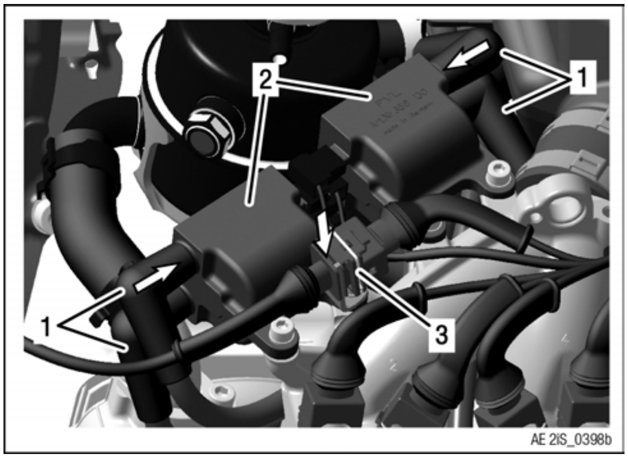

Figure 15.30

1	*Ignition coil connector*	2	*Double ignition coils*
3	*EGT connector*		

NOTICE
The Allen screw for the cable clamp reaches the intake duct and is therefore glued in with LOCTITE 243.

Step	Procedure
6	Secure the cable clamp 12/M6 with an Allen screw M6x14 and washer with LOCTITE 243. Tightening torque 10 Nm (89 in. lb.).

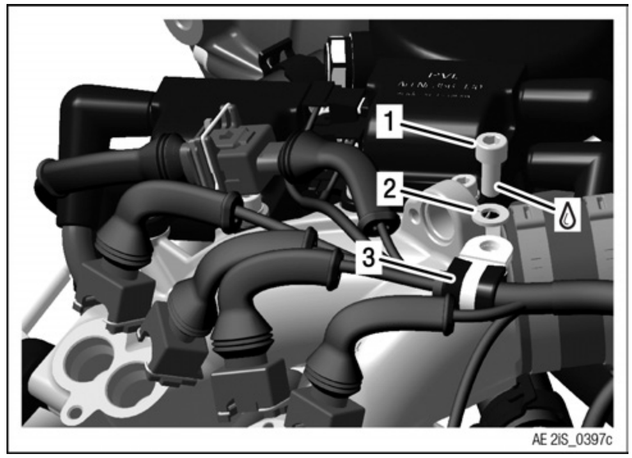

Figure 15.31

1	*Allen screw M6x14*	2	*Lock washer A6*
3	*Cable clamp 12/M6*		

NOTICE
Push on 90° ignition coil connectors should be attached with cable ties to reduce vibration. Pull the cable tie tight so it does not allow movement/chafing.

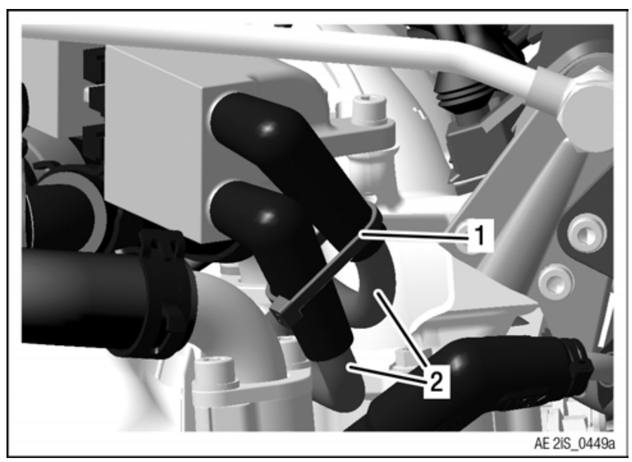

Figure 15.32

1	*Cable tie*	2	*Ignition coil connectors*

INTERNAL GENERATOR — INSTALLATION

See Chapter 24–20–00 section Internal generator.

FINISHING WORK

Carry out an engine test run.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Planned maintenance.

Chapter: 75–00–00
COOLING SYSTEM

TOPICS IN THIS CHAPTER

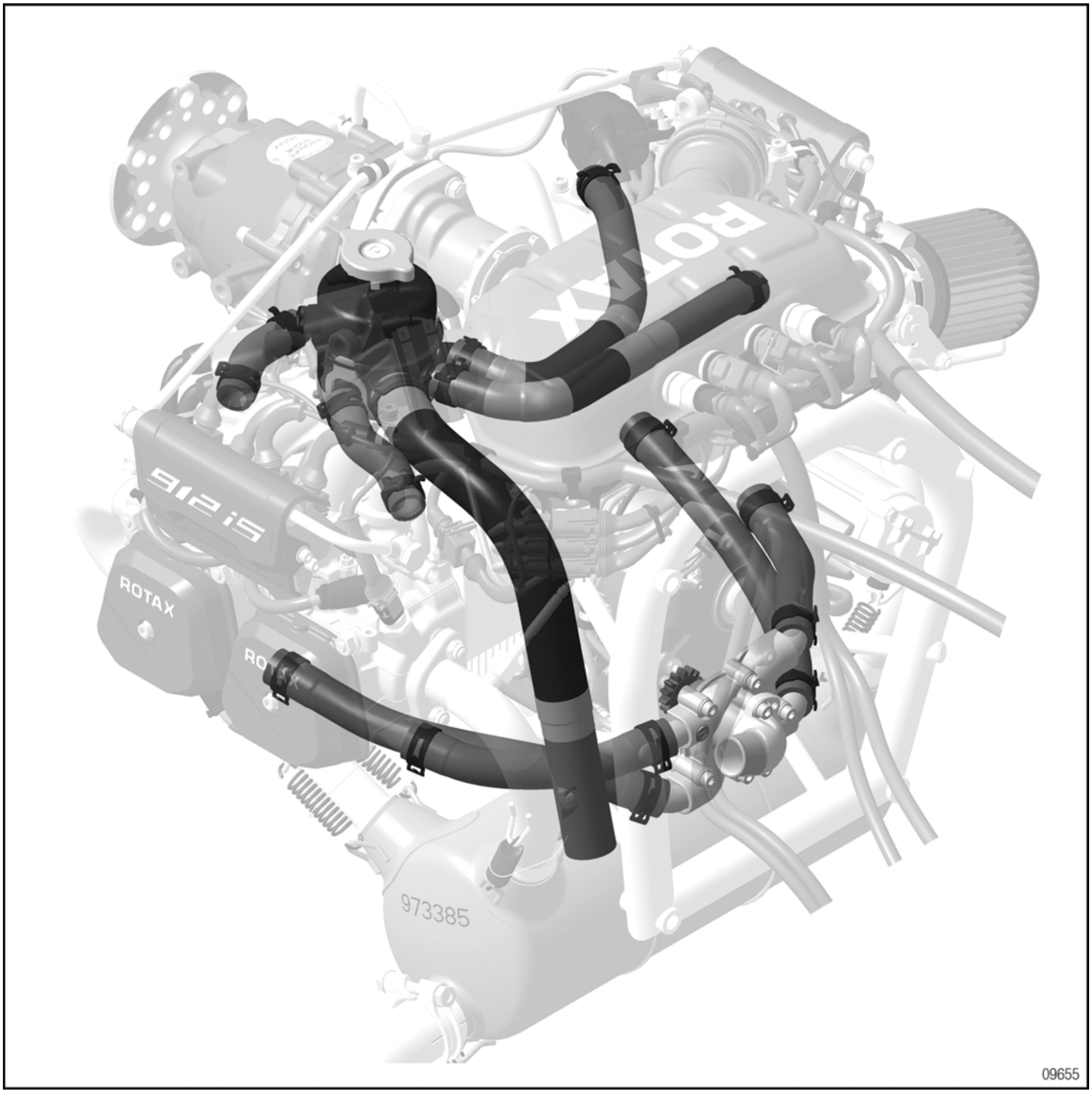

Figure 16.1: Location on the engine

SPECIAL TOOLS

Description	Part number
Hose clamp pliers	877840
Impeller wrench assy.	877295
Insertion jig	876510
Insertion jig	877258
Socket driver T30 ball head	876180
Socket 19x12.5	876130

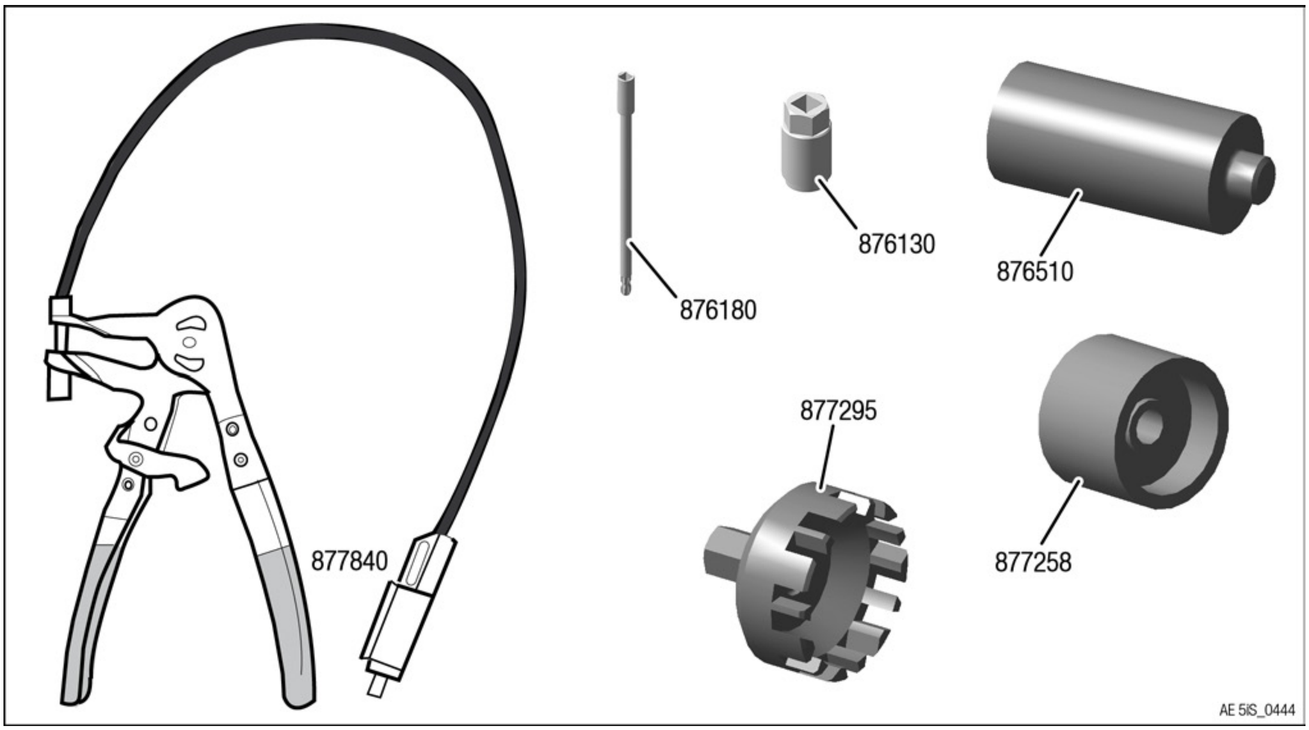

Figure 16.2: Special tools

SERVICE PRODUCTS

Description	Part number
LOCTITE 243	897651
Engine oil	n.a.
LOCTITE 577	899796
LOCTITE 603	899789
LOCTITE 7063	n.a.

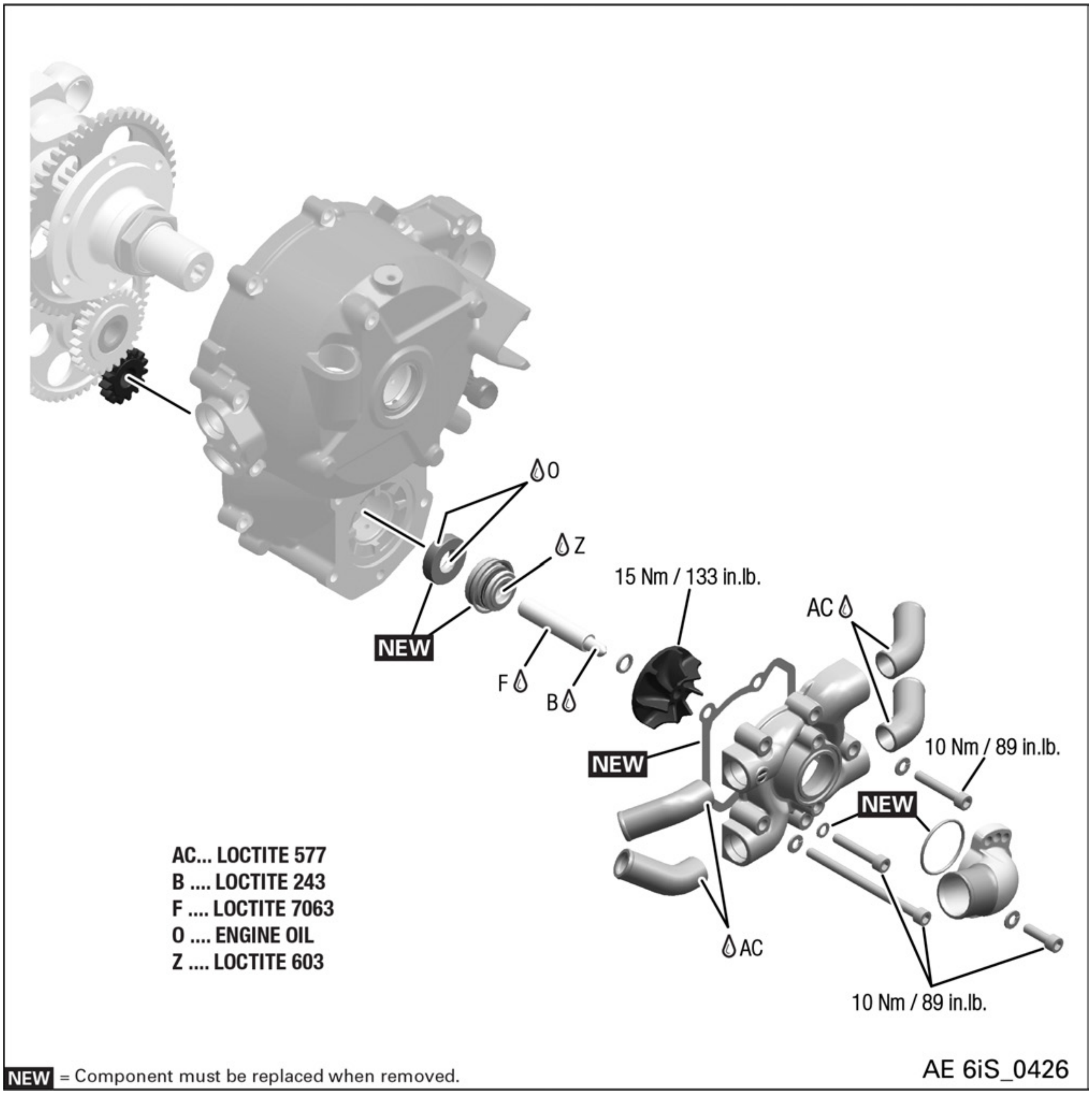

Figure 16.3: Cooling system

Figure 16.4

SYSTEM DESCRIPTION

The engine is cooled by liquid-cooled cylinder heads and ram-air-cooled cylinders. The cooling system of the cylinder heads is a closed cooling circuit with an expansion tank and overflow bottle.

COOLANT

The coolant is pumped by a camshaft-driven water pump, from the radiator to the individual cylinder heads. The coolant flows out of the top of the cylinder heads and is collected in the expansion tank. Since the standard location of the radiator is below engine level, the expansion tank located on top of the engine allows for coolant expansion.

RADIATOR

See current Installation Manual (IM) for the respective engine type. For more detailed information on operation, maintenance, safety or flight, consult the documentation provided by the aircraft manufacturer and dealer.

WATER PUMP

The water pump is integrated in the ignition housing. The ignition housing must be removed for repair work on the water pump.

EXPANSION TANK

The expansion tank is closed by a pressure cap (with pressure relief valve and return valve). When the coolant heats up and expands, it opens the pressure relief valve and flows via a hose at atmospheric pressure into the transparent overflow bottle. When the coolant cools down, it is sucked back into the cooling circuit.

OVERFLOW BOTTLE

See current Installation Manual (IM) of the respective engine type. For more detailed information on operation, maintenance, safety or flight, consult the documentation provided by the aircraft manufacturer and dealer.

SAFETY INFORMATION

⚠ WARNING

Danger of severe burns and scalds!
Always allow the engine to cool down to ambient temperature before starting any work. The radiator cap on the expansion tank must only be opened when the engine has cooled down!

Ensure that the engine is in the horizontal position!

NOTICE

High pressure in the cooling system might cause damage.
The hose between the expansion tank and the overflow bottle must be free of blockage and venting bore must not be clogged.

ENVIRONMENTAL NOTE

Please observe the disposal regulations applicable in your area.

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.

CONNECTIONS FOR DISPLAY SYSTEMS

Follow the instructions in the current Installation Manual (IM) for the respective engine type regarding connections for instrumentation.

COOLANT TEMPERATURE SENSOR (CTS)

Coolant flows around the temperature sensor, which measures the coolant temperature directly.

The temperature sensor is situated in cylinder head 4.

MAINTENANCE

As well as the maintenance and special checks, see current Maintenance Manual Line (MML) for the respective engine type.

Before the cooling system is removed, the work described below must be carried out to identify any further malfunctions in the cooling system and rectify them as part of the repair work.

NOTICE
If these checks are omitted, it may be necessary to dismantle the cooling system again to rectify any malfunctions after it has been repaired.

General visual inspection.
See current Maintenance Manual Line (MML) for the respective engine type.

Engine cleaning.
See current Maintenance Manual Line (MML) for the respective engine type.

Carry out an engine test run.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Planned maintenance.

REMOVAL

⚠ WARNING
Danger of severe burns and scalds! Always allow the engine to cool down to ambient temperature before starting any work.

ENVIRONMENTAL NOTE
Please observe the disposal regulations applicable in your area.

ENVIRONMENTAL NOTE
Ensure that no coolant gets into the waste water system or the ground – risk of contaminating drinking water!

NOTICE
Prevent the ingress of debris particles into all disconnected lines and connections. Use appropriate protective coverings.

Preparation

- Switch the ignition switch OFF.

Drain coolant.
See Maintenance Manual Line (MML) for the respective engine type.

Drain the fuel.
See Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Planned maintenance.

Disconnect coolant hose. Follow the instructions in the aircraft manufacturer's manual.

Remove the fuel outlet and inlet line on the fuel rail. Follow the instructions in the aircraft manufacturer's manual.

SURROUNDING ASSEMBLIES — REMOVAL

Only necessary for upper coolant system and cooling air baffle.

NOTE

The assemblies and lines are only to be removed if necessary and only as far as necessary.

Step	Procedure
1	Unplug Coolant Temperature Sensor (CTS), Oil Temperature Sensor (OTS), Oil Pressure Sensor (OPS), Knock sensor and Crankshaft Position Sensor (CPS 1/2). See Chapter 76-50-00 Wiring harness.
2	Unplug the spark plug connectors and remove the lower spark plug connectors. See Chapter 74-20-00, section Spark plug connector and ignition cable assy. — removal and Spark plug — removal.
3	Release the attachment of the airbox to ignition housing.
4	Loosen the Allen screw and lock washer from the fuel line assy.
5	Loosen the banjo bolts from cylinder 2/4 and 1/3 and remove the fuel line assy. with sealing rings.
6	If necessary remove air filter. Follow the instructions of the aircraft manufacturer.
7	Remove Exhaust Gas Temperature sensor (EGT) from the exhaust pipes. See Chapter 76-70-00, section Exhaust gas temperature sensor (EGT_1, EGT_2, EGT_3, EGT_4) — removal.
8	Loosen 4 hex./torx collar screws from the intake manifold (cylinder 2/4 and cylinder 1/3). See 73-10-00 Fuel system and distribution.
9	Remove the isolating flanges between the intake manifold and the cylinder head.

Step	Procedure
10	Pull back the airbox including the intake manifolds carefully.
11	Close the intake ducts using a plug (part no. 860397).

NOTICE

Close the intake duct immediately so that no debris particles can get into the combustion chamber!

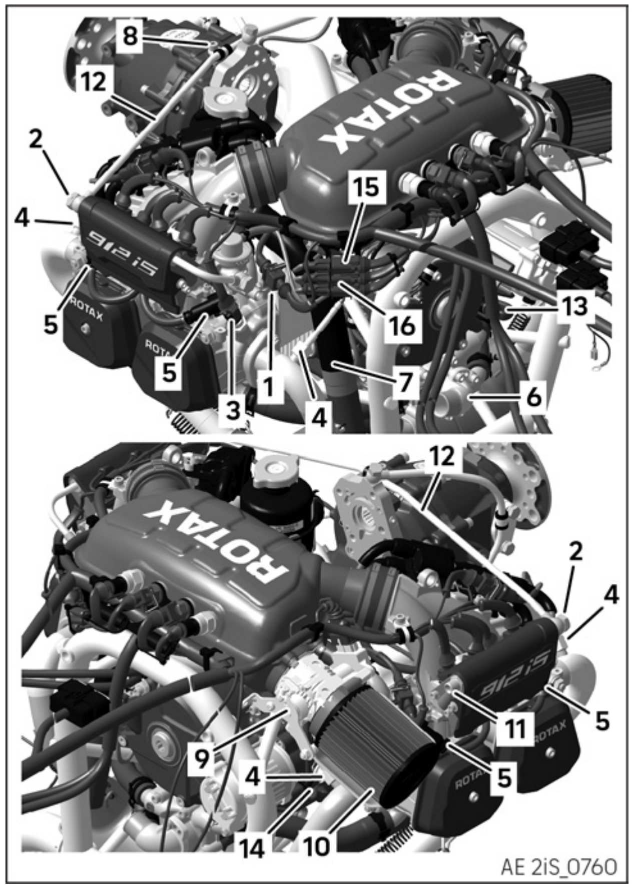

Figure 16.5

1	*Fuel outlet*	2	*Banjo bolt with sealing rings*
3	*Coolant Temperature Sensor (CTS)*	4	*Exhaust Gas Temperature (EGT)*
5	*Spark plug connector*	6	*Water inlet elbow*
7	*Coolant outlet*	8	*Allen screw with lock washer and cable clamp*
9	*Throttle body*	10	*Air filter*
11	*Fuel inlet*	12	*Fuel hose assy.*
13	*Oil Pressure Sensor (OPS)*	14	*Oil Temperature Sensor (OTS)*
15	*Knock sensor*	16	*Crankshaft Position Sensor (CPS 1/2)*

EXPANSION TANK WITH UPPER FORM HOSES - REMOVAL

NOTICE

Risk of pressure and scuffing marks!
Mark the position of the spring clamps. The spring clamps must be re-installed in the same position, otherwise it may not be possible to install the intake manifold.

NOTICE

When removing the form hoses, ensure that the bent sockets are not damaged!

Step	Procedure
1	Take off the spring clamps using spring clamp pliers part no. 877840.
2	Remove the form hose from the bent socket with a suitable tool. **NOTE** *Mark the position of the bent socket with a suitable pen (touch-up pen).*

Cylinder 2/4

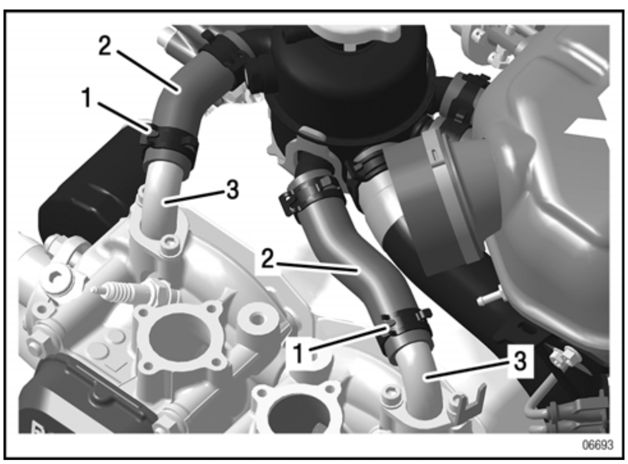

Figure 16.6

1 Spring clamp *2 Form hose*

3 Bent socket

Cylinder 1/3 TYPICAL

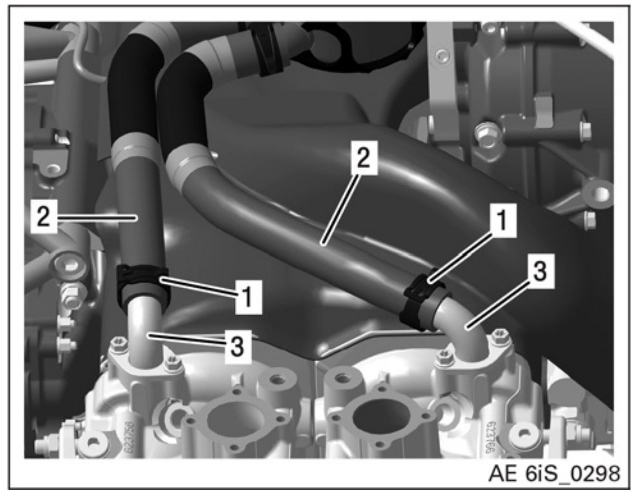

Figure 16.7

1 Spring clamp *2 Form hose*

3 Bent socket

Step	Procedure
3	Remove the expansion tank assy. with all its form hoses.

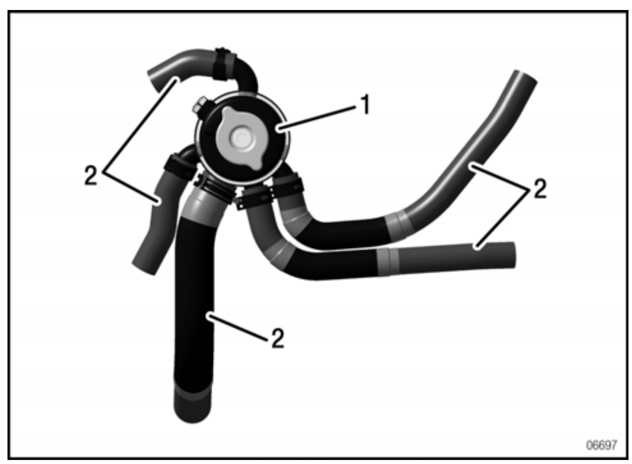

Figure 16.8

1 Expansion tank assy. *2 Form hoses*

COOLING AIR BAFFLE - REMOVAL

Preparation

- See Surrounding assemblies – removal

Step	Procedure
1	Remove expansion tank with upper form hoses.
2	Lift up and remove cooling air baffle.

WATER PUMP HOUSING WITH LOWER FORM HOSES — REMOVAL

Preparation

Remove the coolant hose from water inlet elbow. Follow the instructions in the manufacturer’s manual.

NOTE

Mark the position of the bent socket with a suitable pen (touch-up pen).

Step	Procedure
1	Remove the form hoses with heat protection tube from bent socket using spring clamp pliers part no. 877840.

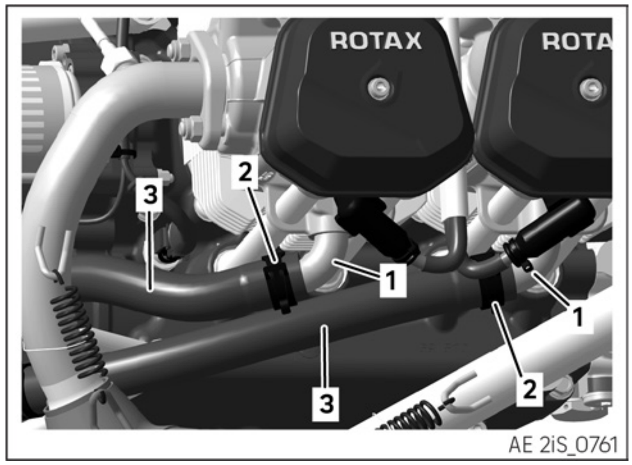

Figure 16.9

1 Bent socket *2 Spring clamp*
3 Form hose

Step	Procedure
2	Remove all 4 spring type hose clamps using spring clamp pliers part no. 877840 and detach the coolant hoses from the water pump housing.

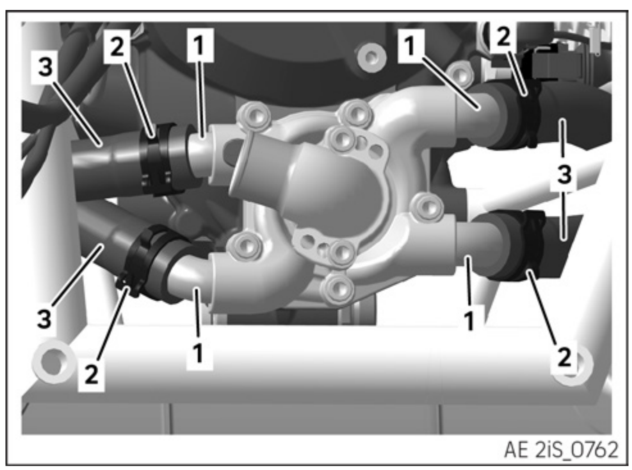

Figure 16.10

1 Bent socket *2 Spring clamps*
3 Form hoses

Step	Procedure
3	Loosen the 2 Allen screws of the water inlet elbow with washers and remove the water inlet elbow with the O-ring. **NOTE** *Mark the position of the water inlet elbow with a suitable pen (touch-up pen).*

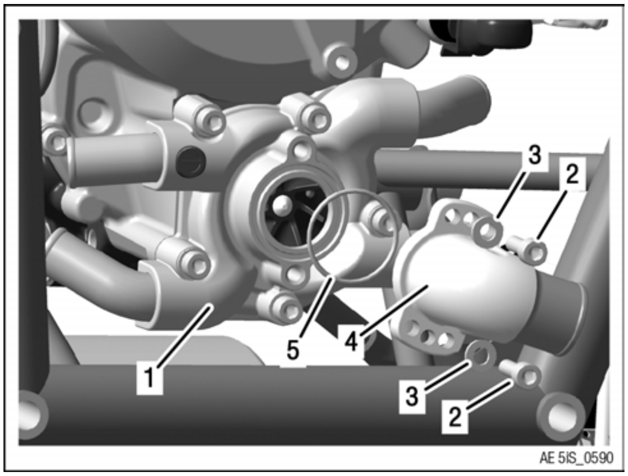

Figure 16.11

1	*Water pump housing*	2	*Allen screws*
3	*Washers*	4	*Water inlet elbow*
5	*O-ring*		

Step	Procedure
4	The water pump housing and gasket can be removed by loosening the other 5 Allen screws with washers.

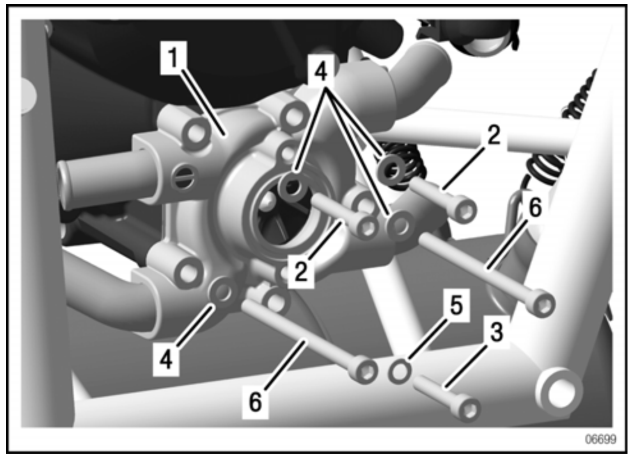

Figure 16.12: TYPICAL

1	*Water pump housing*	2	*Allen screw*
3	*Allen screw (stainless steel)*	4	*Washer*
5	*Sealing ring*	6	*Allen screw*

Step	Procedure
5	Remove the impeller anti-clockwise with the special tool part no. 877295 with locked crankshaft.

Lock the crankshaft.
See current Maintenance Manual Line (MML) for the respective engine type.

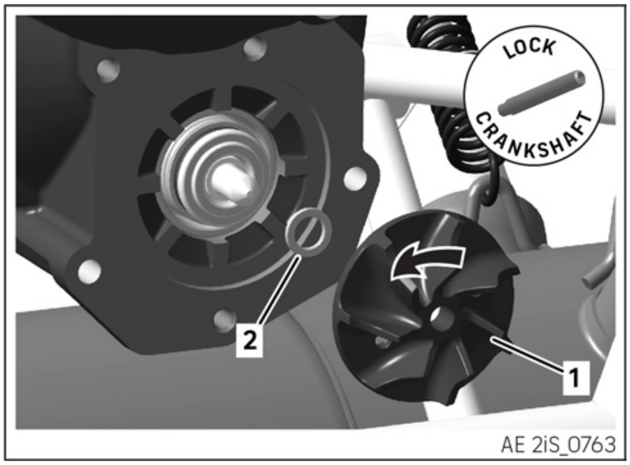

Figure 16.13

1 Impeller *2 Washer*

DISASSEMBLY

IGNITION HOUSING — DISASSEMBLY

Preparation

- Remove the ignition housing. See Chapter 24-20-00 section Ignition housing – installation.

WATER PUMP SHAFT — REMOVAL

Step	Procedure
1	Place the ignition cover on a suitable flat surface.
2	Press out the water pump shaft with a suitable tool.
3	Pull out the water pump gear.

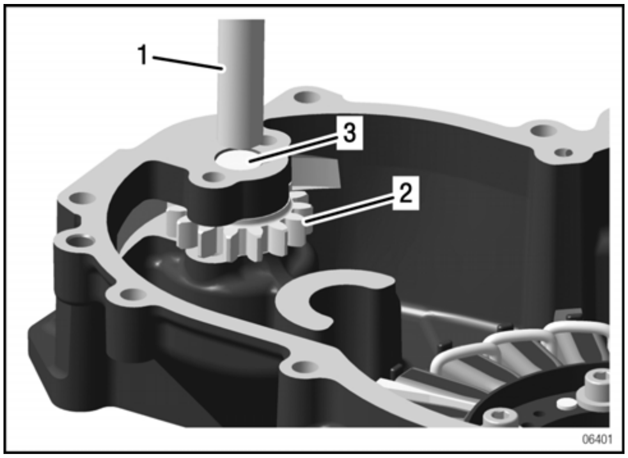

Figure 16.14

1 Press-out tool *2 Water pump gear 15T*
3 Water pump shaft

OIL SEAL AND ROTARY SEAL — REMOVAL

NOTICE

The oil seal and rotary seal are destroyed by this process and must be replaced.

Step	Procedure
1	Press out the old oil seal and the rotary seal with two pins or bolts and a suitable jig.

NOTE

The diameter of the pins/bolt is 5 mm (0.1969 in.).

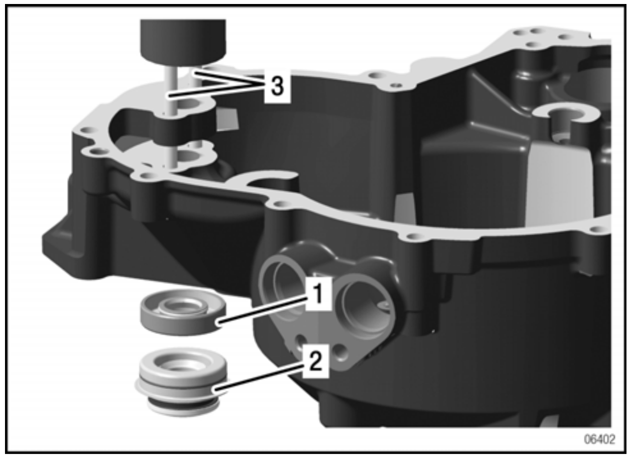

Figure 16.15

1 Oil seal *2 Rotary seal*
3 Press-out tool

FORM HOSES — REMOVAL

Step	Procedure
1	Take off spring clamps using spring clamp pliers part no. 877840.

2	Remove the form hoses from the bent socket on the expansion tank with a suitable tool. **NOTE** *Mark the position of the bent socket with a suitable pen (touch-up pen).*
3	Remove the rubber plate.

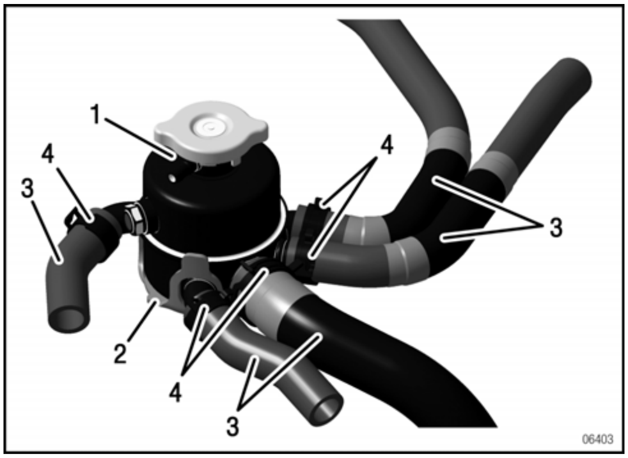

Figure 16.16

1	*Expansion tank*	*2*	*Rubber plate*
3	*Form hoses*	*4*	*Spring clamps*

WATER PUMP HOUSING — DISASSEMBLY

⚠ WARNING

Danger of severe burns and scalds!
Wear heat resistant gloves!

NOTE

Only remove the bent socket when absolutely necessary!

Step	Procedure
1	Mark the position of the bent socket.
2	Heat the water pump housing to approx. 100 to 120 °C (212 °F to 248 °F) and unscrew the bent socket.
3	Clean the thread (remove LOCTITE residues).

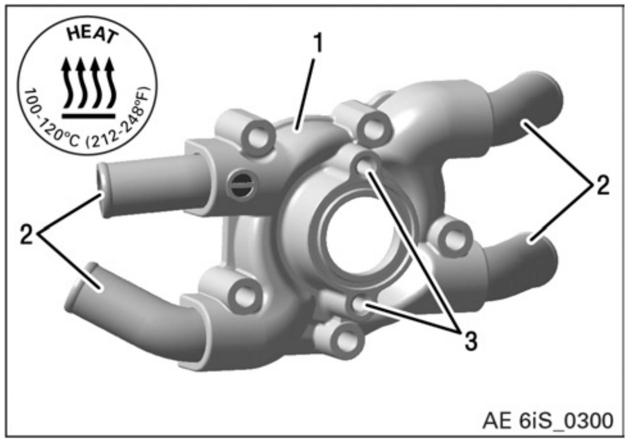

Figure 16.17

1	*Water pump housing*	*2*	*Bent socket*
3	*Thread*		

INSPECTION

COOLING SYSTEM SINGLE PARTS — INSPECTION

NOTICE
Cracks in cooling system components are not permissible! If in doubt, check the affected parts for cracks using the dye penetrant or similar method.

NOTICE
Form hoses must not be shortened, as this affects the position of the expansion tank. Replace non-reusable or damaged hoses.

- Clean all parts carefully.
- Check the form hoses for damage and wear.
- Check the temperature sensor. To do this, see Chapter 76-70-00 section Sensors and actuators.

NOTE

Scuffing marks (including scratches) are permissible up to a maximum depth of 0.50 mm (0.0197 in.).

- Check spring clamps for damage or deformation.

AXIAL POSITION OF WATER PUMP SHAFT INSPECTION

Step	Procedure
1	Check the water pump shaft for wear and corrosion. **NOTE** *If corrosion is found, the water pump shaft must be replaced.*
2	Check the axial position of the water pump shaft and pump gear.

NOTE

The shoulder of the gear points inwards towards the crankcase.

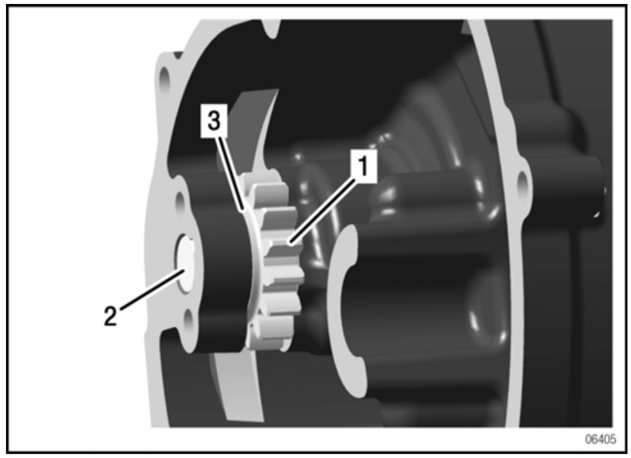

Figure 16.18

1 Water pump gear 15T 2 Water pump shaft

3 Shoulder of gear

EXPANSION TANK — INSPECTION

Step	Procedure
1	Check the expansion tank for damage, deformation and leaks.

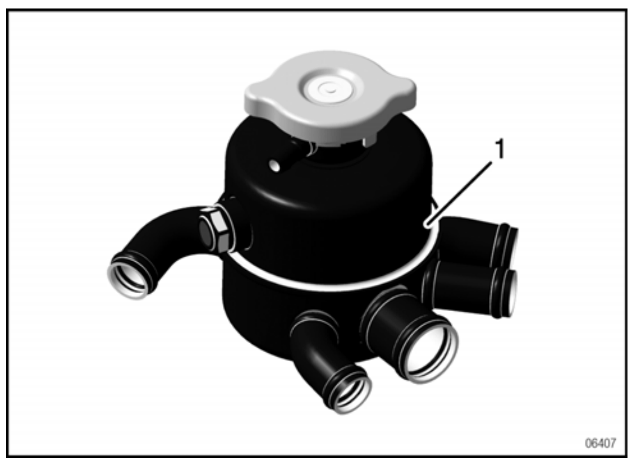

Figure 16.19

1 Expansion tank

WATER PUMP HOUSING — INSPECTION

Step	Procedure
1	Check the water pump housing for damage, deformation and leaks.
2	Check the inner side for any signs of contact with the impeller.
3	Measure the gap between impeller and water housing using a feeler gauge, see section Wear limits (WP02).

NOTE

If signs of contact are found, the water pump housing must be replaced.

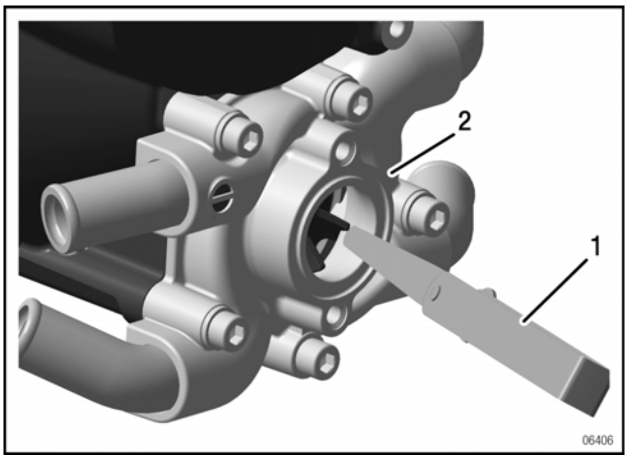

Figure 16.20: TYPICAL

1 *Feeler gauge* 2 *Water pump housing*

WEAR LIMITS

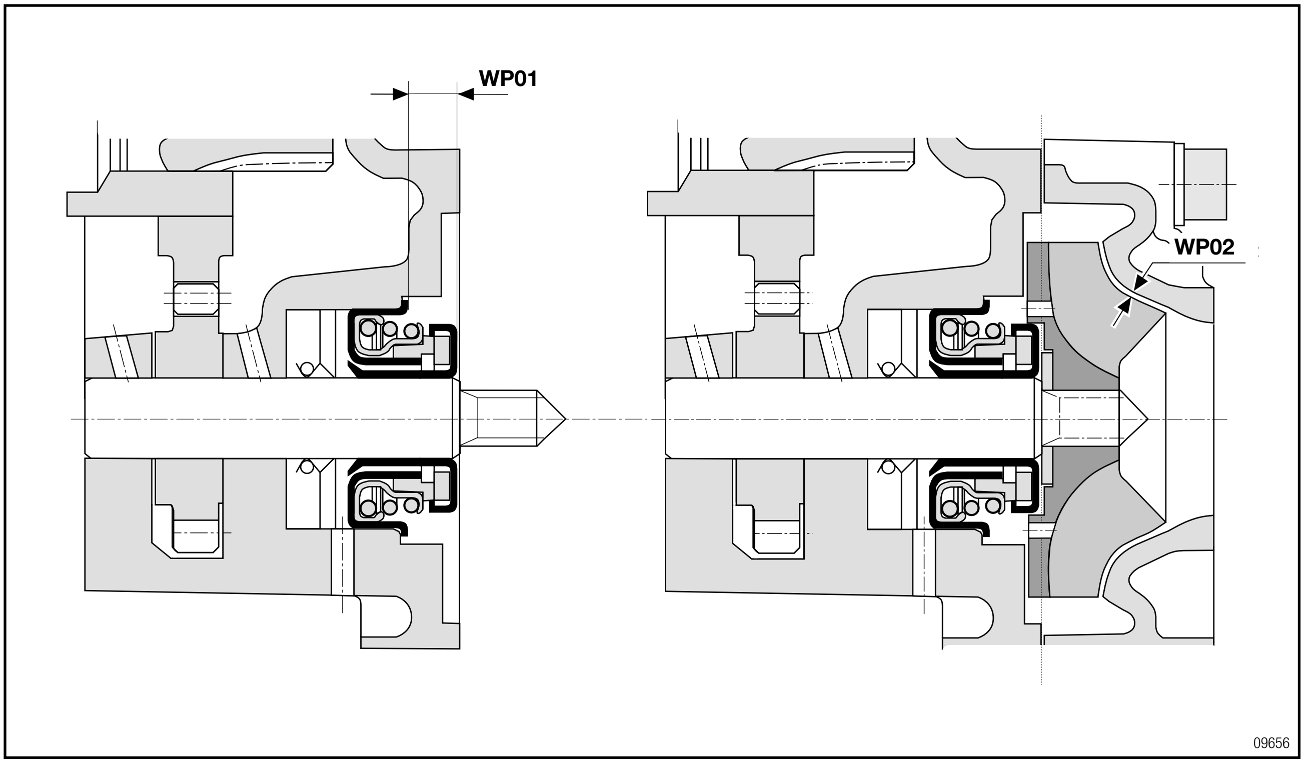

Figure 16.21

Description	Code	Reading new		Wear limit		Readings	
		min.	max.	100 %	50 %		
Water pump							
Reference to flat surface	WP01	8.55 mm 0.3366 in	8.85 mm 0.3484 in	8.85 mm 0.3484 in		actual	
						renewed	
Distance from impeller	WP02	0.3 mm 0.012 in	0.5 mm 0.020 in	0.7 mm 0.028 in	0.6 mm 0.024 in	actual	
						renewed	

ASSEMBLY

IGNITION HOUSING – ASSEMBLY

Oil seal – Installation

Step	Procedure
1	Lubricate the outside of a new oil seal 12x30x7 and press it (with open side showing to crankcase) using a suitable jig part no. 876510 into the ignition housing till end stop. **NOTE** *Oil seal must not be visible through the leakage bore.*

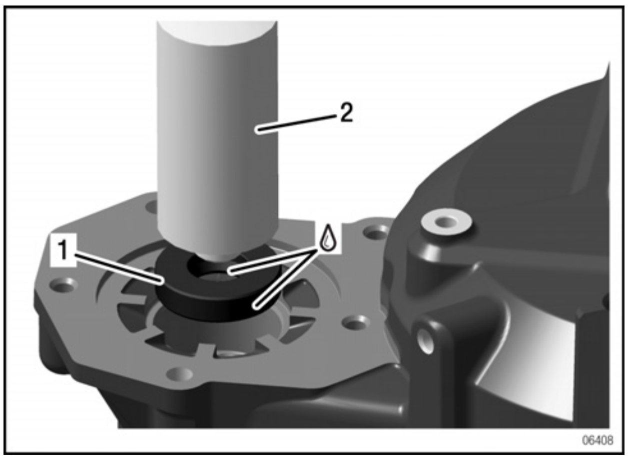

Figure 16.22

1	*Oil seal 12x30x7*	2	*Insertion jig part no. 876510*

Water pump shaft – Installation

NOTE

Degrease water pump shaft with LOCTITE 7063.

Step	Procedure
1	Apply small amount of LOCTITE 603 to the inner diameter of the new rotary seal and press it into the insertion jig part no. 877258. Then press in the water pump shaft as far as it will go.

NOTE

The spacing WP01 is automatically established with insertion jig part no. 877258.

NOTE

Ensure that no LOCTITE 603 is in contact with the oil seal.

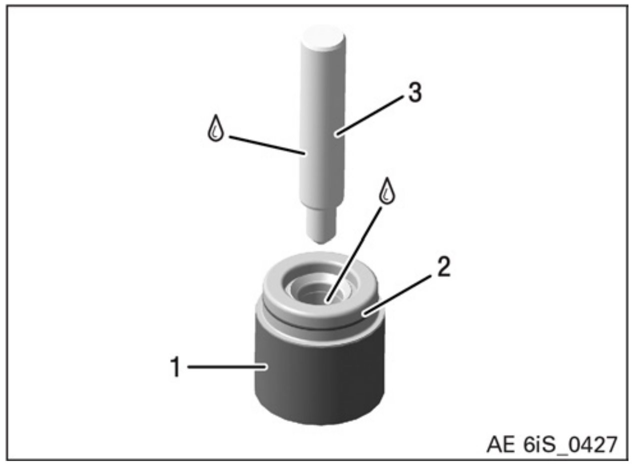

Figure 16.23

1	*Insertion jig part no. 877258*	2	*Rotary seal*
3	*Water pump shaft*		

Step	Procedure
2	Insert the pump gear 15 T in the ignition housing. **NOTE** *The wide collar of the gear points inwards towards the crankcase.*
3	Press the pump shaft with the rotary seal already compressed into the ignition housing using the insertion jig part no. 877258. **NOTE** *Ensure that the pump gear is aligned with the pump shaft.*

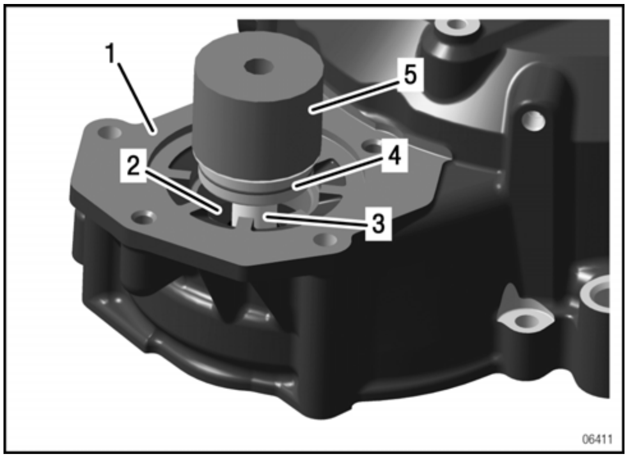

Figure 16.24: TYPICAL

1	*Ignition housing*	2	*Oil seal*
3	*Pump shaft*	4	*Rotary seal*
5	*Insertion jig part no. 877258*		

Step	Procedure
4	Install the ignition housing. See Chapter 24-20-00 section Ignition housing – installation.
5	Push on the washer 8.2/12.5/1.5 and apply LOCTITE 243 to the thread of the water pump shaft. Then fasten the impeller with the special tool part no. 877295 with locked crankshaft. Tightening torque 15 Nm (133 in. lb.).

Lock the crankshaft.
See current Maintenance Manual Line (MML) for the respective engine type.

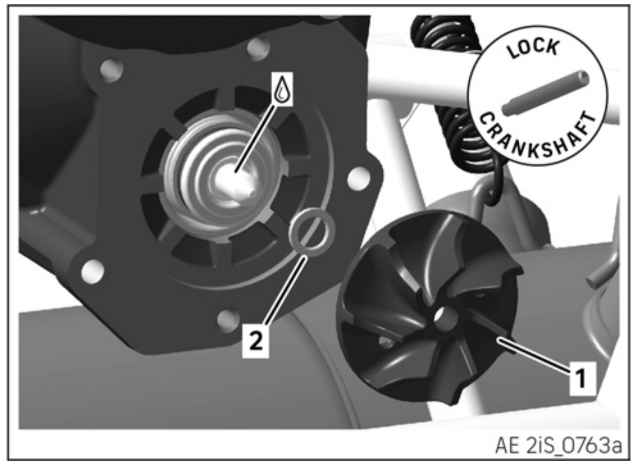

Figure 16.25

1	*Impeller*	2	*Washer 8.2/12.5/1.5*

NOTE

Ensure that the impeller runs true. If there is noticeable runout, this, and possibly also the pump shaft, must be replaced.

WATER PUMP HOUSING — ASSEMBLY

Step	Procedure
1	Lubricate the bent sockets with LOCTITE 577.
2	Screw the bent socket at least 5 revolutions into the water pump housing and position it.

NOTE

3 bent socket with a bend angle of 45° and 1 bent socket with a bend angle of 20° are installed.

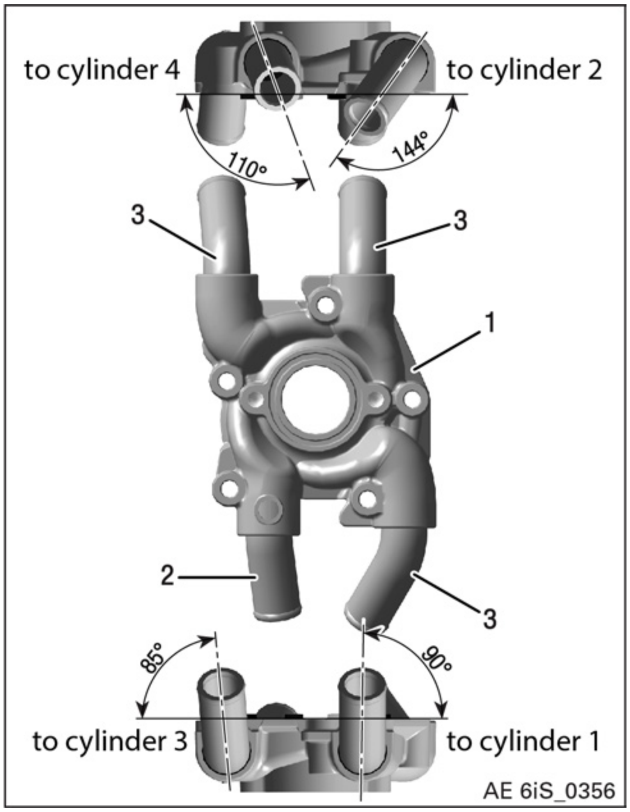

Figure 16.26

1	*Water pump housing*	*2*	*Bent socket 20°*
3	*Bent socket 45°*		

Step	Procedure
3	Allow the water pump housing to harden for at least 12 hours (at room temperature).

FORM HOSE – INSTALLATION

NOTICE

The push-on length of the expansion tank is 25 mm (0.9843 in.)!

NOTICE

Hoses must not be shortened!

NOTE

The hoses are all preformed and cut to length in the factory, and the hose length and push-on length therefore defines the position of the expansion tank. The correct position of the expansion tank ensures trouble-free installation of the governor.

NOTE

Mark the push-on lengths of the hoses on the water elbows.

Step	Procedure
1	Install the rubber plate on form hose connection 2, 4 and 1.

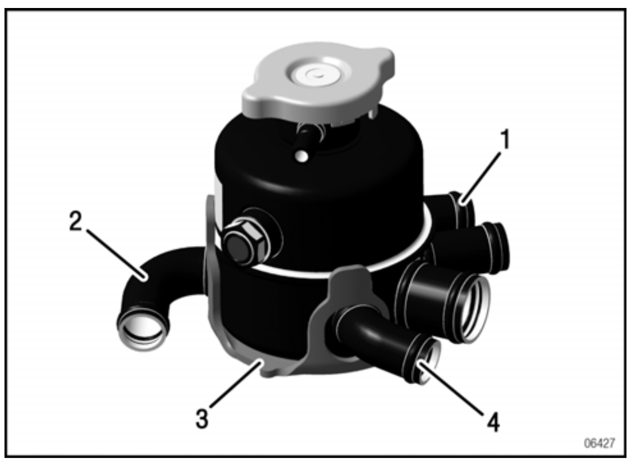

Figure 16.27

1	*Form hose connection 1*	*2*	*Form hose connection 2*
3	*Rubber plate*	*4*	*Form hose connection 4*

Step	Procedure
2	Install the spring clamp 35 on the form hose radiator outlet.
3	Push on the form hose onto the radiator outlet and align it vertically.

NOTE

Align the spring clamp 35 vertically too so that the remaining form hoses can be installed.

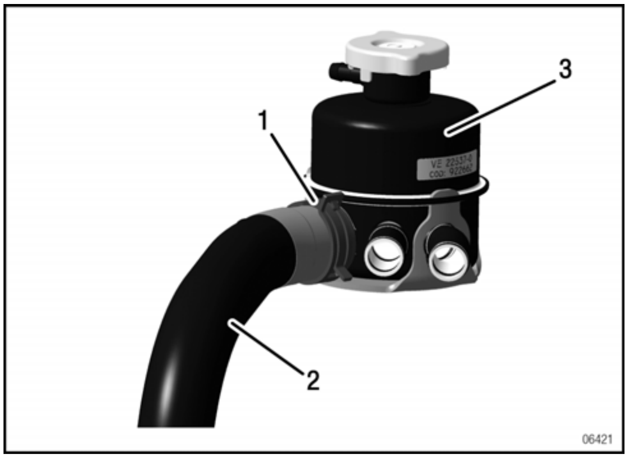

Figure 16.28

1 *Spring clamp 35*	2 *Form hose radiator outlet*
3 *Expansion tank*	

Step	Procedure
4	Install the spring clamp 25 on the form hose 3 and align it vertically.

NOTE

Align the spring clamp 25 so that it does not come into contact with the other spring clamp 35.

Step	Procedure
5	Push on form hose 3 and align it horizontally.

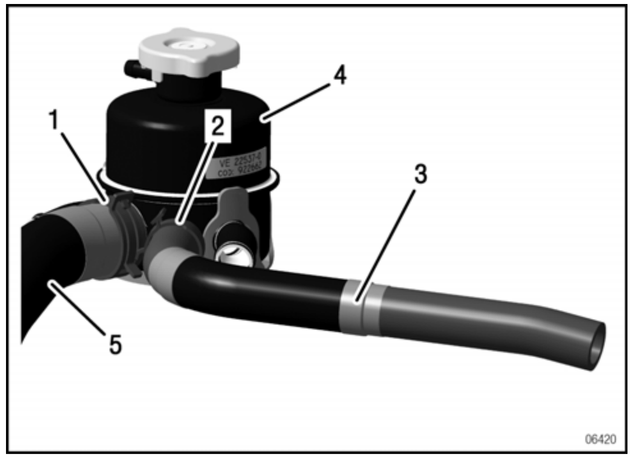

Figure 16.29

1 *Spring clamp 35*	2 *Spring clamp 25*
3 *Form hose 3*	4 *Expansion tank*
5 *Form hose radiator outlet*	

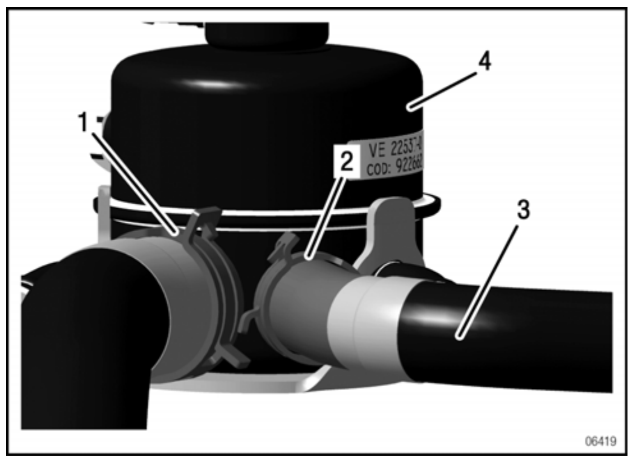

Figure 16.30

1 *Spring clamp 35*	2 *Spring clamp 25*
3 *Form hose 3*	4 *Expansion tank*

Step	Procedure
6	Install the spring clamp 25 on form hose 1.

NOTE

Align the spring clamp 25 so that it is 2 mm (0.0787 in.) away from the spring clamp 25 on form hose 3.

Step	Procedure
7	Push on form hose 1 and align it horizontally like form hose 3.

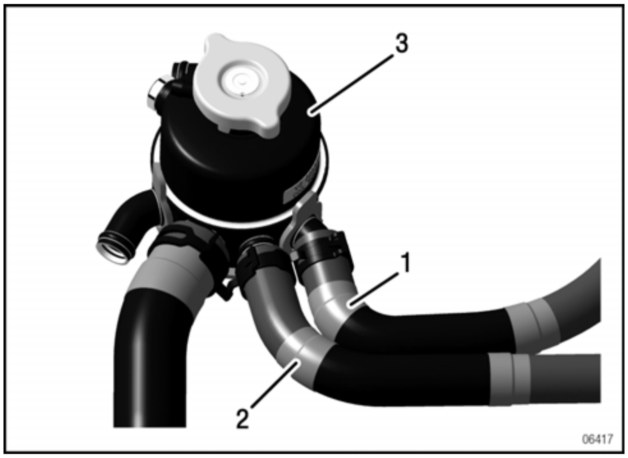

Figure 16.31

1 Form hose 1 *2 Form hose 3*
3 Expansion tank

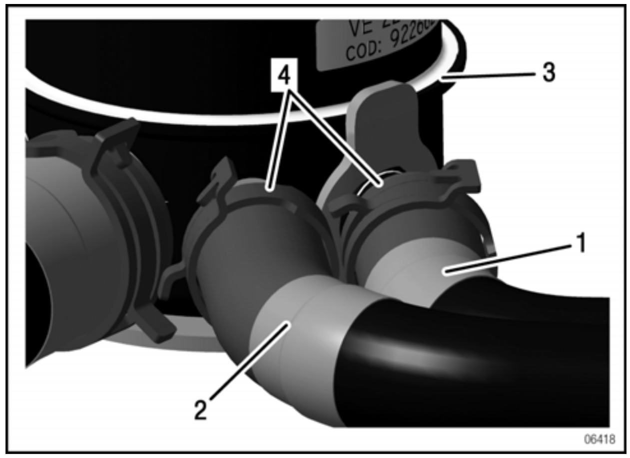

Figure 16.32

1 Form hose 1 *2 Form hose 3*
3 Expansion tank *4 Spring clamp 25*

Step	Procedure
8	Install the spring clamp 25 on form hose 4.

NOTE

Align the spring clamp 25 so that it does not come into contact with the other spring clamp 35.

Step	Procedure
9	Push on form hose 4 and align it horizontally like form hoses 3 and 1.

NOTE

Form hose 4 is symmetrical.

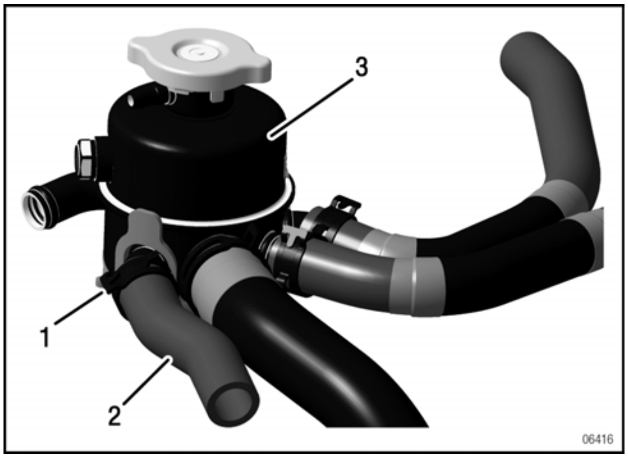

Figure 16.33

1 Spring clamp 25 *2 Form hose 4*

3 Expansion tank

Step	Procedure
10	Install the spring clamp 25 on form hose 2 and position it vertically.
11	Push on form hose 2 and align it horizontally.

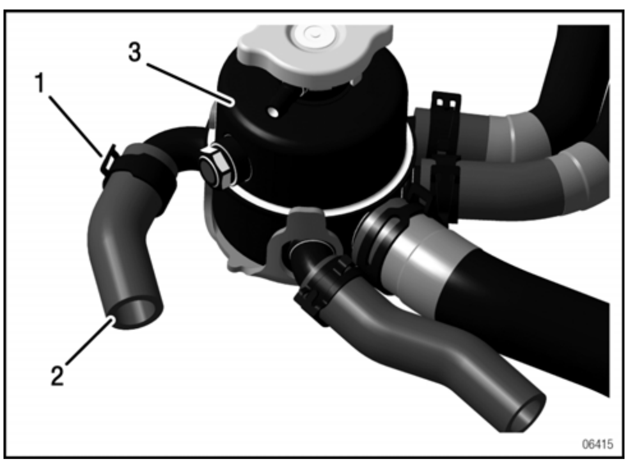

Figure 16.34

1 Spring clamp 25 *2 Form hose 2*

3 Expansion tank

NOTE

Form hose 2 is symmetrical.

INSTALLATION

IGNITION HOUSING — INSTALLATION

See Chapter 24–20–00 section Ignition housing – installation

WATER PUMP HOUSING WITH LOWER FORM HOSES — INSTALLATION

NOTICE

The impeller must not touch the pump housing.
If necessary, the axial position of the impeller must be adjusted.

NOTE

Measure the gap between impeller and water pump housing using a feeler gauge, see section (WP02).

Step	Procedure
1	Put on a new gasket and fasten the water pump housing to the ignition housing with 2 Allen screws M6x90 and 2 Allen screws M6x35 with washers 6.4. Tightening torque 10 Nm (89 in. lb.). **NOTE** *Apply lithium-base grease on both sides of the new gasket.*
2	Install Allen screw M6x35 (stainless steel) with new sealing ring 6x10. Tightening torque 10 Nm (89 in. lb.).

NOTICE

The bottom M6x35 Allen screw extends into the water chamber and is therefore stainless steel and sealed with a new sealing ring.

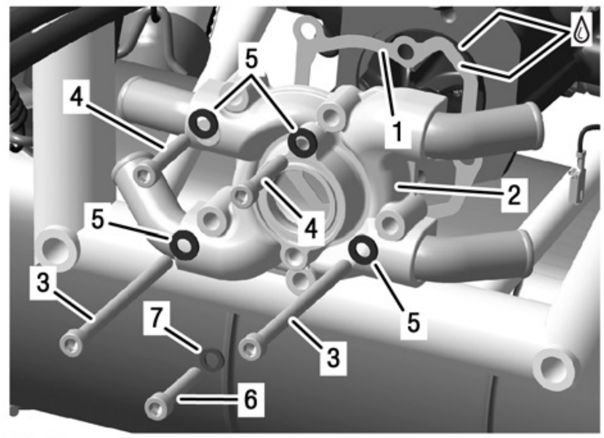

Figure 16.35: : TYPICAL

1	*Gasket*	2	*Water pump housing*
3	*Allen screw M6x90*	4	*Allen screw M6x35*
5	*Washers 6.4*	6	*Allen screw M6x35 (stainless steel)*
7	*Sealing ring 6x10*		

Step	Procedure
3	Insert the new O-ring 32x2 in the water pump housing and fasten the water inlet elbow in the marked position with 2 Allen screws M6x20 and washers 6.4. Tightening torque 10 Nm (89 in. lb.).

NOTE

The water inlet elbow is symmetrical and can, if required, be fitted in other positions.

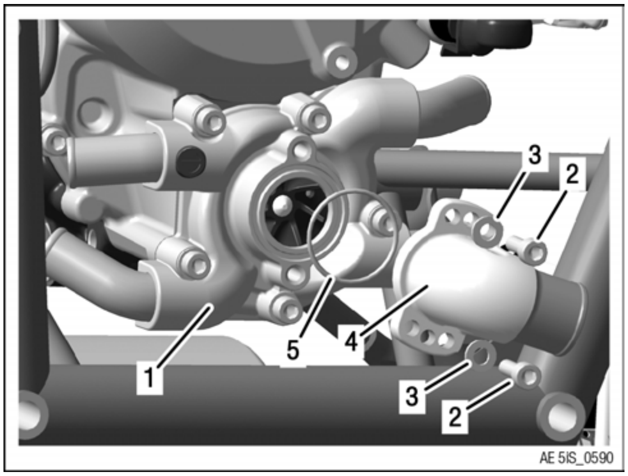

Figure 16.36: TYPICAL

1	*Water pump housing*	2	*Allen screw M6x20*
3	*Washer 6.4*	4	*Water inlet elbow*
5	*O-ring 32x2*		

Step	Procedure
4	Install 4 form hoses including heat protection tubes with spring clamps 25 on the water pump housing. Use spring clamp pliers part no. 877840.

NOTICE

Ensure that the push-on length is correct! The push-on length onto the bent socket on the water pump housing and cylinder head is 27 mm (1.06 in.)

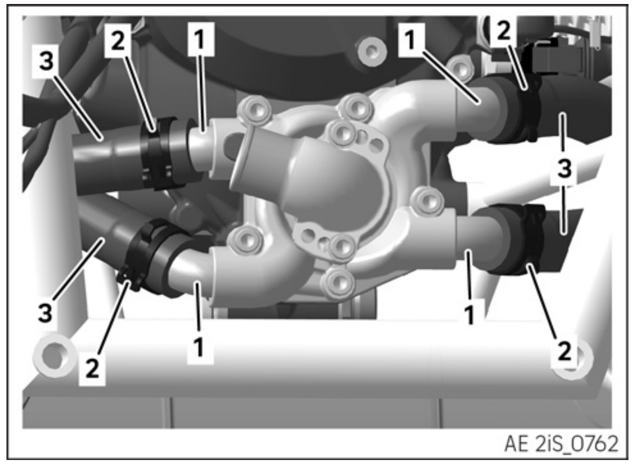

Figure 16.37

1	*Bent sockets*	2	*Spring clamps*
3	*Form hoses*		

Step	Procedure
5	Install form hoses with spring clamps 25 on the cylinder head. Use spring clamp pliers part no. 877840.

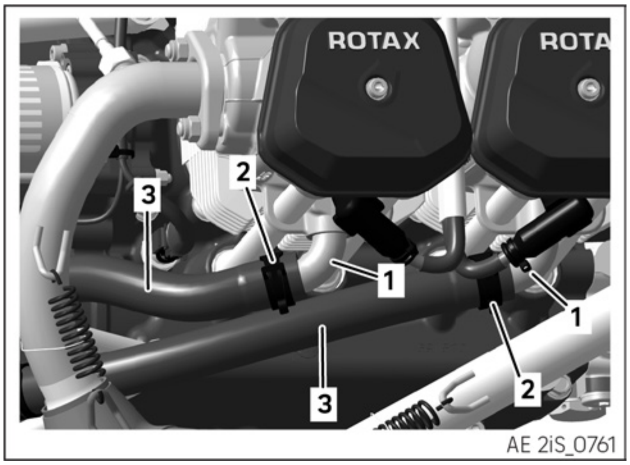

Figure 16.38

1	*Bent sockets*	2	*Spring clamps 25*
3	*Form hoses*		

COOLING AIR BAFFLE – INSTALLATION

Step	Procedure
1	Attach cooling air baffle.
2	Install expansion tank with upper form hoses.
3	See surrounding assemblies- installation.

EXPANSION TANK AND FORM HOSES — INSTALLATION

Preparation

- if necessary, install bent socket on cylinder head (1 to 4). See Chapter 72-30-00 section Coolant elbow – installation.

NOTICE

Ensure that the expansion tank is fixed without tension.

NOTE

Check the push-on lengths, readjust the form hoses if necessary.

Step	Procedure
1	Install 1 spring clamp 25 each on form hoses 1, 2, 3, and 4.
2	Position the expansion tank assy. with the 5 form hoses on the engine.

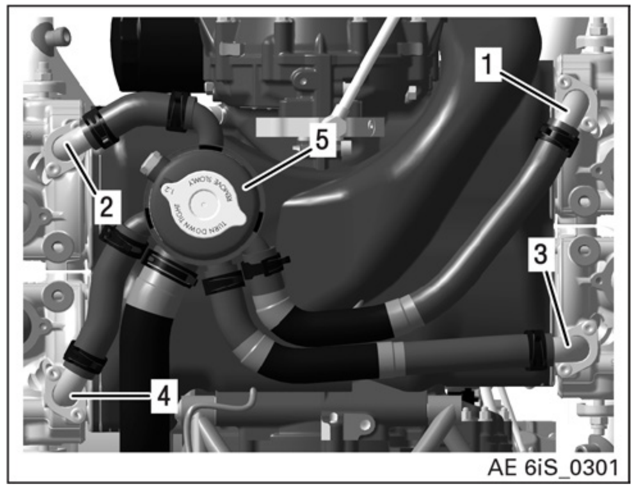

Figure 16.39

1	*Bent socket 1*	2	*Bent socket 2*
3	*Bent socket 3*	4	*Bent socket 4*
5	*Expansion tank*		

NOTICE

Ensure that the push-on length is correct!
The push-on length onto the bent socket on the cylinder head is 27 mm (1.06 in.).

Step	Procedure
3	Fasten form hoses 1 to 4 with spring clamps 25.

NOTE

Start with the shortest hose (form hose 2). Then form hose 1, then form hose 3 and form hose 4.

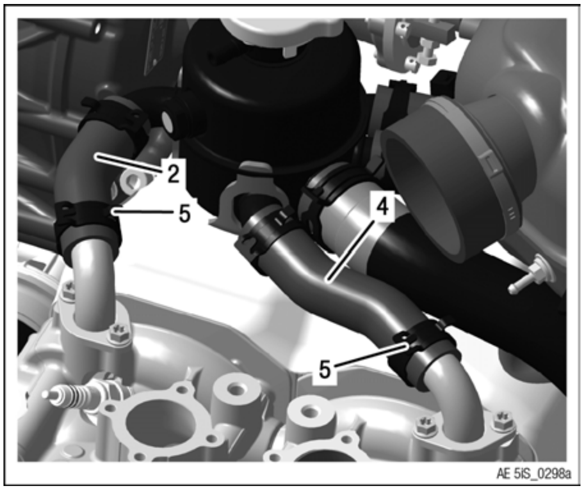

Figure 16.40: Cylinder 2 and 4 TYPICAL

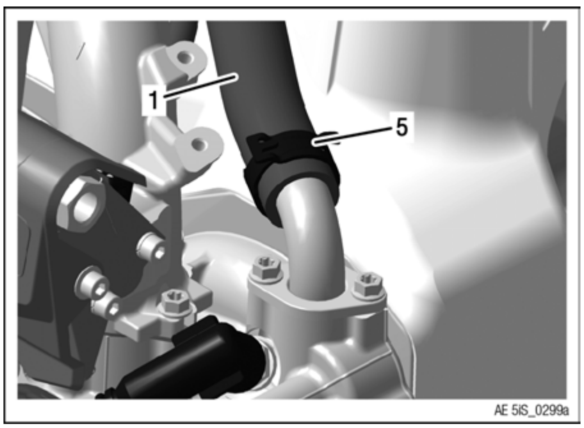

Figure 16.41: Cylinder 1 TYPICAL

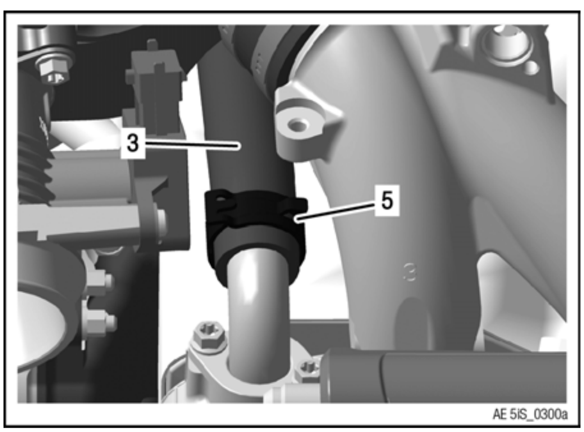

Figure 16.42: Cylinder 3 TYPICAL

1	*Form hose 1*	2	*Form hose 2*
3	*Form hose 3*	4	*Form hose 4*
5	*Spring clamp*		

SURROUNDING ASSEMBLIES — INSTALLATION

Only necessary for upper coolant system and cooling air baffle.

Step	Procedure
1	Remove plug (part no. 860397) from the intake ducts.
2	Push the airbox including the intake manifolds onto the engine carefully.
3	Install the isolating flange between the intake manifold and the cylinder head.
4	Install intake manifolds (cylinder 2/4 and cylinder 1/3) with 4 hex./torx collar screws onto the cylinder heads. See Chapter 73-10-00, section Intake manifold — installation.
5	Install the air intake hose onto the throttle body. . Follow the instructions in the aircraft manufacturer's manual.
6	Install Exhaust Gas Temperature sensor (EGT) on the exhaust pipes. See Chapter 76-70-00, section Exhaust gas temperature sensor — installation.
7	Fix the fuel line assy. on the left and right of the fuel rails with banjo bolts M12x1,5x24 and new sealing rings 12x18. Tightening torque 25 Nm (18 ft. lb.).
8	Install the fuel line assy. with cable clamp 8/M6, Allen screw M6x16 and with washer 6.4 on the gearbox housing. tightening torque 10 Nm (89 in. lb.)
9	Fix the airbox with a new lock nut M6 and washer 6.4 on the ignition housing. Tightening torque 10 Nm (89 in. lb.).

Step	Procedure
10	Route lower ignition cables and install and connect lower spark plug connectors. See Chapter 74-20-00, section Spark plug connector and ignition cable assy. — installation.
11	Connect Coolant Temperature Sensor (CTS), Oil Temperature Sensor (OTS), Oil Pressure Sensor (OPS), Knock sensor (KNOCK), Crankshaft Position Sensor (CPS 1/2). See 76-50-00 Wiring harness – installation

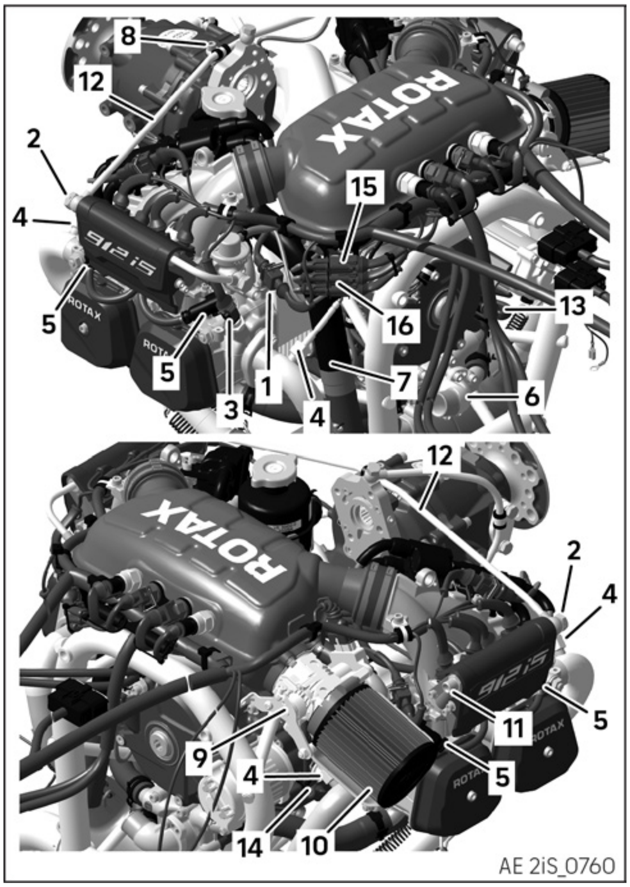

Figure 16.43

1	*Fuel outlet*	2	*Banjo bolt with sealing rings*
3	*Coolant Temperature Sensor (CTS)*	4	*Exhaust Gas Temperature (EGT)*
5	*Spark plug connector*	6	*Water inlet elbow*
7	*Coolant outlet*	8	*Allen screw with lock washer and cable clamp*
9	*Throttle body*	10	*Air filter*
11	*Fuel inlet*	12	*Fuel hose assy.*
13	*Oil Pressure Sensor (OPS)*	14	*Oil Temperature Sensor (OTS)*
15	*Knock sensor*	16	*Crankshaft Position Sensor (CPS 1/2)*

FINISHING WORK

Install the fuel outlet and inlet line on the fuel rail.
Follow the instructions in the aircraft manufacturer's manual.

Install coolant hoses (inlet and outlet).
Follow the instructions in the aircraft manufacturer's manual.

Fill with operating fluids or check filling levels.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-10-00 section Adding operating fluids.

Flush the engine cooling system.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Flushing the engine cooling system.

Purge the oil system.
See current Installation Manual (IM) for the respective engine type, Chapter 79-00-00 section Purging the lubrication system.

Carry out an engine test run.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Planned maintenance

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Chapter: 76–00–00
ENGINE CONTROL

TOPICS IN THIS CHAPTER

Introduction

The Engine Management System (EMS) consists primarily of:

- Control unit (Electronic Control Unit = ECU)
- ECU signals
- EMS power supply
- Fuse box
- Switches
- Wiring

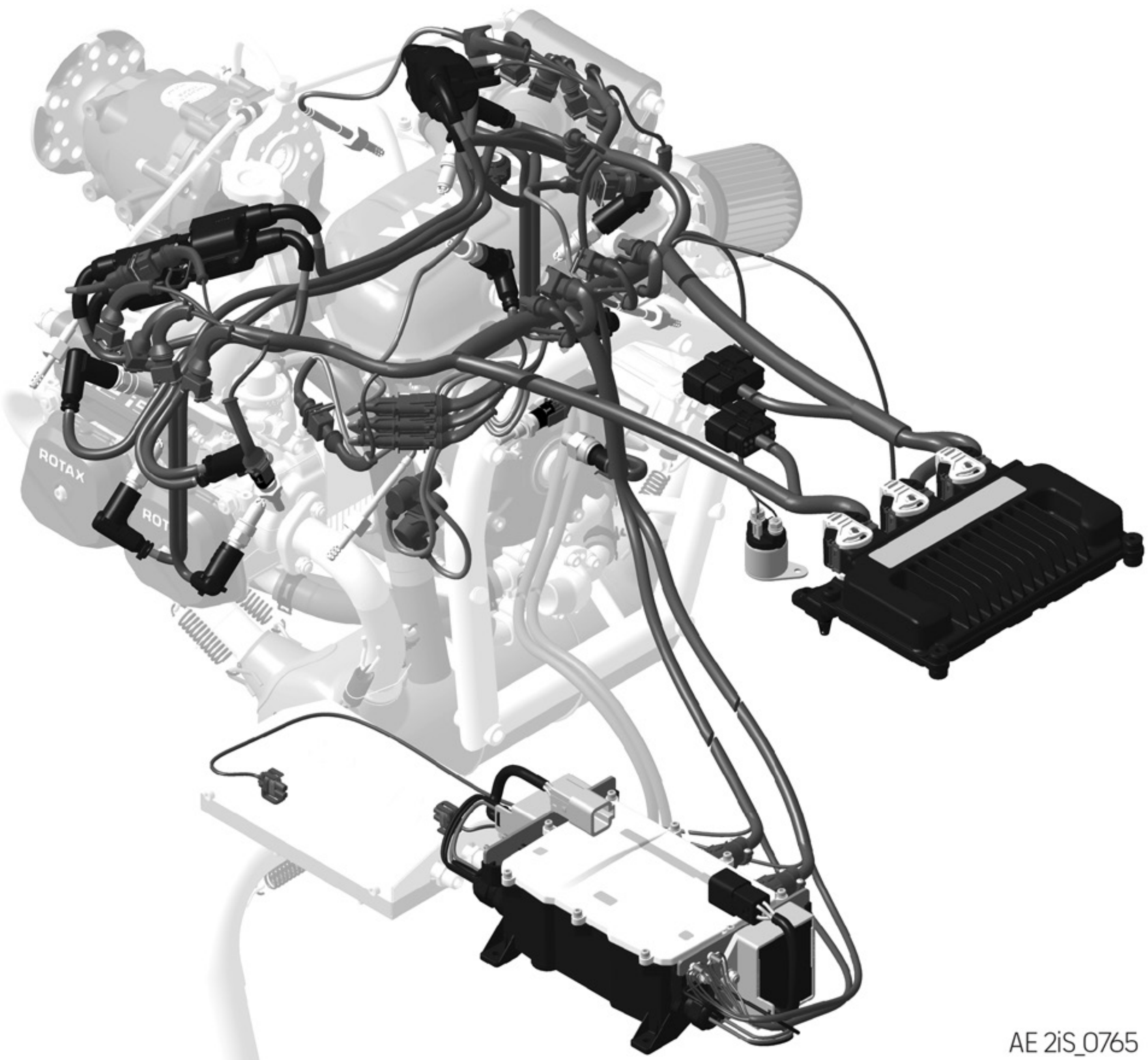


Figure 4.1: Location on the engine

Chapter: 76–10–00
ENGINE CONTROL UNIT (ECU)

TOPICS IN THIS CHAPTER

SPECIAL TOOLS

Description	Part number
B.U.D.S SET LEVEL 1	864021
B.U.D.S SET LEVEL 2	864022
B.U.D.S SET LEVEL 3	864023
Service Wiring Harness 1)	864280
Y-Cable (Sub-D DE9 female on male/male junction) 2) 3)	n.a.
B.U.D.S. Aircraft Software	n.a.
Computer/Notebook/Netbook	n.a.

1) Only required if ECU is detached from the wiring harness.

2) Only required if the aircraft has two separate Sub-D DE9 connectors.

3) The y-cable must be according to the wiring diagram in Fig. 1.

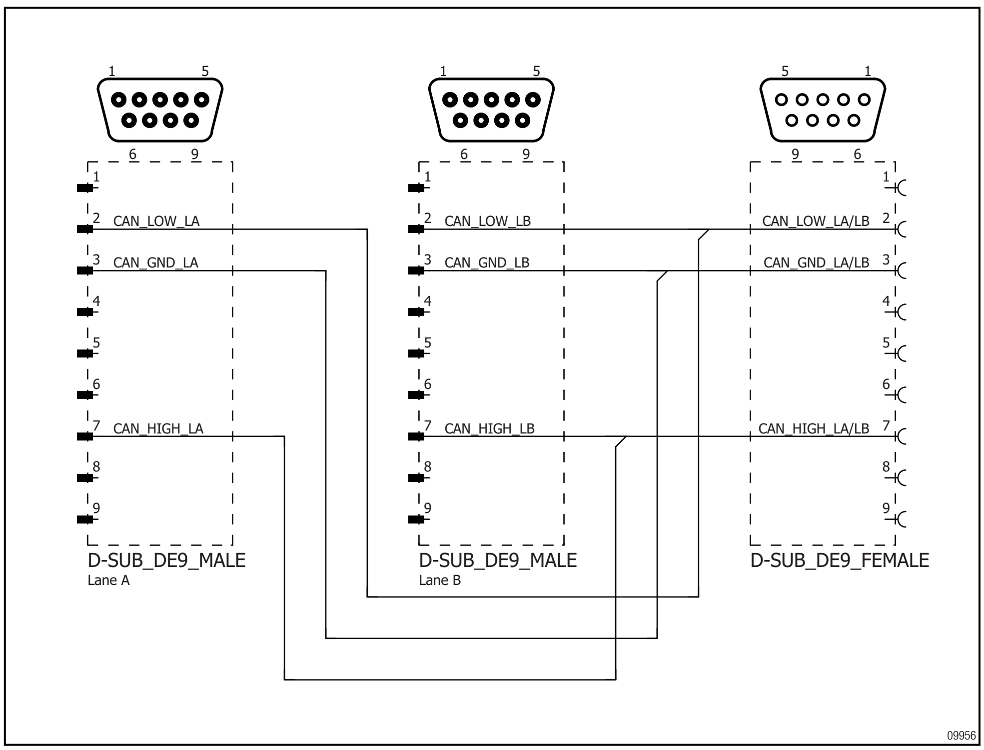


Figure 17.1

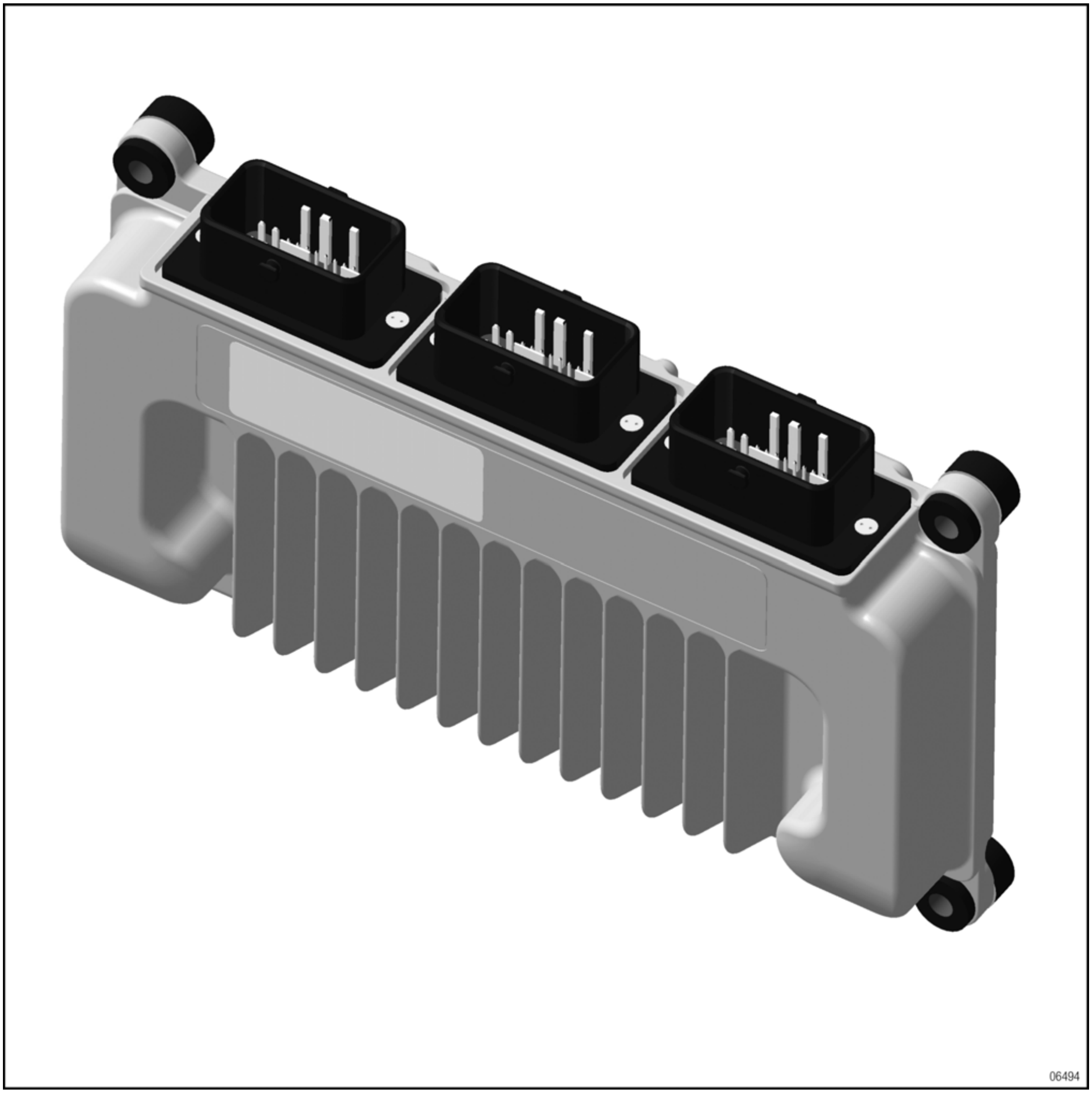


Figure 17.2: Control unit (ECU)

SYSTEM DESCRIPTION

GENERAL NOTE

The control unit is the central module in the engine management system.
Sensors continuously measure pressure, rotation speed, temperature, load and knock signals and send these measurement values to the ECU.
The digital ECU uses these measurement values to determine not only the mixture but also the optimum injection point for the fuel and ignition points specifically for each cylinder.

NOTE

The general safety instructions must be followed during all work on the ECU!

SAFETY INSTRUCTION

⚠ WARNING
Danger of damage to engine! There is a risk of short circuits and cable fires during work on the engine management system. All installation work on the engine management system should be carried out with the engine switched off and the battery (negative terminal) disconnected. All engine controls (e.g. switches) must be set in a way that the engine in not supplied with electrical power.

NOTICE
Danger of damage to the fuel distribution system and ignition unit!

MAINTENANCE

As well as the maintenance and special checks, see current Maintenance Manual Line (MML) for the respective engine type.

TECHNICAL DATA

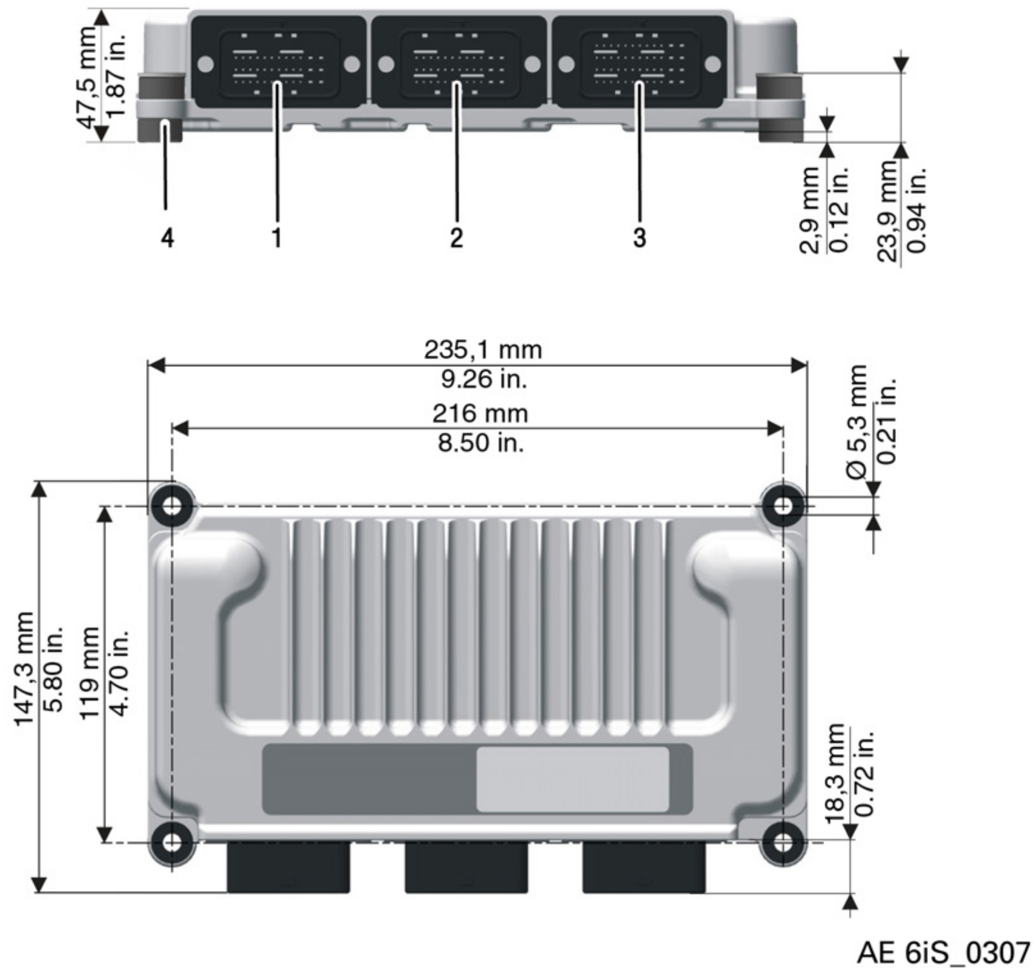


Figure 17.3: ECU

1	*Connector socket A1*	2	*Connector socket A2*
3	*Connector socket B*	4	*Attachment points*

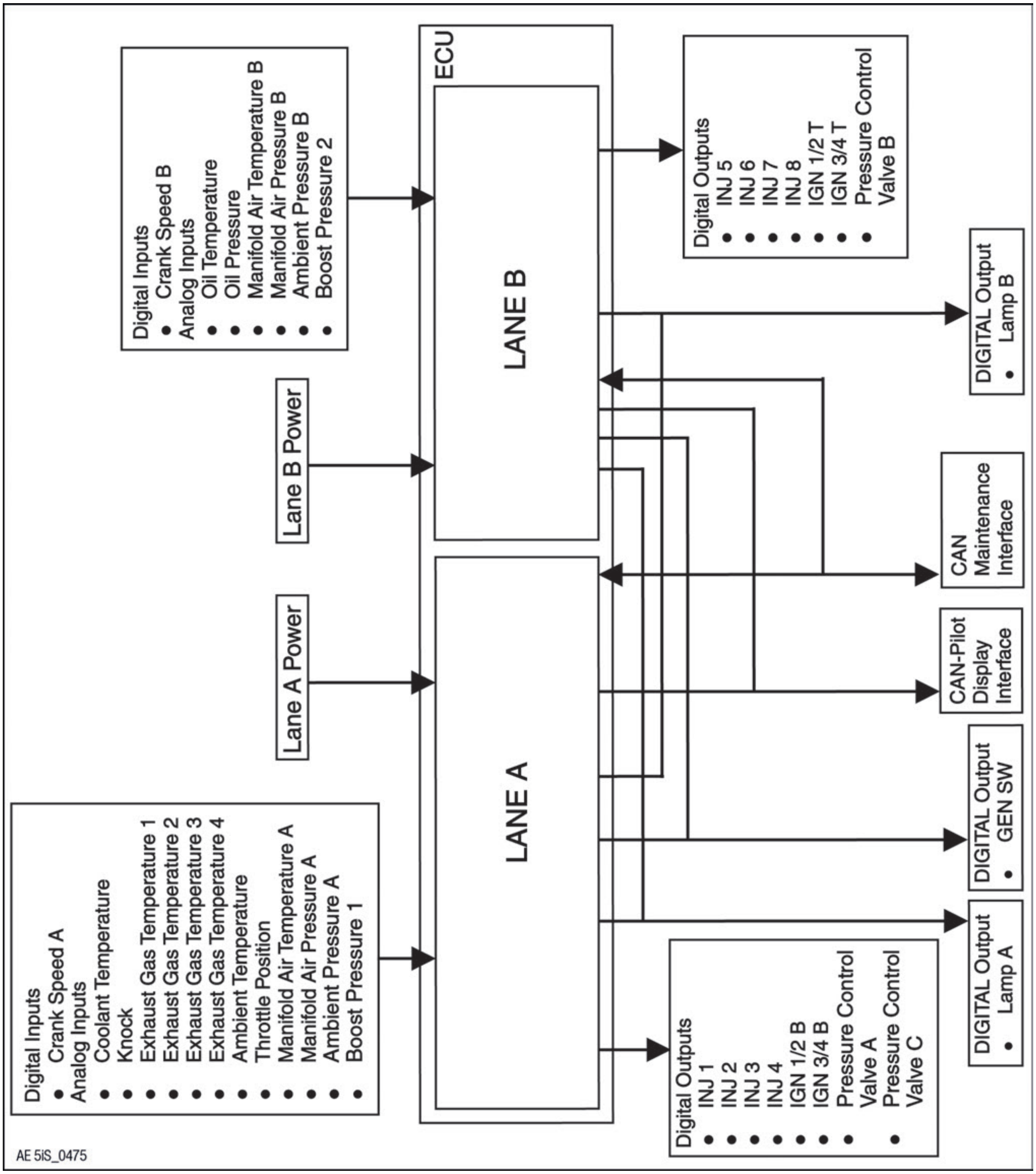


Figure 17.4: Control unit ECU

REMOVAL

Preparation

Before the ECU is removed, the work and checks described below must be carried out to identify any malfunctions and rectify them as part of the repair work.

- Turn the ignition switch "OFF"

General visual inspection. See relevant Maintenance Manual Line (MML) Chapter 05-00-00 and 12-20-00.

> **NOTICE**
>
> **The wire connectors of the ECU must not be opened and closed more than 20 times! This must be shown on the device by a clearly visible label with a printed numerical sequence (1-20) and by documentation conforming to self-monitoring guidelines.**

ECU — REMOVAL

> **NOTICE**
>
> **Removal must be carried out according to the aircraft manufacturer's instructions.**

Step	Procedure
1	Remove the battery grounding cable according to the aircraft manufacturer's specifications.
2	Unplug the connectors (Lane A1, Lane A2 and Lane B). • Press in the lock so to rotate the lever. • Press the lever down until it latches. • Remove the connector.
3	Remove the screws according to the aircraft manufacturer's specifications. Remove the ECU.

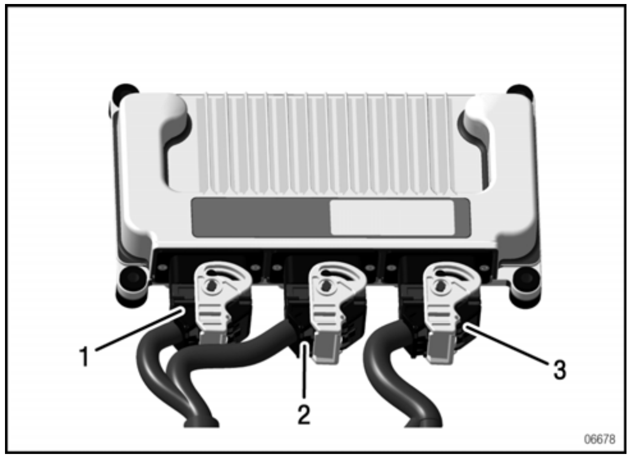


Figure 17.5

1 Connector (Lane A1) *2 Connector (Lane A2)*
3 Connector (Lane B)

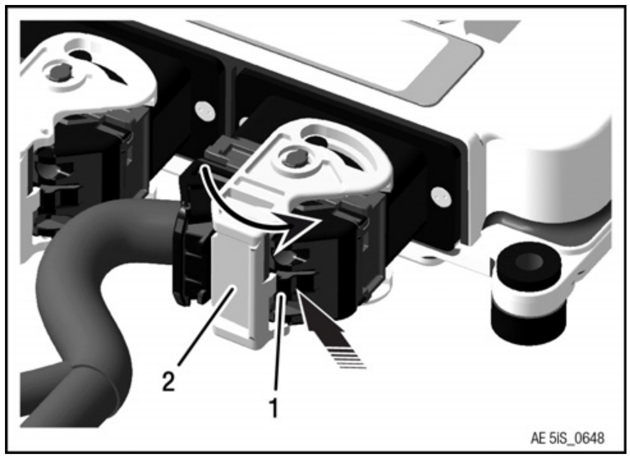


Figure 17.6

1 Lock *2 Lever*

INSPECTION

ECU — INSPECTION

NOTICE

The functional test of the ECU can only be carried out with the corresponding software (B.U.D.S. Aircraft), as part of an engine test run (see relevant Maintenance Manual Line 12-20-00) or on an approved test bench.

General visual inspection.
See Maintenance Manual Line (MML) for the respective engine type, Chapter 05-00-00 and 12-20-00.

Step	Procedure
1	Check the component surfaces of the ECU for damage.

NOTE

Deformation and deep scratches are not permissible.

Step	Procedure
2	Check flat and contact surfaces for Allen/hex. screws and nuts.
3	Check the screws and nuts for damage and wear.

NOTE

Replace damaged screws and nuts. Check the corresponding internal thread too when changing the screws.

Step	Procedure
4	Check the plug connection for damage and wear.
5	Check the rubber grommets for damage.
6	Check the label on the ECU for readability.

INSTALLATION

Preparation

NOTICE
The wire connectors of the ECU must not be opened and closed more than 20 times! This must be shown on the device by a clearly visible label with a printed numerical sequence (1-20) and by documentation conforming to self-monitoring guidelines.

NOTE

The ECU can only be replaced as a complete spare part.

ECU — INSTALLATION

NOTICE
Installation must be carried out according to the aircraft manufacturer's and to the specifications of the Installation Manual (IM).

Step	Procedure
1	Install the control unit according to the aircraft manufacturer's instructions.
2	Plug the wiring harness (main strand) into the ECU and turn lever until it locks. • Plug in connector Lane A1 • Plug in connector Lane A2 • Plug in connector Lane B

Step	Procedure
3	Install the battery grounding cable according to the aircraft manufacturer's instructions.

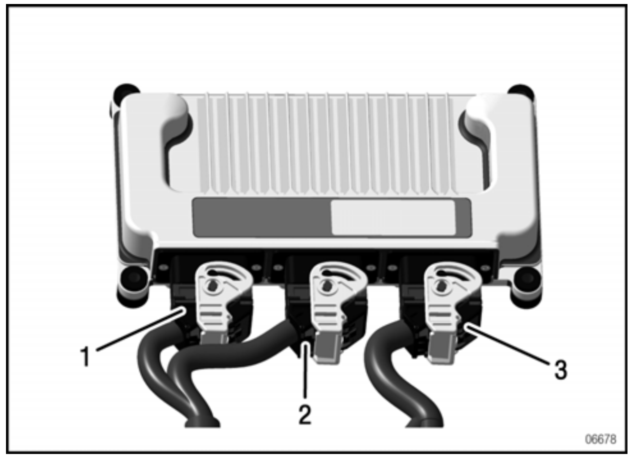


Figure 17.7

1 Connector (Lane A1) *2 Connector (Lane A2)*
3 Connector (Lane B)

NOTE

Put the clamp completely horizontal, place on the connector, then close the clamp 90°. The lock must engage.

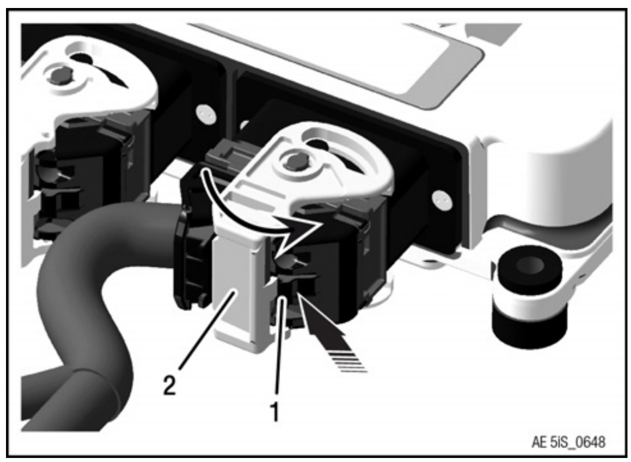


Figure 17.8

1 Lock *2 Lever*

NOTE

Ensure that the correct connection is made to the corresponding LANE by using the marking.

ECU – READ OUT AND FLASHING

Introduction
The intention of this procedural instruction is to guide users through the process of identifying the software- and hardware version of an ECU. Although ECU software changes must be documented within the engine logbook and on the ECU (update label), it is mandatory to identify the current ECU software- and hardware version by using B.U.D.S. Aircraft software.

Generally this process can be performed in two different ways:

- **Situation 1:** ECU has been removed from an Aircraft. That means the ECU has been disconnected from the wiring harness and removed from the aircraft
- **Situation 2:** ECU is installed in an Aircraft. The ECU is connected to the wiring harness and installed in the Aircraft.

Because the situations are essentially different, those two situations will be described independently in this chapter.

NOTE

Before extracting logs or loading ECU software make sure you have installed the latest version of B.U.D.S. Aircraft in accordance to SI-912 i-002. See also Service Bulletin SI-912 i-003.

ECU ON WORKBENCH

NOTICE

Do not open and close the ECU connectors more than 20 times, otherwise it is required to change the ECU and the wiring harness. If it is possible it is recommended to perform the software loading process as described in Situation 2 to save connection cycles. For a flawless software loading procedure ensure that the selected power supply is able to provide constant voltage.

CONNECTION

Step	Procedure
1	Connect B.U.D.S. Aircraft Set with the USB-Port of your computer. If the device is connected and installed the RED indicator light should light up.
2	Connect the B.U.D.S. Aircraft Set Sub-D DE9 connector with the Sub-D DE9 socket of the Service Wiring Harness.
3	Connect the Service Wiring Harness with the LANE A1 and LANE B connectors of the ECU.

NOTICE

Please note labeling of the ECU and the Service Wiring Harness.

Step	Procedure
4	Connect power adapter of Service Wiring Harness with power supply (100-230 V~50/60 Hz, 500 mA).
5	Now the setup should be as shown in following figure.

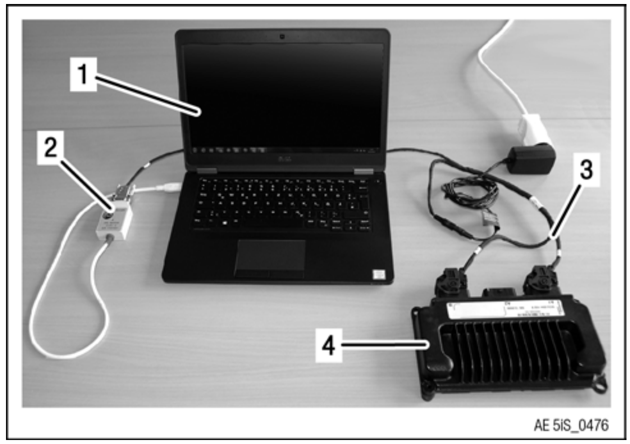


Figure 17.9: Computer with ECU

1	*Computer*	*2*	*B.U.D.S. Aircraft Set*
3	*Service Wiring Harness*	*4*	*ECU*

IDENTIFY CURRENT ECU CONFIGURATION

Step	Procedure
1	Launch B.U.D.S. Aircraft by double clicking the desktop icon. Alternatively B.U.D.S. Aircraft can also be started through the start menu entry (e.g. Start - Programs - BUDS - run BUDS).

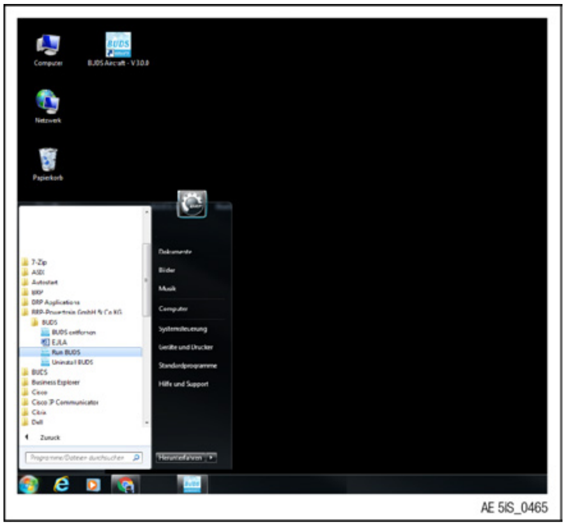


Figure 17.10: B.U.D.S. Aircraft Start

Step	Procedure
2	Wait until the program has been started completely.
3	Check if both Lane Health Indicators (top-left corner) turn green. If they are gray check connections and power supply and/or restart B.U.D.S. Aircraft.
4	Change to “ECU configuration” tab.

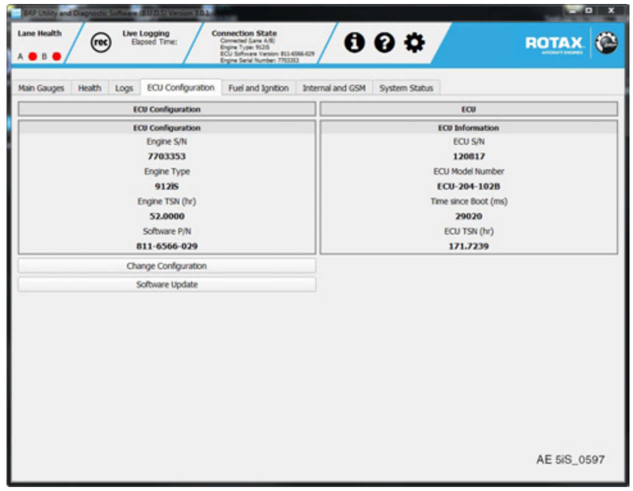


Figure 17.11: ECU configuration tab

Step	Procedure
5	Read and note the values of following fields: • Software P/N: This value indicates the current software installed on the ECU. **NOTE** *Knowing the current “Software Config. Part Number” and “ECU part number” is crucial, when loading ECU software or verifying if ECU has the latest software installed.*
6	Disconnect the wiring attached to connect the ECU with the computer. • Disconnect power supply of the Service Wiring Harness. • Disconnect B.U.D.S. Aircraft Set • Disconnect Service Wiring Harness connectors

READ OUT LOG FILES

General

To have all information it is recommended to extract Lane A and B and also Fault and Data logs. The extraction process (read out) may take 10 minutes or more depending on the number of logs.

NOTE

Fault logs: Fault, failure and warning entries in the ECU.
Data logs: ECU data recorded in a rolling memory.

Step	Procedure
1	Change to “Logs” tab.
2	Select “Extract logs”.

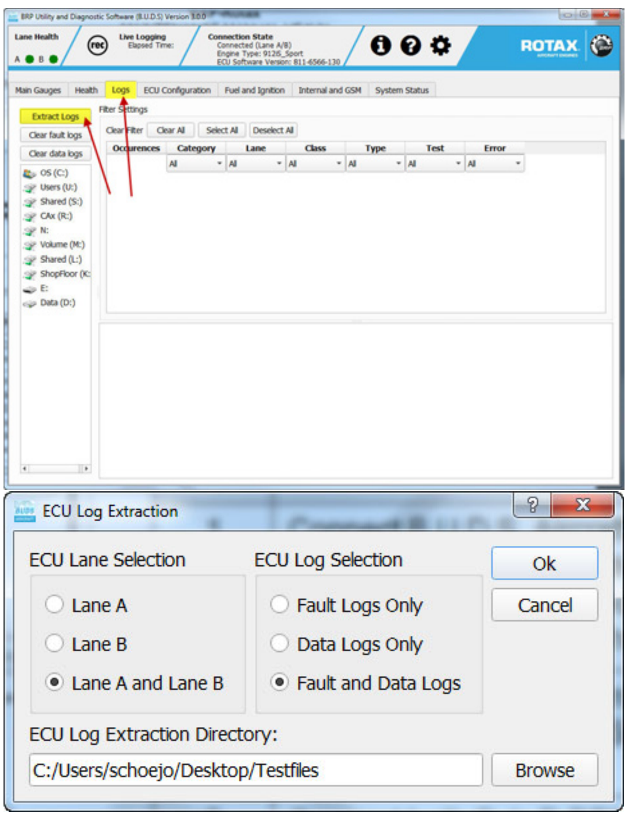


Figure 17.12

Step	Procedure
3	Disconnect and re-connect the power supply if B.U.D.S. Aircraft requests to do so.

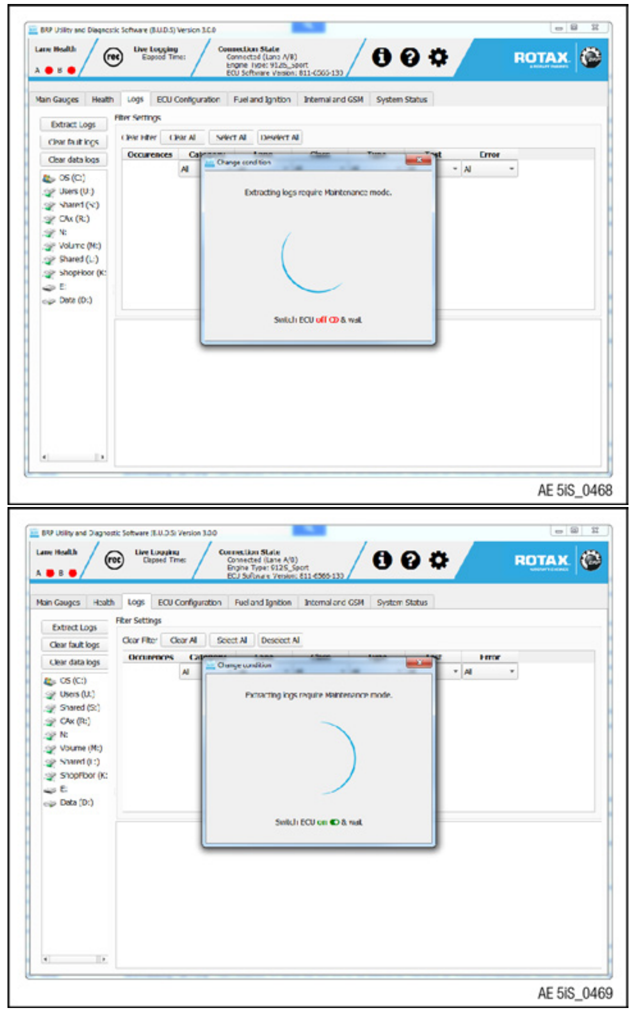


Figure 17.13

NOTE

After the extraction process has finished B.U.D.S. Aircraft requests to power cycle the ECU (Disconnect + Re-connect power supply).

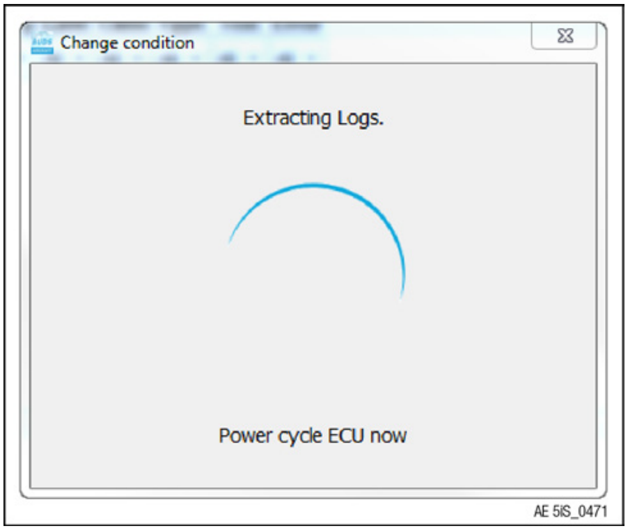


Figure 17.14

Step	Procedure
4	Disconnect the wiring connecting the ECU with the computer. • Disconnect power supply of the Service Wiring Harness. • Disconnect B.U.D.S. Aircraft Set • Disconnect Service Wiring Harness connectors
5	With the Windows Explorer navigate to the created Log-File. This file can now be copied and for example attached to an E-mail or otherwise used.

SOFTWARE UPDATE

Preparation
Connect Computer with ECU and identify configuration as described in the previous subsections in this chapter.

Step	Procedure
1	Check the currently installed ECU Software version and the set Engine type. **NOTE** *The last three digits of the “Software P/N“ illustrate the currently installed ECU Software version.*

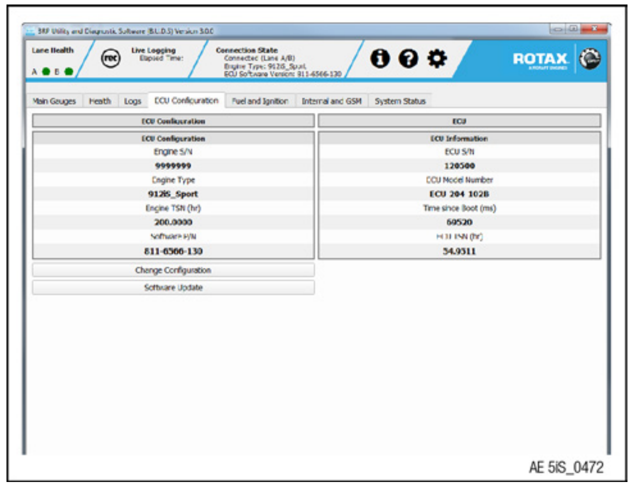


Figure 17.15

⚠ WARNING

Only Software that is compatible with a specific engine type is allowed to be flashed on an ECU (see SB-912 i-002iS). If the engine type in the ECU deviates from the hardware configuration of the engine, contact a distributor immediately.

Step	Procedure
2	Select “Software Update”.
3	Disconnect and re-connect the power supply if B.U.D.S. Aircraft requests to do so.
4	Select “Browse” and navigate to the appropriate ECU Software file (.ath) and confirm with “Open“.
5	The path to this file and the Software P/N will be shown.

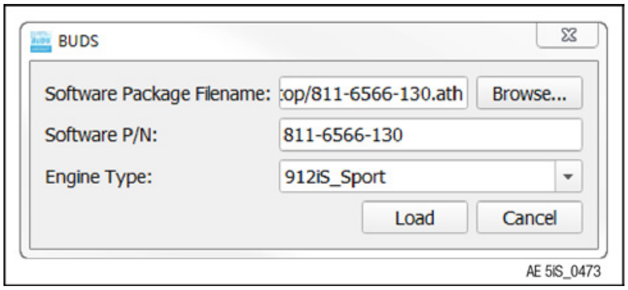


Figure 17.16: : TYPICAL

Step	Procedure
6	Select “Load”.
7	After the extraction process has finished B.U.D.S. Aircraft requests to power cycle the ECU (Disconnect + Re-connect power supply).
8	Please wait until the Software flashing process is finished. The process itself should take approximately 1 minute (a status display will indicate the progress).

Check of the Software version

NOTE

If the Software flashing process was interrupted (e.g. the ECU was disconnected from the computer) it is necessary to restart the flashing process with the desired Software. If this flashing process also fails, flash the initial software on the ECU and afterwards retry flashing the desired Software version.

Step	Procedure
1	Check warning lamp indicators. If both warning lamp indicators (section “Lane Health“/top toolbar) start to flash “RED“ after rebooting the ECU, check compatibility between set Engine type and ECU Software version.
2	Change to “Health“-Tab and check the Sensor Status and Device Status. If there are Errors/Events the ECU might be damaged and further investigation needs to be done. See following Figure for example of correct health tab (using service harness only).
3	The Software flashing process itself is now complete. Switch “OFF” the ECU.
4	Remove all wiring connections.

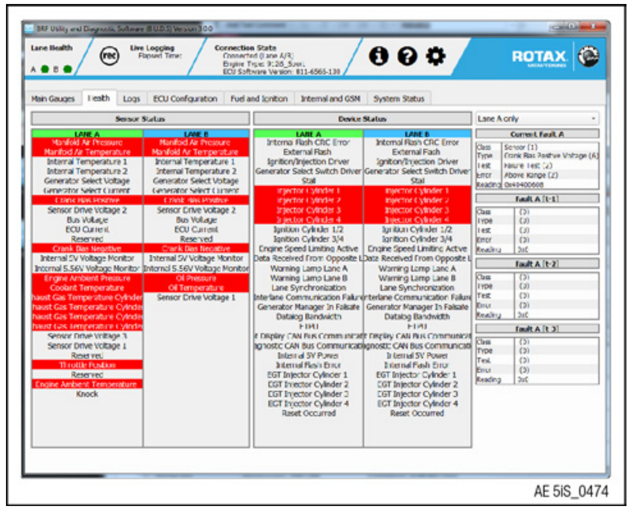


Figure 17.17: Health tab

ECU INSTALLED IN AIRCRAFT

The identification of current ECU configuration, read out of logs and the software updating process is the same as on workbench, see previous section.

CONNECTION

NOTICE

The battery must provide constant voltage thru the whole extraction process. If this can‘t be ensured, an external power supply must be used.

Connect computer with ECU

NOTE

If 2 Sub-D connectors are installed, proceed as follows. If only 1 Sub-D connector is installed, connect B.U.D.S. Aircraft Set directly.

Step	Procedure
1	Connect B.U.D.S. Aircraft Set with the USB-Port of your computer. If the device is connected and installed the RED indicator light should light up.
2	Connect the B.U.D.S. Aircraft Set Sub- D DE9 connector with the Sub-D DE9 socket of the Y-cable.
3	Connect both Sub-D DE9 sockets of the Maintenance CAN with the Sub-D DE9 connectors of the Y-cable.
4	Now the setup should be as shown in following figure.
5	Activate the EMS by supplying it with aircraft power.

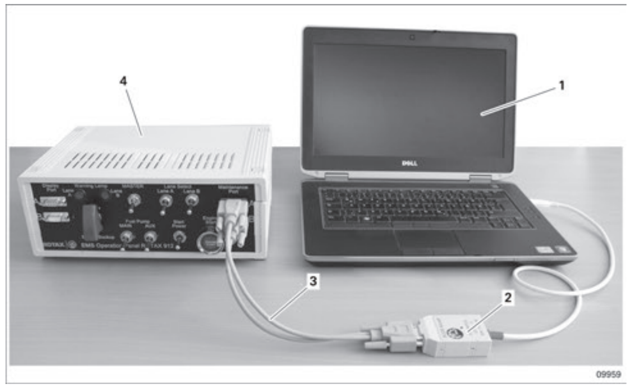


Figure 17.18

1 Computer
2 B.U.D.S. Aircraft Set
3 Y-cable
4 Cockpit (Simulation)

FINISHING WORK

- Attach all the necessary fastenings (e.g. cable ties, holders, clamps etc.) of the wiring harness.
- Transfer the actual data documented when removing the old ECU to the newly installed ECU.
- Delete the error memory of the new ECU.
- Carry out an engine test run.
- Read out the ECU.

Chapter: 76–20–00
FUSE BOX

TOPICS IN THIS CHAPTER

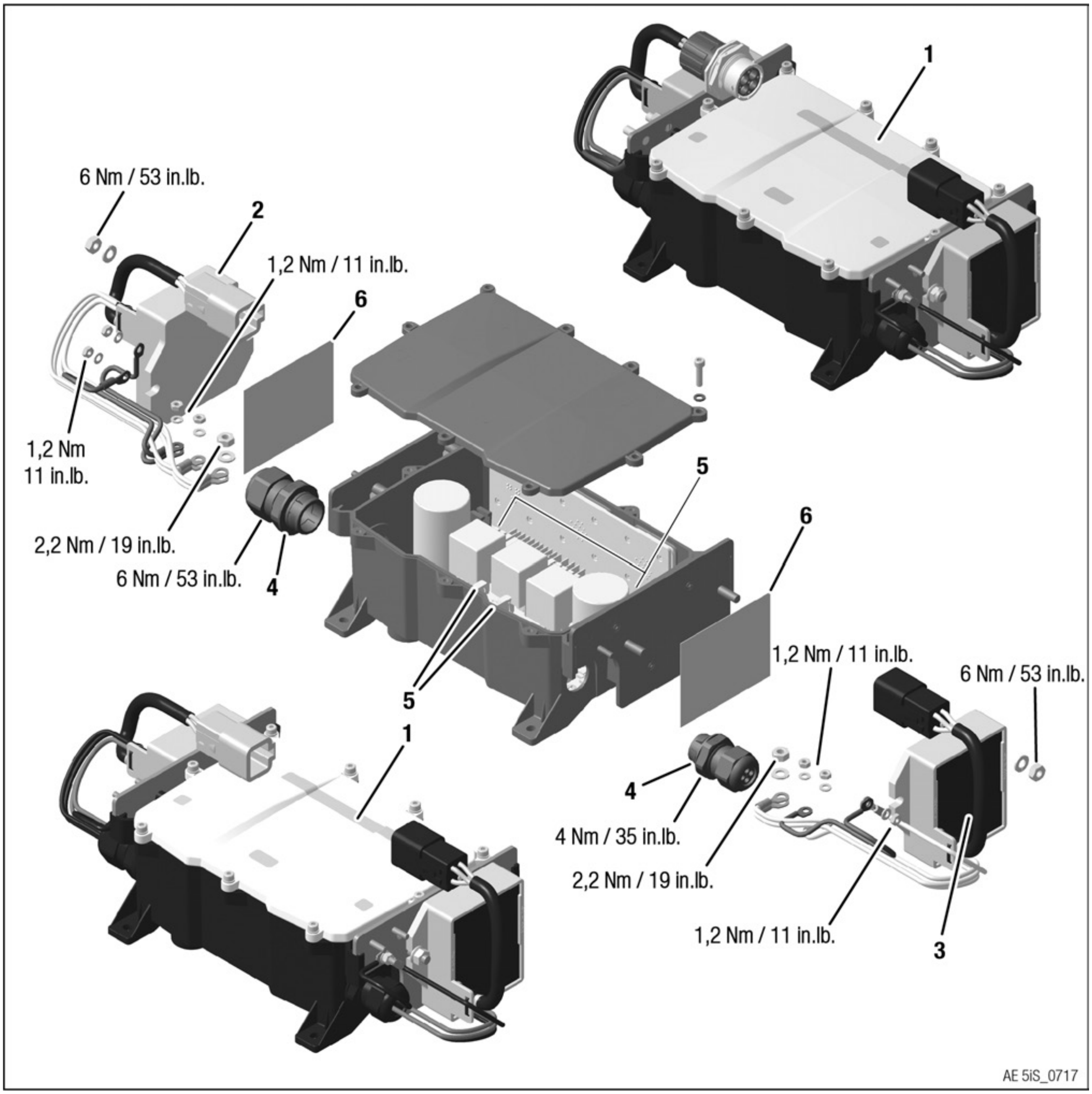


Figure 18.1

1	*Fuse box assy.*	2	*Regulator B*
3	*Regulator A*	4	*Sealing insert*
5	*Fuses*	6	*Heat transfer pad*

SYSTEM DESCRIPTION

GENERAL NOTE

All the components of the voltage supply, e.g. fuses, are included in the power supply unit.

SAFETY INSTRUCTION

⚠ WARNING

Danger of damage to engine!
There is a risk of short circuits and cable fires during work on the fuse box. All engine controls (e.g. switches) must be set in a way that the engine in not supplied with electrical power.

NOTE

The general safety instructions must be followed during all work on the fuse box!

MAINTENANCE

As well as the maintenance and special checks, see current Maintenance Manual Line (MML) for the respective engine type.

TECHNICAL DATA

NOTE

Dimensions are the same as with Deutsch connector (regulator B).

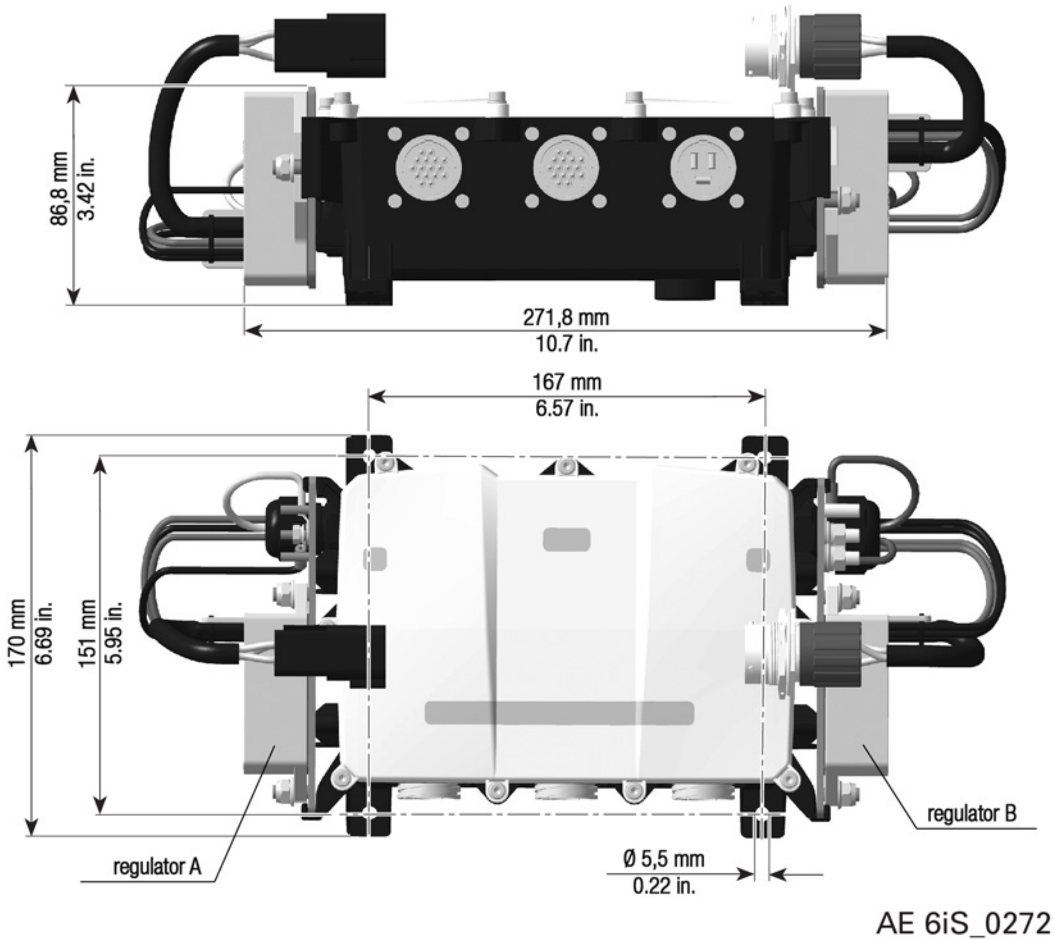


Figure 18.2: Fuse Box, TYPICAL

REMOVAL

Preparation

Before the fuse box is removed, the work and checks described below must be carried out to identify any further malfunctions in the engine and rectify them as part of the repair work.

- Turn the ignition switch “OFF”

General visual inspection. See relevant Maintenance Manual Line (MML) Chapter 05-00-00 and 12-20-00.

FUSE BOX — REMOVAL

Preparation

- Remove all the necessary fastenings (e.g. cable ties, holders, clamps etc.) of the wiring harness and the aircraft wiring harness.

Step	Procedure
1	Unplug the engine wiring harness and grounding connectors from the fuse box. See Chapter 76-50-00 section Wiring harness.
2	Unplug the aircraft wiring harness in accordance with the aircraft manufacturer’s specifications.
3	Press in the latch on the top of the connector (Regulator A) or unscrew the connector (Regulator B) and disconnect the connectors.

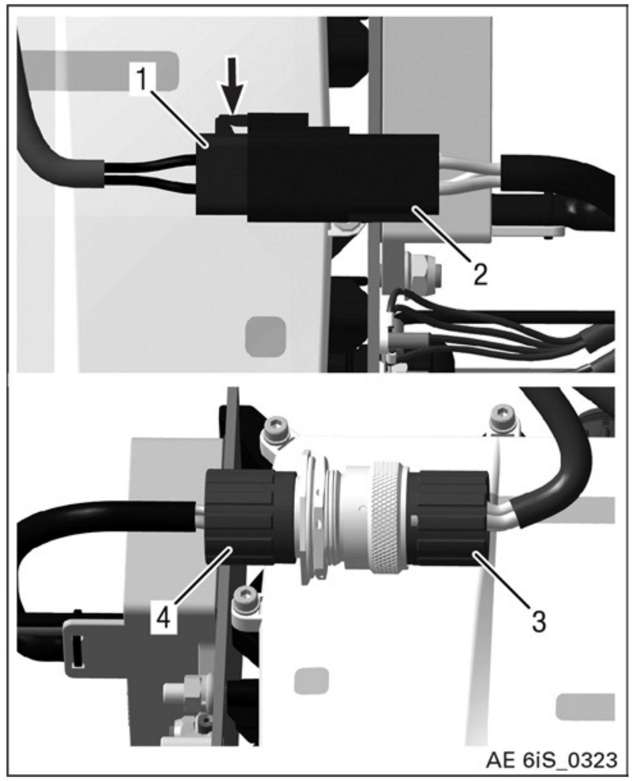


Figure 18.3: : TYPICAL

1	*Stator connector A (DEUTSCH black)*	2	*Connection socket (Regulator A)*
3	*Stator connector B (Amphenol)*	4	*Connection socket (Regulator B)*

NOTICE

Removal must be carried out according to the aircraft manufacturer's instructions.

Step	Procedure
4	Remove the attachment screws of the fuse box according to the aircraft manufacturer’s specifications. Remove the fuse box.

REGULATOR B — REMOVAL

Step	Procedure
1	Loosen the gasket screw connection. Wrench size A/F 30.

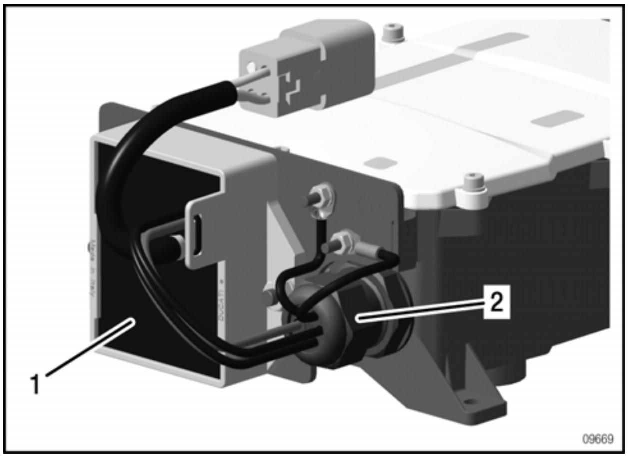


Figure 18.4: DEUTSCH connector

1	*Regulator B*	*2*	*Cap nut of the gasket screw connection*

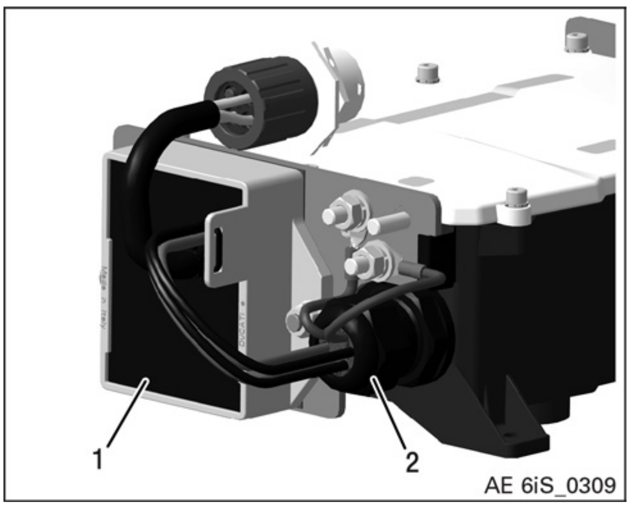


Figure 18.5: AMPHENOL connector

1	*Regulator B*	*2*	*Cap nut of the gasket screw connection*

Step	Procedure
2	Remove the cover. Loosen 9 M4 Allen screws along with plastic washer. Allen wrench A/F 3 mm.

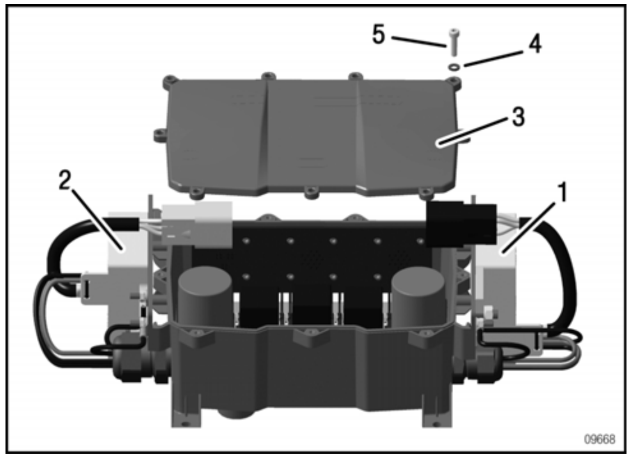


Figure 18.6: TYPICAL

1	*Regulator A*	*2*	*Regulator B*
3	*Cover*	*4*	*Plastic washer M4*
5	*Allen screws M4*		

Step	Procedure
3	Disconnect the 2 RED/WHITE cable from connection bolt B+. Remove the M5 lock nut with washer. Wrench size: A/F 8. Remove the cable from connection bolt.
4_old version	Disconnect the 2 BLACK cable from regulator plate. Remove the 2 M4 lock nut with washer. Wrench size: A/F 7 Remove the cable from connection bolt.
4_new version	Disconnect the 2 BLACK cable from regulator plate. Loosen the 2 M6 lock nut with washer. Wrench size: A/F 10 Remove the cable from connection bolt.
5	Disconnect the 2 BLACK cable from connection bolt B. Remove the M4 lock nut with washer. Wrench size: A/F 7. Remove the cable from connection bolt.
6	Disconnect the 2 BLACK cable from connection bolt B-. Remove the M4 lock nut with washer. Wrench size: A/F 7. Remove the cable from connection bolt.

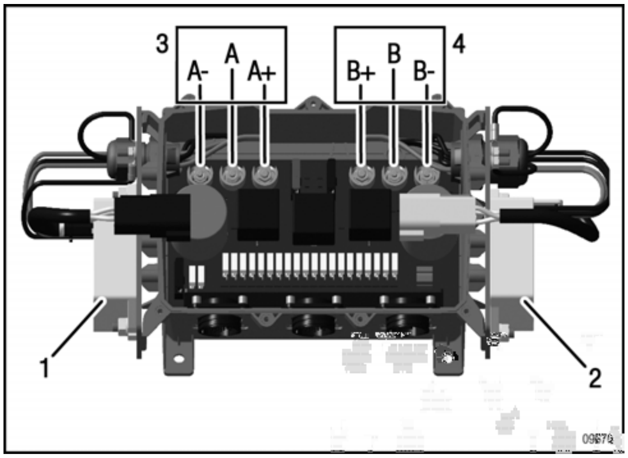


Figure 18.7: TYPICAL

1	*Regulator A*	*2*	*Regulator B*
3	*Connection bolt regulator A*	*4*	*Connection bolt regulator B*

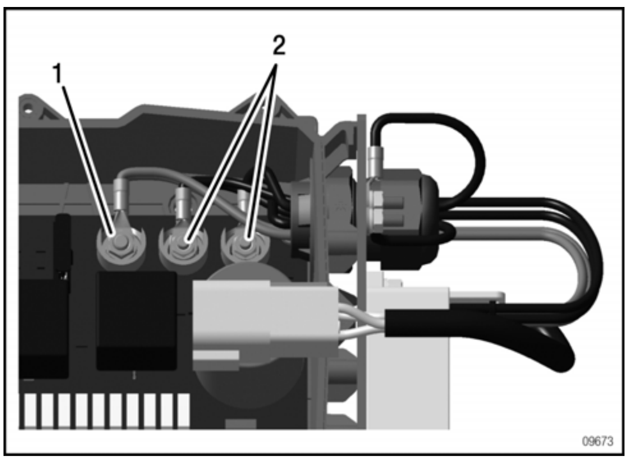


Figure 18.8: TYPICAL

1	*Lock nut M5 with washer*	*2*	*Lock nut M4 with washer*

Step	Procedure
7	Remove the regulator B. Remove the 2 M6 lock nut with washer. Wrench size: A/F 10. **NOTE** *Previous versions of the fuse box may have M4 lock nuts on Regulator B, new versions have M6 lock nuts.*

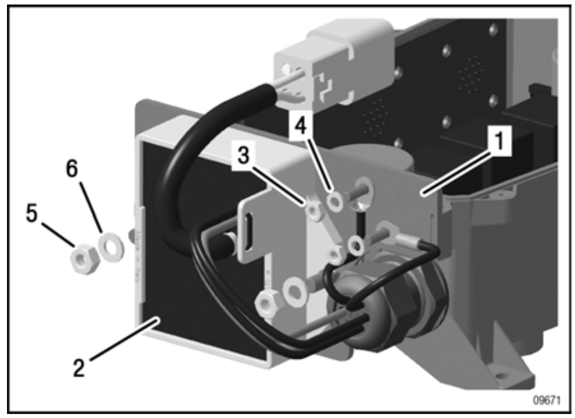


Figure 18.9: TYPICAL

1	*Regulator plate*	*2*	*Regulator B*
3	*Lock nut*	*4*	*Washer*
5	*Lock nut*	*6*	*Washer*

Step	Procedure
8	Pull the 2 RED-WHITE and the 4 BLACK cables with grommet out of the fuse box. To pull out the cables easily, avoid bending the ring terminals.

NOTE

The connecting thread of sealing union must not be dismantled, if you replace the regulator. An exchange of this plastic insert is only necessary if it is damaged.

Step	Procedure
9	Remove the regulator.

NOTE

Be careful when handling the dismantled regulator. On the back side of the regulator and the regulator plate thermal paste can adhere.

REGULATOR A — REMOVAL

Step	Procedure
1	Loosen the gasket screw connection. Wrench size A/F 25.

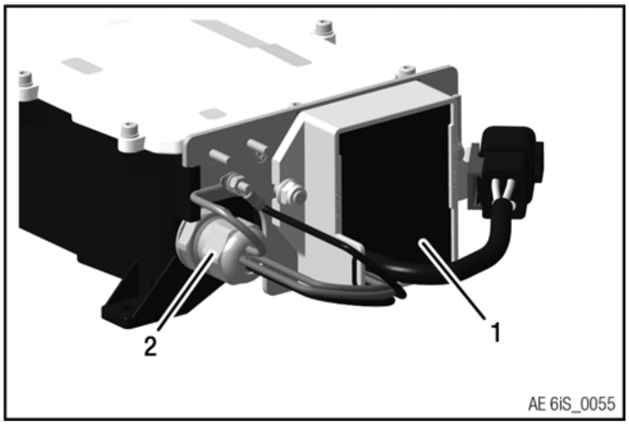


Figure 18.10: : TYPICAL

1	*Regulator B*	2	*Cap nut of the gasket screw connection*

Step	Procedure
2	Remove the cover. Loosen 9 Allen screws along with plastic washer. Allen wrench A/F 3 mm.

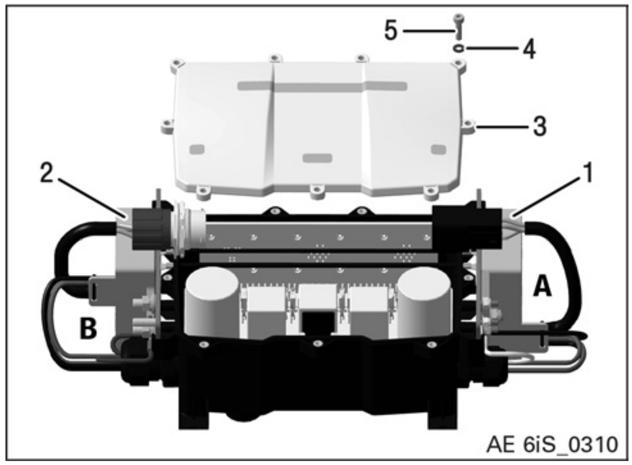


Figure 18.11: TYPICAL

1	*Regulator A*	2	*Regulator B*
3	*Cover*	4	*Plastic washer*
5	*Allen screws*		

Step	Procedure
3	Disconnect the 2 RED/WHITE cable from connection bolt A+. Loosen the M5 lock nut with washer. Wrench size: A/F 8. Loosen the cable from connection bolt.
4	Disconnect the 2 BLACK cable from regulator plate. Loosen the 1 M4 lock nut with washer. Wrench size: A/F 7 Loosen the cable from connection bolt.
5	Disconnect the 1 BLACK cable from connection bolt A. Loosen the M4 lock nut with washer. Wrench size: A/F 7. Loosen the cable from connection bolt.
6	Disconnect the 1 BLACK cable from connection bolt A-. Loosen the M4 lock nut with washer. Wrench size: A/F 7. Loosen the cable from connection bolt.

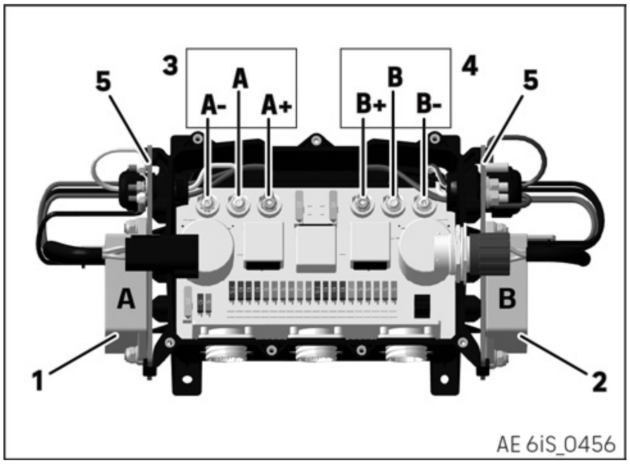


Figure 18.12: TYPICAL

1	*Regulator A*	2	*Regulator B*
3	*Connection bolt regulator A*	4	*Connection bolt regulator B*
5	*Regulator plate*		

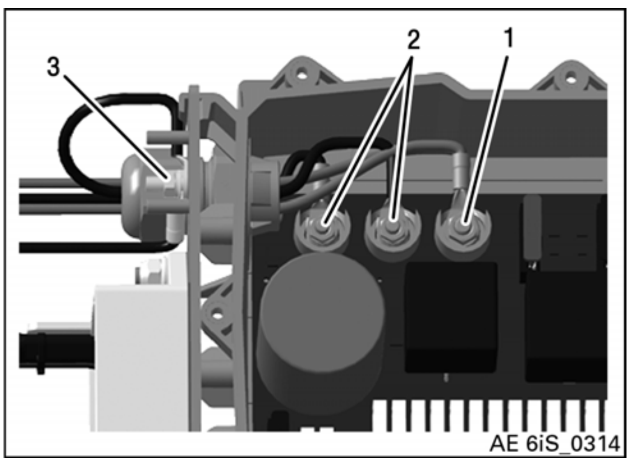


Figure 18.13: TYPICAL

1	*Lock nut M5 with washer*	2	*Lock nut M4 with washer*
3	*Lock nut M4 with washer*		

Step	Procedure
7	Remove the regulator A. Loosen the 2 M6 lock nut with washer. Wrench size: A/F 10.

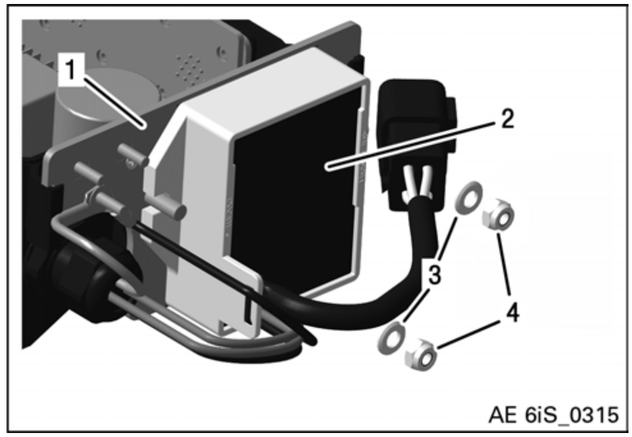


Figure 18.14: TYPICAL

1	*Regulator plate*	2	*Regulator A*
3	*Washer*	4	*Lock nut M6*

Step	Procedure
8	Pull the 2 RED-WHITE and the 2 BLACK cables with grommet out of the fuse box. To pull out the cables easily, avoid tilting of the cable lugs.

NOTE

The connecting thread of sealing union must not be dismantled, if you replace the regulator. An exchange of this plastic insert is only necessary, if it is damaged.

Step	Procedure
9	Remove the regulator A.

NOTE

Be careful when handling the dismantled regulator. The heat transfer pad may adhere to the back side of the regulator and/or the regulator plate.

INSTALLATION

NOTE

If the wire is broken or the connector is defective, the damage can be repaired. The wire must be long enough if the connector is cut off. Repair with the tools described here must comply with the aircraft standard of the respective country.

Part no. from the Connector Set	Associated Tool
866420 (black)	DEUTSCH HDT-48 - 00
866422 (gray)	
481510 (Amphenol)	DMC® AF8 / DMC® UH2-5 / DMC® QXRT08 or equivalent

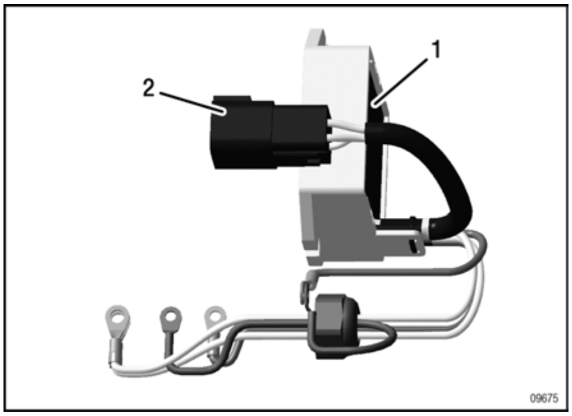


Figure 18.15

1 Regulator A

2 DEUTSCH connector (black)

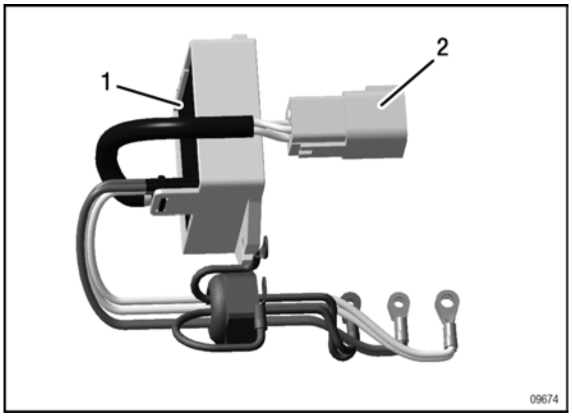


Figure 18.16

1 Regulator B

2 DEUTSCH connector (gray)

NOTE

The regulator B with old DEUTSCH connector can be modified to the round Amphenol connector. See SI-912i-024, latest issue.

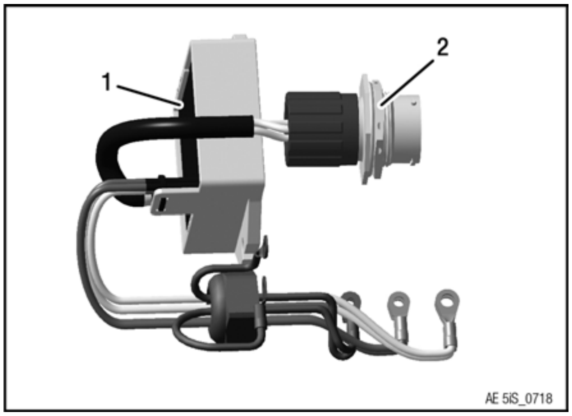


Figure 18.17

1 Regulator B

2 Amphenol connector

NOTICE

All hex nuts (self-locking) must be replaced after each removal (e.g. replacement of a regulator).

REGULATOR B — INSTALLATION

NOTICE

The surface on the back of the regulator must be cleaned before applying the heat transfer pads. Remove the protective film with caution, because rapid stripping can damage the heat transfer pad.

Step	Procedure
1	Clean the regulator plate: Remove residues of the thermal paste or the heat transfer pads.
2	Bonding the heat transfer pad to the regulator: Remove the protective film from heat transfer pad and stick the heat transfer pad with the adhesive surface onto the regulator (avoid any folds or bubbles). The positioning has to be done as shown in following Figure.

NOTE

When using a heat transfer pad, no additional application of a thermal compound is required.

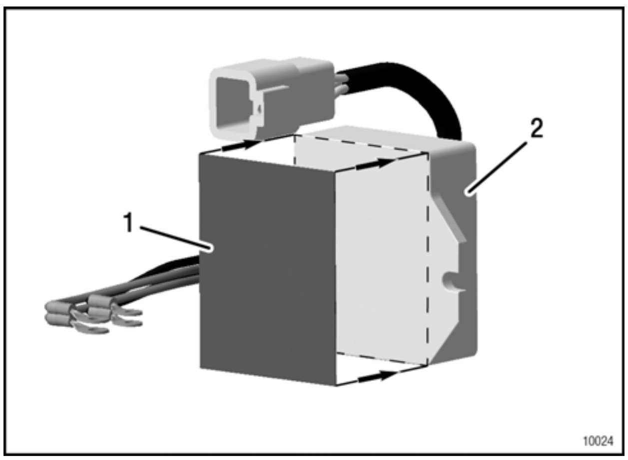


Figure 18.18: TYPICAL

1 *Heat transfer pad* 2 *Regulator*

NOTICE

The regulator must be mounted so that it does not project beyond the regulator plate.

Step	Procedure
3	Fasten regulator to the fuse box with 2 new lock nuts M6 and washers. Tightening torque: 6 Nm (53 in.lb). Wrench size: A/F 10.

NOTE

Tighten the two new lock nuts M6 alternately to ensure a smooth seat of regulator on the regulator plate.

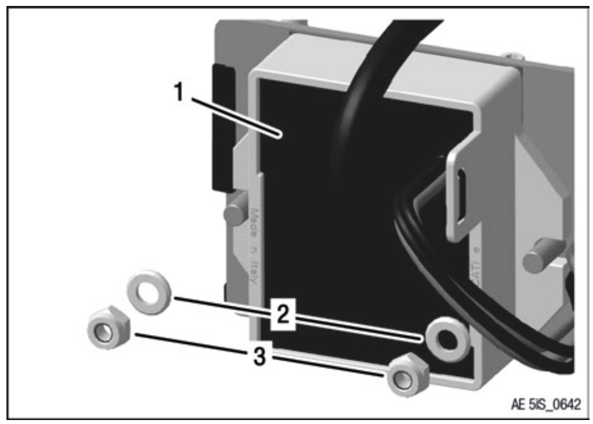


Figure 18.19

1 *Regulator B* 2 *Washer 6.4*
3 *Lock nuts M6*

Step	Procedure
4	Remove the connecting thread of sealing union of the regulator that should be mounted.

NOTE

The connecting thread of sealing union is included with each regulator as replacement part. An exchange of this plastic insert is only necessary if it is damaged.

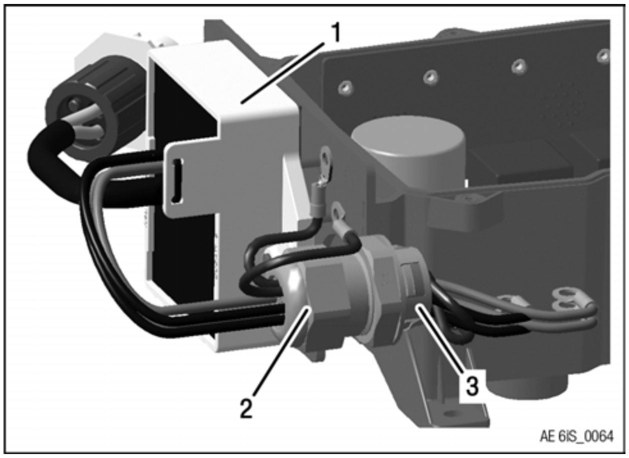


Figure 18.20: TYPICAL, AMPHENOL

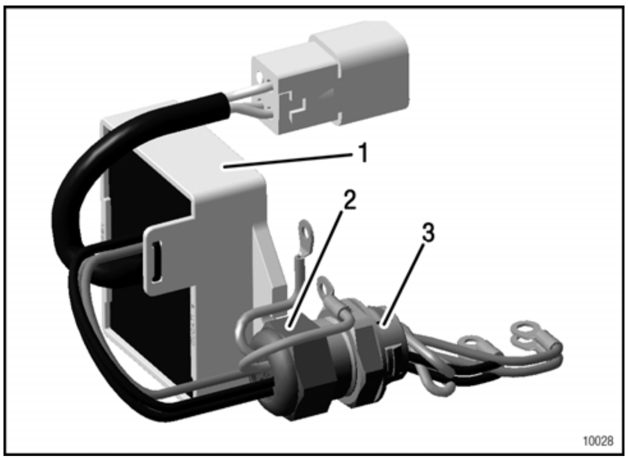


Figure 18.21: : TYPICAL, DEUTSCH

1 *Regulator B*

2 *Cap nut of the gasket screw connection*

3 *Thread of the gasket screw connection*

NOTICE

When pressing in the gasket screw connection, avoid damaging the connecting thread.

Step	Procedure
5	Pull all the cables 2 RED/WHITE (marking: B+) and 4 BLACK (marking: B and B-) into the fuse box. The plastic insert must be pressed completely into the connecting thread of sealing union.

NOTICE
Note the wire marking and labeling of the connecting bolts (labeled on the board of the fuse box). All cables must be installed without kinks.

NOTICE
The ring terminals attached to the connecting ports B-, B and B+ must not touch each other (except those rings which are attached to the same connection bolt).

Step	Procedure
6	BLACK cable (2 pcs, labeled: B-) connect to connection bolt B-. Fasten the ring terminal with new locking nut M4 and washer on the connection bolt. The crimping of the lower ring terminal must be directed towards the board of fuse box. The crimping of the upper ring terminal must be directed toward the cover of the fuse box Tightening torque: 1.2 Nm (11 in.lb). Wrench size: A/F 7.
7	BLACK cable (2 pcs, labeled: B) connect to connection bolt B. Fasten the ring terminal with new locking nut M4 and washer on the connection bolt. The crimping of the lower ring terminal must be directed towards the board of fuse box. The crimping of the upper ring terminal must be directed toward the cover of the fuse box Tightening torque: 1.2 Nm (11 in.lb). Wrench size: A/F 7.
8	RED-WHITE cable (2 pcs, labeled: B+) connect to connection bolt B+. Fasten the ring terminal with new locking nut M5 and washer on the connection bolt. The crimping of the lower ring terminal must be directed towards the board of fuse box. The crimping of the upper ring terminal must be directed toward the cover of the fuse box Tightening torque: 2.2 Nm (19 in.lb). Wrench size: A/F 8.

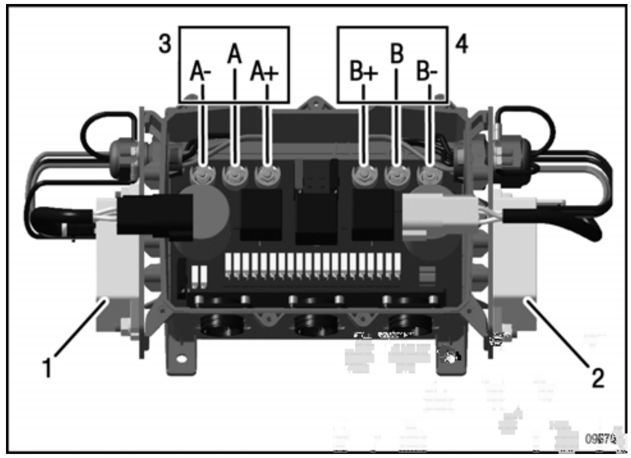


Figure 18.22: Connection overview

1	*Regulator A*	2	*Regulator B*
3	*Connection bolt regulator A*	4	*Connection bolt regulator B*

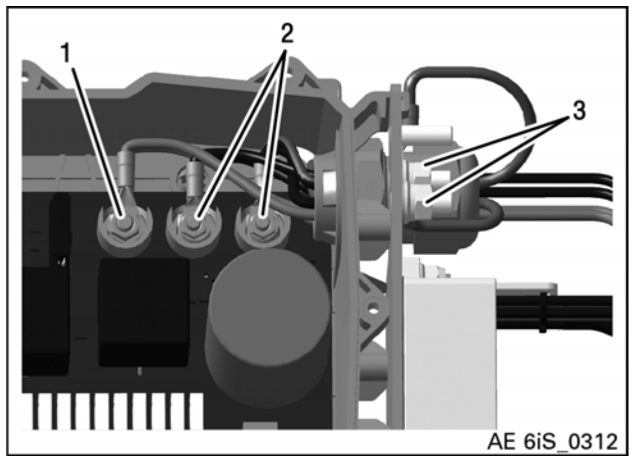


Figure 18.23: Connection

1	*Lock nut M5 with washer 5.3*	2	*Lock nut M4 with washer 4.3*
3	*Lock nut M6 with washer 6.4*		

NOTICE

The ring terminals attached to the connecting ports B-, B and B+ must not touch each other (except those rings which are attached to the same connection bolt).

Step	Procedure
9	Connect the unlabeled cable ends coming out of the fuse box and the regulator (2 pcs. BLACK) with the regulator plate. Positioning of the cables must be as shown in figure connection overview and connection above. OLD VERSION: Fasten the cable lug with locking nut M4 and washer 4.3 on the connection bolt. Tightening torque: 1.2 Nm (11 in.lb) Wrench size: A/F 7 NEW VERSION: Fasten the cable lug with locking nut M6 and washer 6.4 on the connection bolt. Tightening torque: 6 Nm (53 in.lb). Wrench size: A/F 10.
10	Fasten gasket screw connection. Tightening torque: 6 Nm (53 in.lb). Wrench size: A/F 30.

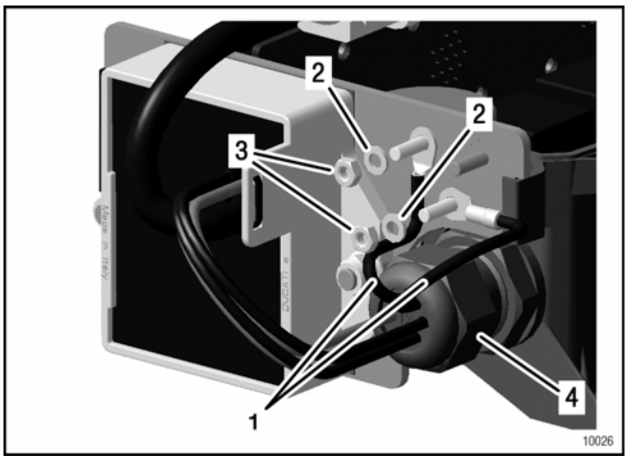


Figure 18.24

1 Cable BLACK
2 Washer 4.3 or 6.4
3 Lock nut M4 or M6
4 Cap nut of the gasket screw connection

REGULATOR A — INSTALLATION

NOTICE

The surface on the back of the regulator must be cleaned before applying the heat transfer pads. Remove the protective film with caution, because rapid stripping can damage the heat transfer pad.

Step	Procedure
1	Clean the regulator plate. Remove residues of the thermal paste or the heat transfer pads.
2	Bonding the heat transfer pad to the regulator A. Remove the protective film from heat transfer pad and stick the heat transfer pad with the adhesive surface onto the regulator A (avoid any folds or bubbles).

NOTE

When using a heat transfer pad, no additional application of a thermal compound is required.

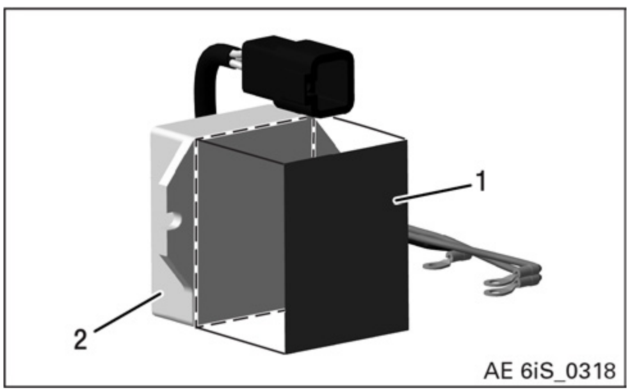


Figure 18.25

1 Heat transfer pad
2 Regulator

NOTICE

The regulator must be mounted so that it does not project beyond the regulator plate.

Step	Procedure
3	Fasten regulator A on the regulator plate with 2 new lock nuts M6 and washers 6.4. Tightening torque: 6 Nm (53 in. lb). Wrench size: A/F.

NOTE

Tighten the two new lock nuts M6 alternately to ensure a smooth seat of regulator on the regulator plate.

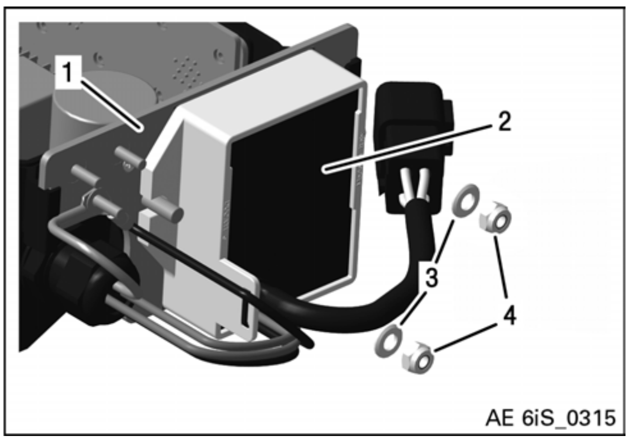


Figure 18.26

1 Regulator plate *2 Regulator B*
3 Washer 6.4 *4 Lock nut M6*

Step	Procedure
4	Remove the connecting thread of sealing union of the regulator that should be mounted..

NOTE

The connecting thread of sealing union is included with each regulator as replacement part. An exchange of this plastic insert is only necessary if it is damaged.

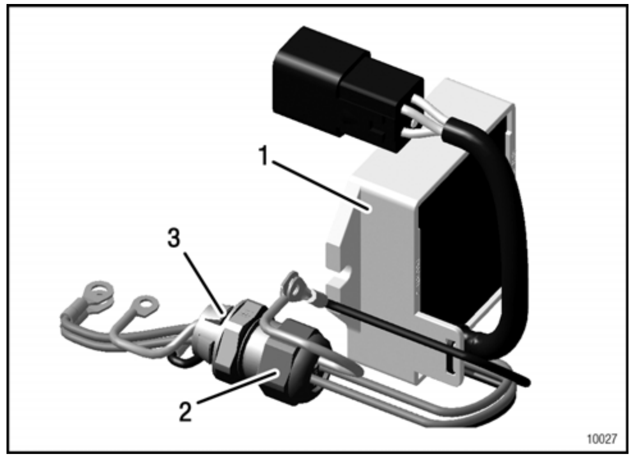


Figure 18.27

1 Regulator A *2 Cap nut of the gasket screw connection*
3 Thread of the gasket screw connection 4

NOTICE

When pressing in the gasket screw connection, avoid damaging the connecting thread.

Step	Procedure
5	Pull all the cables 2 RED/WHITE (marking: A+) and 4 BLACK (marking: A and A-) into the fuse box. The plastic insert must be pressed completely into the connecting thread of sealing union.

NOTICE
Note the wire marking and labeling of the connecting bolts (labeled on the board of the fuse box). All cables must be installed without kinks.

NOTICE
The ring terminals attached to the connecting ports A-, A and A+ must not touch each other (except those rings which are attached to the same connection bolt).

Step	Procedure
6	BLACK cable (2 pcs, labeled: A-) connect to connection bolt A-. Fasten the ring terminal with new locking nut M4 and washer on the connection bolt. The crimping of the lower ring terminal must be directed towards the board of fuse box. The crimping of the upper ring terminal must be directed toward the cover of the fuse box Tightening torque: 1.2 Nm (11 in.lb). Wrench size: A/F 7.
7	BLACK cable (2 pcs, labeled: A) connect to connection bolt A. Fasten the ring terminal with new locking nut M4 and washer on the connection bolt. Tightening torque: 1.2 Nm (11 in.lb). Wrench size: A/F 7.
8	RED-WHITE cable (2 pcs, labeled: A+) connect to connection bolt A+. Fasten the ring terminal with new locking nut M5 and washer on the connection bolt. The crimping of the lower ring terminal must be directed towards the board of fuse box. The crimping of the upper ring terminal must be directed toward the cover of the fuse box Tightening torque: 2.2 Nm (19 in.lb). Wrench size: A/F 8.

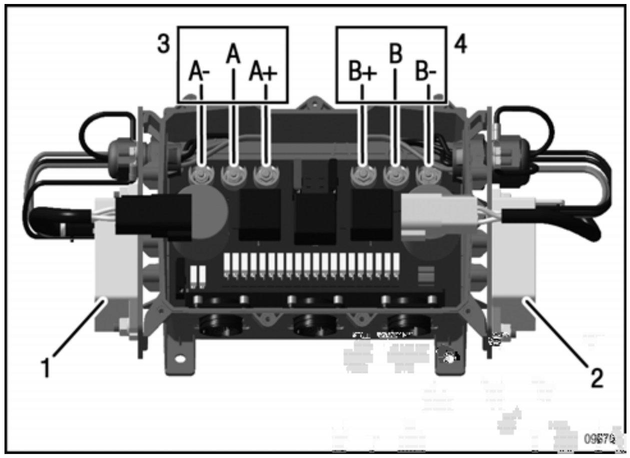


Figure 18.28: Connection overview

1	*Regulator A*	2	*Regulator B*
3	*Connection bolt regulator A*	4	*Connection bolt regulator B*

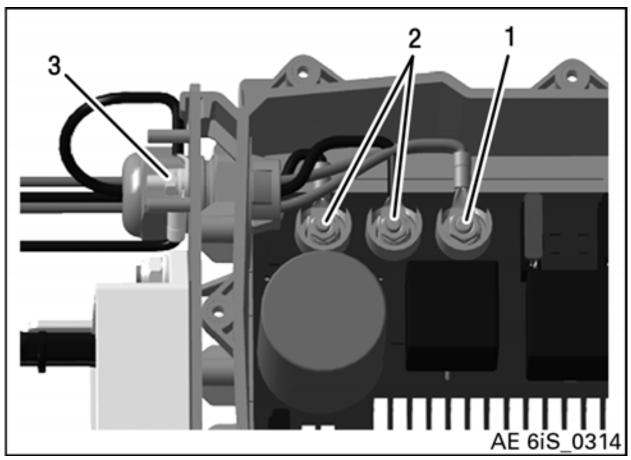


Figure 18.29: Connection

1	*Lock nut M5 with washer 5.3*	2	*Lock nut M4 with washer 4.3*
3	*Lock nut M4 with washer 4.3*		

Step	Procedure
9	Connect the unlabeled cable ends coming out of the fuse box and the regulator (2 pcs. BLACK) with the regulator plate. Positioning of the cables must be as shown in figure connection overview and connection above. Fasten the ring terminal with new locking nut M4 and washer on the connection bolt. Tightening torque: 1.2 Nm (11 in.lb). Wrench size: A/F 7.
10	Fasten cap nut of the bulkhead fitting. Tightening torque: 4 Nm (35 in.lb). Wrench size: A/F 25.

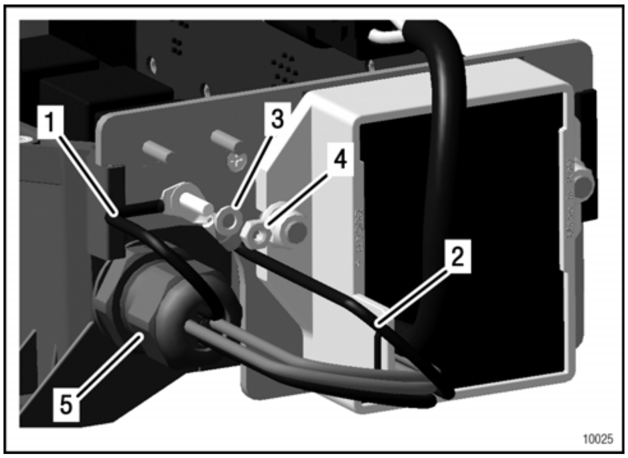


Figure 18.30

1	*Cable BLACK*	*2*	*Cable BLACK*
3	*Washer 4.3*	*4*	*Lock nut M4*
5	*Cap nut of the bulkhead fitting*		

FUSES

If a fuse is damaged, it must be replaced by a new one with the same values.

⚠ WARNING

A fuse with a higher amperage must not be used, as this can lead to severe damage.

Arrangement of the fuses	
F2	7.5 A Selector switch B
F3	7.5 A Selector switch A
F4	10 A Fuel pump B
F5	10 A Fuel pump A
F6	10 A Ignition 3t
F7	10 A Ignition 1b
F8	10 A Ignition 3b
F9	10 A Ignition 1t
F10	5 A Injector 4
F11	5 A Injector 3
F12	5 A Injector 2
F13	5 A Injector 1
F14	2 A Caution lamp A
F15	2 A Caution lamp B
F16	5 A Injector 8
F17	5 A Injector 7
F18	5 A Start switch
F19	Not used
F20	20 A Lane A circuit
F21	35 A Lane B circuit
F22	5 A Injector 6
F23	5 A Injector 5

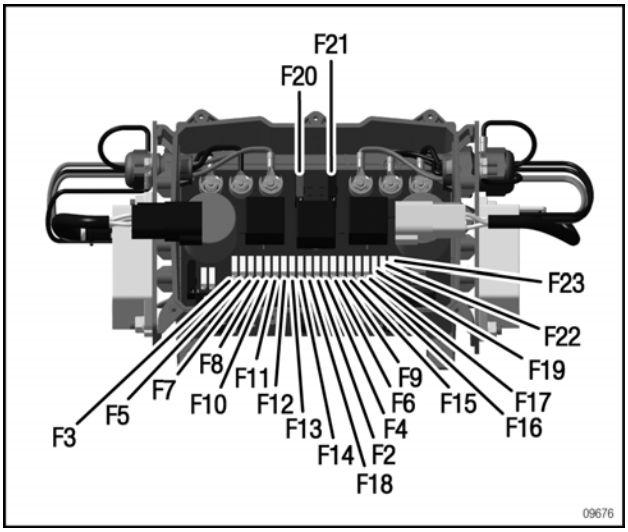


Figure 18.31

1 *Reserve fuses*

COVER – INSTALLATION

NOTICE

Over tightening the Allen screws M4x16 leads to cracking of the cover.

Step	Procedure
1	Hand-tight cover using 9 Allen screws M4x16 with plastic washers.

NOTE

Before attaching the cover, check the correct position of the gasket.

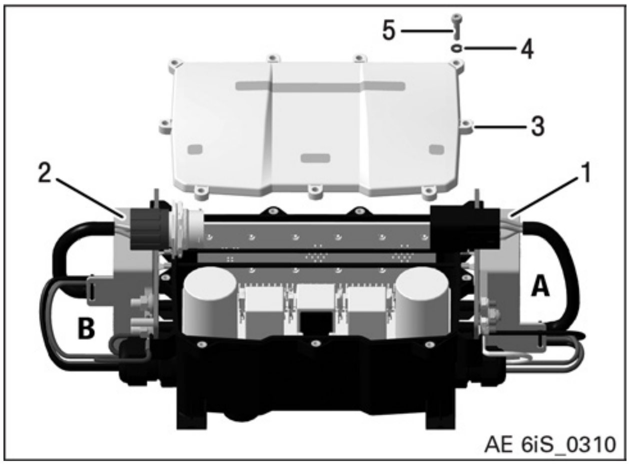


Figure 18.32

1	*Regulator A*	2	*Regulator B*
3	*Cover*	4	*Plastic washer*
5	*Allen screws M4x16*		

REGULATOR – CONTINUITY CHECK

Before installing the fuse box carry out a continuity check using a multimeter between the regulator housing of regulator A and regulator B. A conductive connection (continuity) must not be present.

NOTICE

If a conductive connection (continuity) is present, the installation of the regulator has to be checked. The fuse box must not be installed in an aircraft until the error is fixed and the installation corrected.

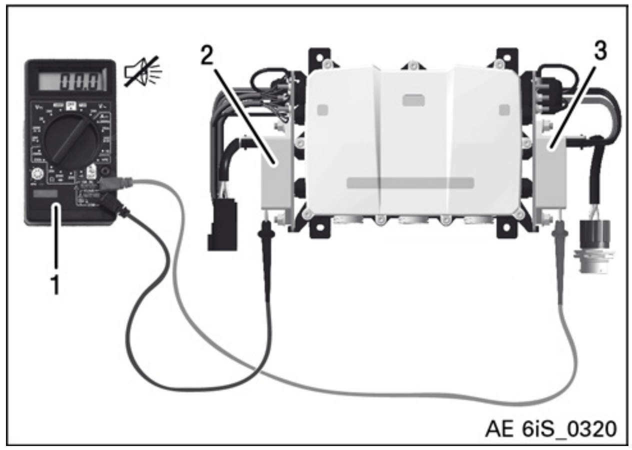


Figure 18.33: :TYPICAL

1	*Multimeter*	2	*Regulator A*
3	*Regulator B*		

FUSE BOX — INSTALLATION

NOTICE

Installation must be carried out according to the aircraft manufacturer's and to the specifications of the Installation Manual (IM).

Step	Procedure
1	Install the fuse box in accordance with the aircraft manufacturer's specifications.
2	Connect the engine wiring harness and grounding connectors on the fuse box. See Chapter 76-50-00 Wiring harness – installation. **NOTE** *Using the marking of the wiring harness.*

Step	Procedure
3	Connect the aircraft wiring harness in accordance with the aircraft manufacturer's specifications.
4	Connect the connector socket (regulator A) and the connector socket (regulator B DEUTSCH) or plug in the connector socket (regulator B AMPHENOL), then screw the outer ring onto the socket.

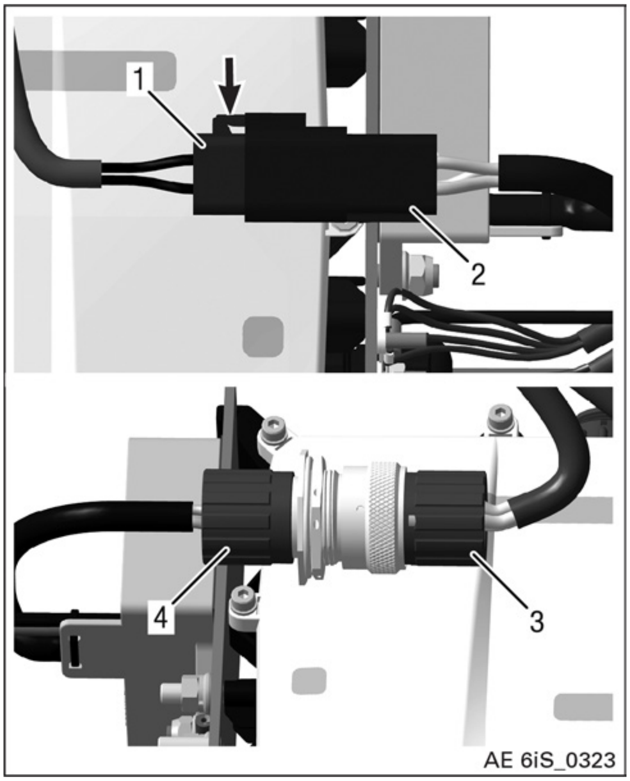


Figure 18.34: TYPICAL

1	*Stator connector A (DEUTSCH black)*	2	*Connection socket (Regulator A)*
3	*Stator connector B (Amphenol)*	4	*Connection socket (Regulator B)*

INSPECTION OF THE FUSE BOX INSTALLATION

See Installation Manual (IM) for the respective engine type.

FINISHING WORK

- Attach all the necessary fastenings (e.g. cable ties, holders, clamps etc.) of the wiring harness.

Carry out an engine test run. See Maintenance Manual Line (MML) for the respective engine type.

Chapter: 76–50–00
WIRING HARNESS (MAIN STRAND)

TOPICS IN THIS CHAPTER

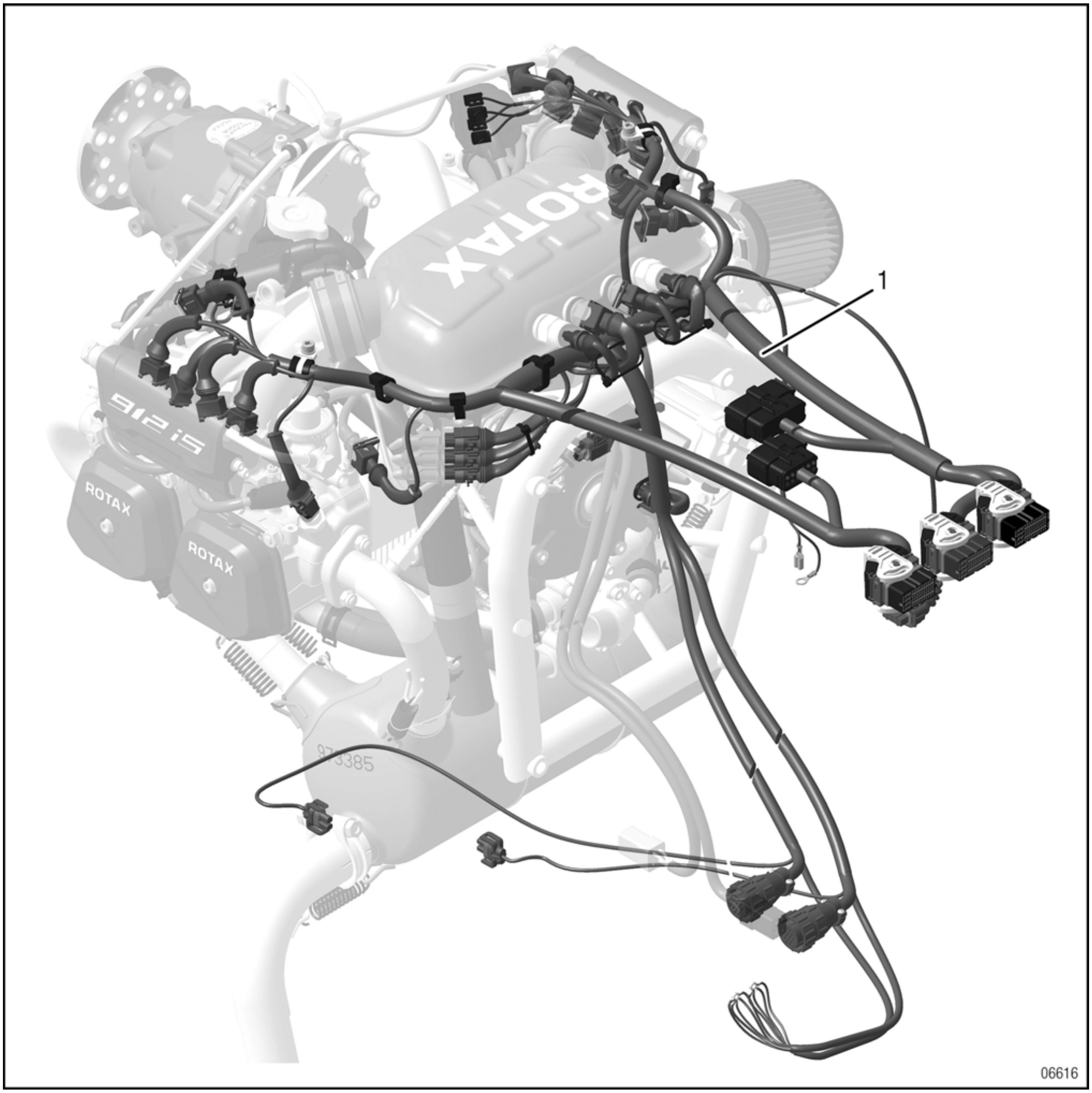


Figure 19.1: Location on the engine

SPECIAL TOOLS

Description	Part number	
Multimeter	n.a.	
ECU Adapter	277012	

SERVICE PRODUCTS

Description	Part number
LOCTITE 243	897651
Deoxit contact spray	n.a.

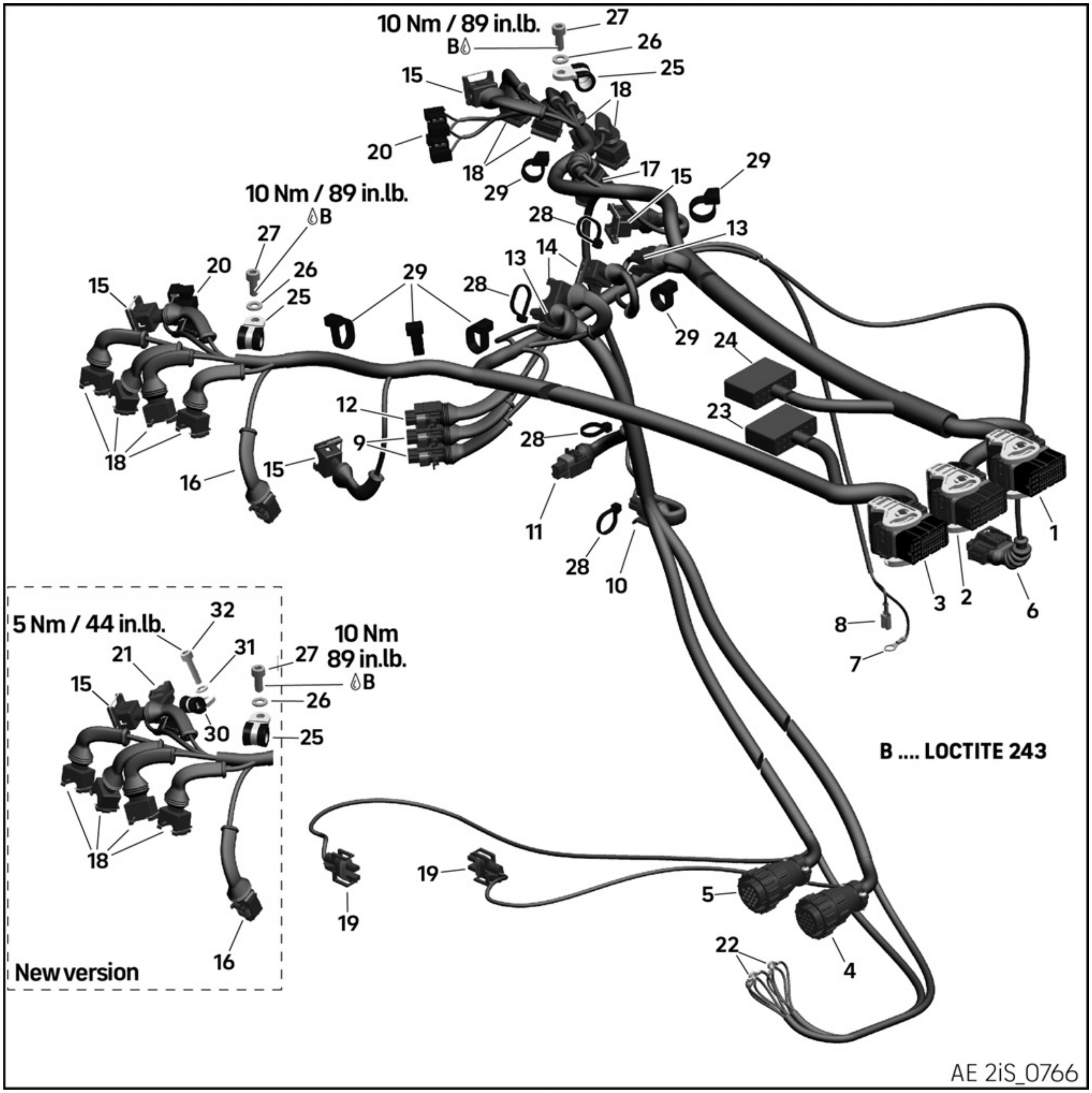


Figure 19.2: Wiring harness (main strand)

1	*ECU LANE A1 connector*	2	*ECU LANE A2 connector*
3	*ECU LANE B connector*	4	*FUSE BOX LANE X2*
5	*FUSE BOX LANE X1*	6	*AAPTS Sensor connector*
7	*Starter relay*	8	*Starter relay*

9	*CPS 1/2 connector*	10	*OPS connector*
11	*OTS connector*	12	*Knock connector (old version only)*
13	*MAPS connector*	14	*MATS connector*
15	*EGT connector*	16	*CTS connector*
17	*TPS connector*	18	*Injector connector*
19	*Fuel pump connector*	20	*Connector ignition coil (old version)*
21	*Connector ignition coil (new version)*	22	*Ring terminal EMS ground*
23	*HIC B connector*	24	*HIC A connector*
25	*Cable clamp 12/M6*	26	*Lock washer A6*
27	*Allen screw M6x14*	28	*Cable tie 203x7.6*
29	*142x3.2 cable tie*	30	*Cable clamp 8/M5*
31	*Lock washer A5*	32	*Allen screw M5x20*

SYSTEM DESCRIPTION

GENERAL NOTE

The wiring harness consists essentially of two main parts, one for LANE A and one for LANE B. Both are each connected with connectors to the ECU and to the individual connectors to the sensors and actuators.

The wiring harness connects all the engine parts necessary for operation. In this way it provides the electric supply for these parts and the exchange of control and regulation signals.

SAFETY INSTRUCTION

⚠ WARNING

Non-compliance can result in serious injuries or death! The wiring harness and connectors may only be disassembled by the manufacturer, by an authorised distributor or by an aerospace company.

NOTICE

Danger of damage to the power plant and aircraft! It must be ensured that no electric voltage is connected and that repairs are carried out properly.

NOTE

The general safety instructions must be followed during all work on the wiring harness!

MAINTENANCE

As well as the maintenance and special checks, see current Maintenance Manual Line (MML) for the respective engine type .

REMOVAL

Preparation

General visual inspection.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 05-00-00 and 12-00-00.

Carry out an engine test run.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12–20–00 section Planned maintenance.

Please observe the instruction of the aircraft manufacturer.

- Turn the ignition switch OFF.
- Disconnect the wiring harness from the aircraft frame in accordance with the aircraft manufacturers specifications.

NOTE

All connectors must be provided with a protective covering after being removed or detached.

HIC A AND HIC B — DISCONNECTION

Wiring harness designation:

- HIC_A
- HIC_B

Disconnect the HIC_A and HIC_B connectors in accordance with the aircraft manufacturer's specifications.

STARTER RELAY — DISCONNECTION

Wiring harness designation:

- Starter relay

Step	Procedure
1	Pull off Faston connector. Press the lock to pull off the Faston connector.
2	Remove the grounding bolt / screw. Observe the instructions of the aircraft manufacturer.

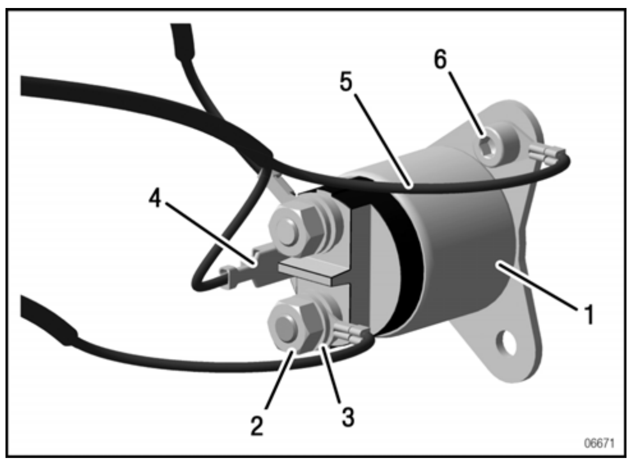


Figure 19.3

1	*Starter relay*	2	*Hex. nut M6*
3	*Washer 6.4*	4	*Faston connector (aircraft)*
5	*Ground (aircraft)*	6	*Bolt / screw (aircraft)*

AMBIENT AIR PRESSURE AND TEMPERATURE SENSOR — DISCONNECTION

Wiring harness designation:

- AAPTS

Step	Procedure
1	Push in the tab on the top of the connector and at the same time pull the connector out of the connection socket.

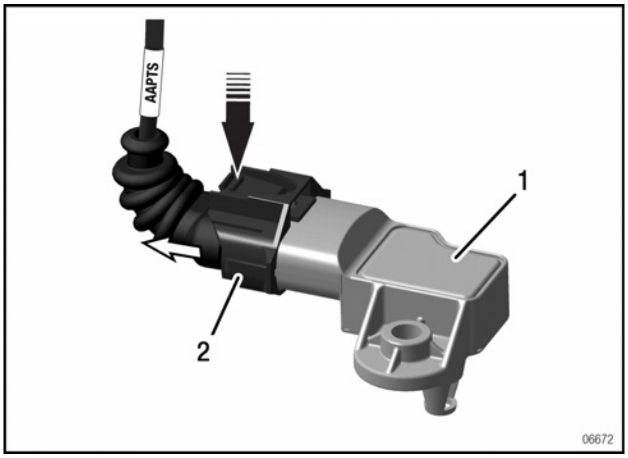


Figure 19.4

1 Ambient Air Pressure and Temperature Sensor (AAPTS) *2 Connection socket*

FUSE BOX — DISCONNECTION

Step	Procedure
1	Loosen lock nut from ground cables on regulator plate A.

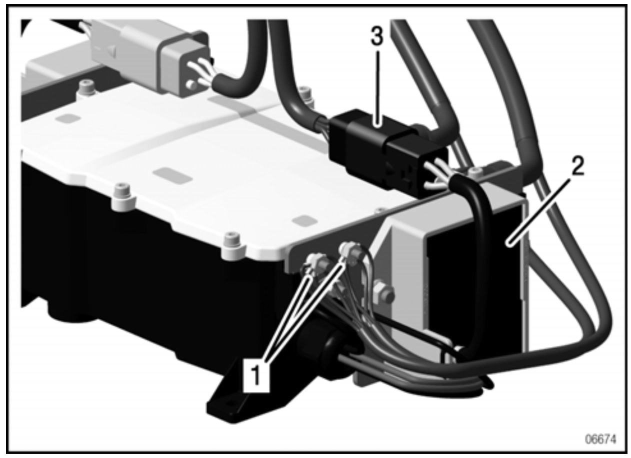


Figure 19.5

1 Ground cable *2 Regulator A*

3 Regulator connector A

Step	Procedure
2	Loosen the two connectors X1, X2 (labelled Fuse box A, Fuse box B) from fuse box.

NOTE

Unscrew the connector cap nut counterclockwise.

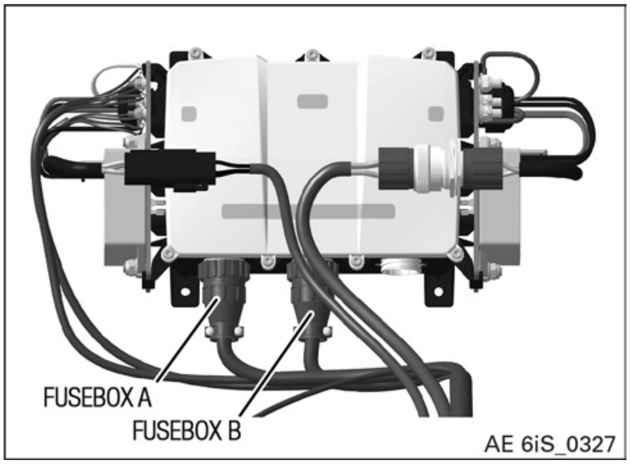


Figure 19.6

NOTE

Round connectors have different index grooves and cannot be mixed up.

Step	Procedure
3	Pull the connectors out of the connector sockets. **NOTE** *Do not lose the grey rubber seals (inside of socket).*

FUEL PUMP — DISCONNECTION

Wiring harness designation:

- FUEL PUMP_1 (MAIN pump)
- FUEL PUMP_2 (AUX pump)

Step	Procedure
1	Loosen the 4 Allen screws from cover of the fuel pump assy.

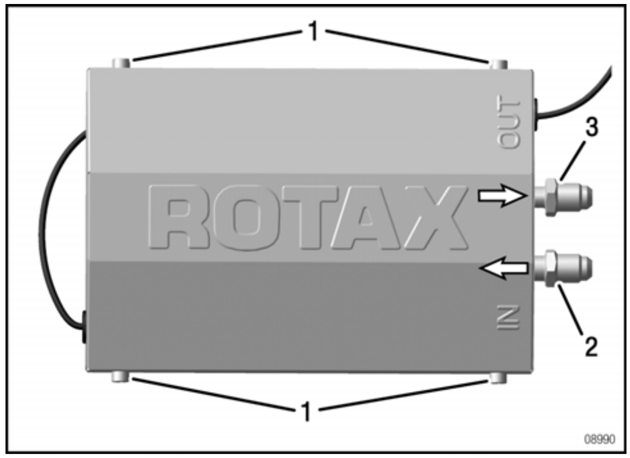


Figure 19.7

1 Allen screws
2 Fuel inlet
3 Fuel outlet

Step	Procedure
2	Unplug the connectors (FUEL PUMP 1, FUEL PUMP 2) from the fuel pumps.

NOTE

First lift one side with a screwdriver, hold the tab and then lift the lower tab with the screwdriver and pull out the connector.

NOTICE
Do not pull on the cable!

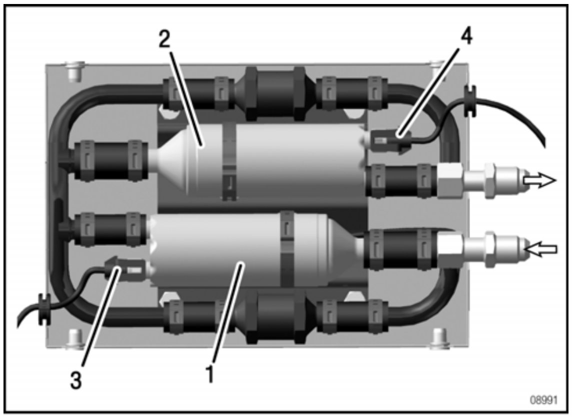


Figure 19.8

1	*Fuel pump (main)*	*2*	*Fuel pump (auxiliary)*
3	*Connector (fuel pump 1)*	*4*	*Connector (fuel pump 2)*

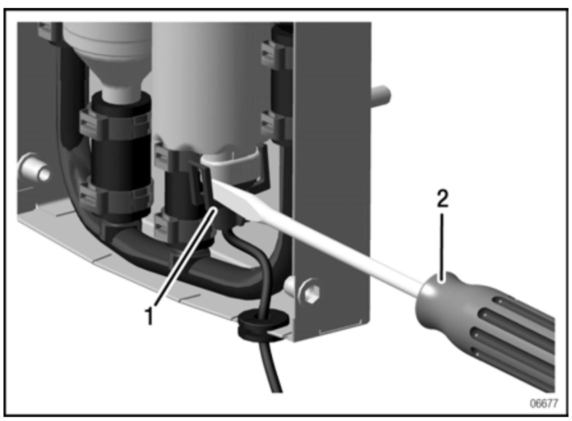


Figure 19.9

1	*Connector (fuel pump 1)*	*2*	*Screwdriver*

ENGINE CONTROL UNIT (ECU) — DISCONNECTION

Wiring harness designation:

- ECU LANE A1
- ECU LANE A2
- ECU LANE B

Step	Procedure
1	Unplug the ECU connectors (ECU LANE A1, ECU LANE A2 and ECU LANE B). See Chapter Chapter 76-10-00 section Engine Control Unit.

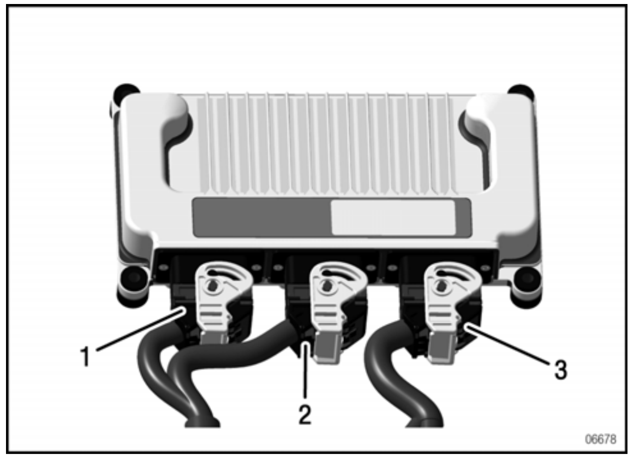


Figure 19.10

1	*Connector (LANE A1)*	*2*	*Connector (LANE A2)*
3	*Connector (LANE B)*		

EXHAUST GAS TEMPERATURE SENSOR (EGT) — DISCONNECTION

See Chapter 74-20-00 section Ignition unit.

Wiring harness designation:

- EGT_1, EGT_2
- EGT_3, EGT_4

Step	Procedure
1	Remove the cable clamps with Allen screws and washers from the intake manifold.

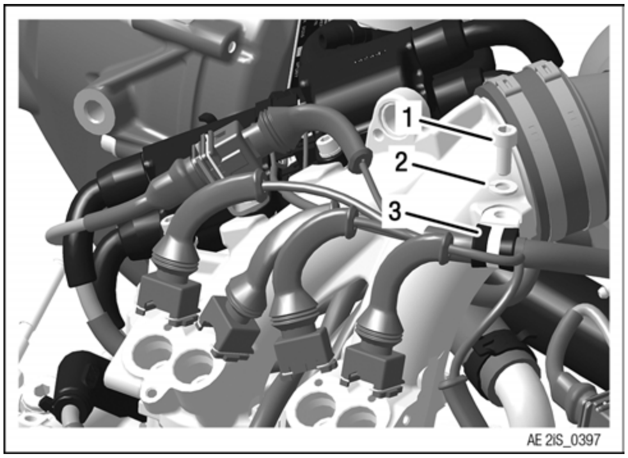


Figure 19.11

1 Allen screw   *2 Washer*

3 Cable clamp

Step	Procedure
2	Carefully pull EGT_1 and EGT_2 (cylinder 1 and 2) out of the connector bracket.
3	Press the metal spring and pull off the connector to the Exhaust Gas Temperature sensor (EGT).

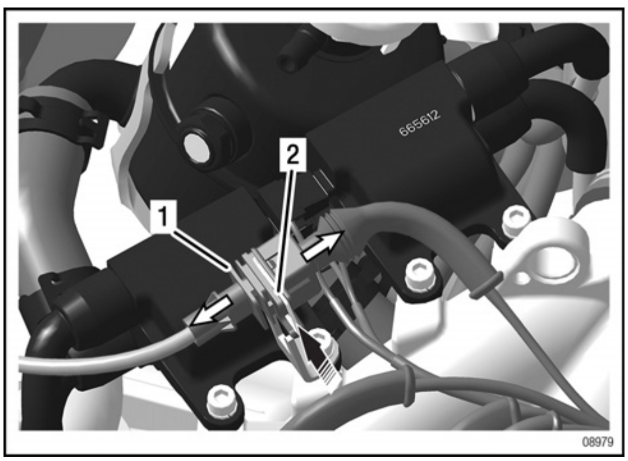


Figure 19.12

1 EGT_1   *2 Metal spring*

Step	Procedure
4	Carefully pull EGT_3 and EGT_4 (cylinder 3/4) out of the connector bracket.
5	Press the metal spring and pull off the connector to the Exhaust Gas Temperature sensor (EGT)

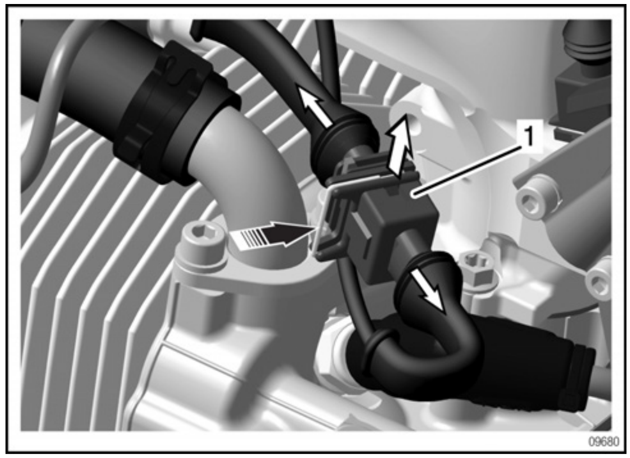


Figure 19.13

1 EGT connector

DOUBLE IGNITION COIL — DISCONNECTION

See Chapter 74-20-00 section Ignition unit.

Wiring harness designation:

- COIL_1
- COIL_2
- COIL_3
- COIL_4

COOLANT TEMPERATURE SENSOR (CTS) — DISCONNECTION

Wiring harness designation:

- CTS

Step	Procedure
1	Disconnect the plug connection to the coolant temperature sensor by lifting the latch and pull off the connector at the same time.

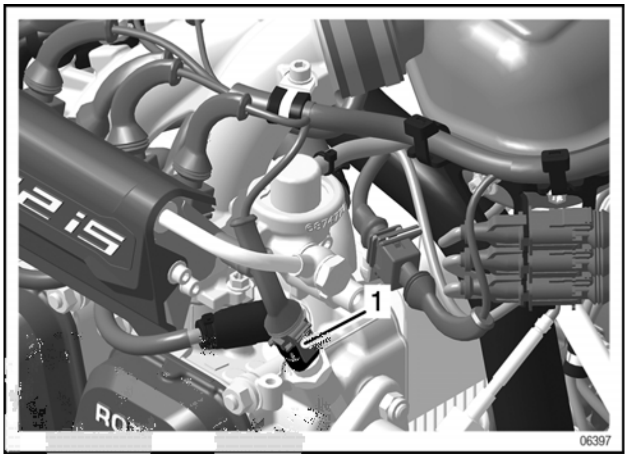


Figure 19.14: Cylinder 4

1	*Coolant Temperature Sensor (CTS)*

FUEL INJECTOR — DISCONNECTION

Wiring harness designation:

- INJ_1 to INJ_8
- See Chapter 73-10-00, section Fuel rail — removal.

NOTE

The cables are labelled INJ_1 to INJ_8.

THROTTLE POSITION SENSOR (TPS) — DISCONNECTION

Wiring harness designation:

- Throttle potentiometer (TPS)

NOTICE

Do not damage the wiring harness. Always cut cable ties on the side of the support plate facing away from the wiring harness.

Step	Procedure
1	Cut 2 cable ties on the airbox.
2	Disconnect the plug connection to the throttle position sensor (TPS) by pressing the lock tab and pull off the connector at the same time.

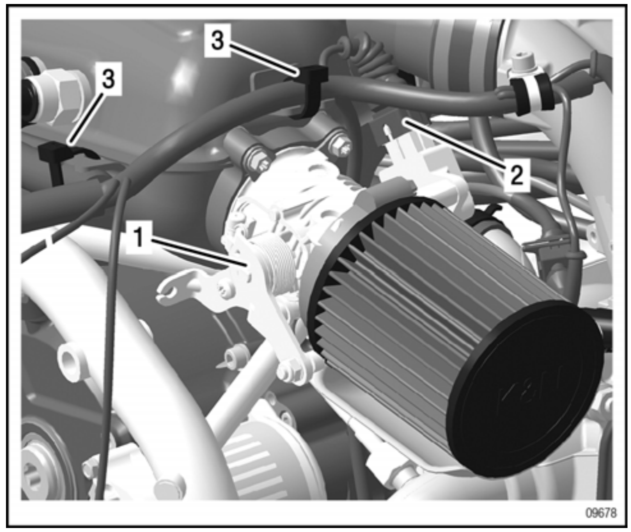


Figure 19.15

1	*Throttle body socket assy.*	*2*	*TPS connector*
3	*Cable ties*		

OIL TEMPERATURE SENSOR AND OIL PRESSURE SENSOR — DISCONNECTION

Wiring harness designation:

- Oil temperature sensor (OTS)
- Oil pressure sensor (OPS)

NOTICE

Do not damage the wiring harness.
Always cut cable ties on the side of the support plate facing away from the wiring harness.

Step	Procedure
1	Remove cable tie.
2	Lift the latch and pull off the connector to the Oil Temperature Sensor (OTS) and Oil Pressure Sensor (OPS).

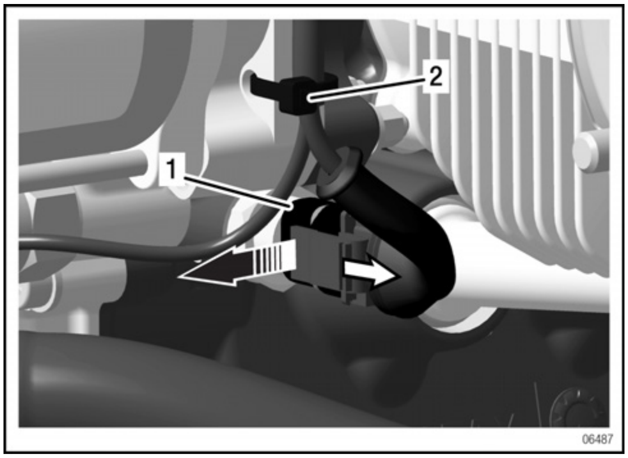


Figure 19.16

1	*Oil Temperature Sensor (OTS)*	*2*	*Cable tie*

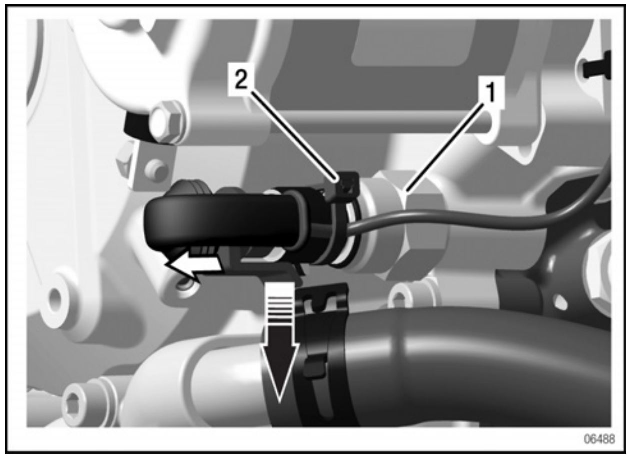


Figure 19.17

1	*Oil Pressure Sensor (OPS)*	*2*	*Cable ties*

CRANKSHAFT POSITION SENSOR (CPS) — DISCONNECTION

Wiring harness designation:

- CPS_1
- CPS_2

NOTICE

Always cut cable ties on the side of the support plate facing away from the wiring harness.

Step	Procedure
1	Remove cable tie.
2	Lift the latch and pull off the connector to the crankshaft position sensors (CPS_1, CPS_2).

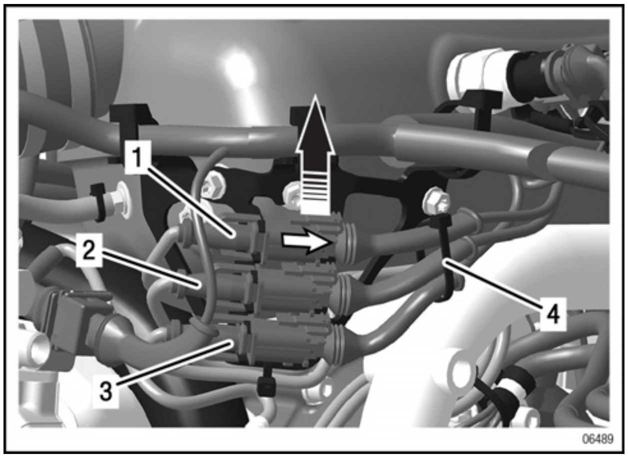


Figure 19.18: TYPICAL

1	*KNOCK sensor connector*	2	*CPS_1 connector*
3	*CPS_2 connector*	4	*Cable tie*

KNOCK SENSOR (KNOCK) — DISCONNECTION

NOTE

KNOCK sensor at old version of wiring harness only.

Wiring harness designation:

- KNOCK

Step	Procedure
1	Remove cable ties.
2	Lift the latch and pull off the connector to the knock sensors (KNOCK).

MANIFOLD AIR PRESSURE SENSOR (MAPS) — DISCONNECTION

Wiring harness designation:

- MAPS_1
- MAPS_2

NOTICE

Do not damage the wiring harness.
Always cut cable ties on the side of the support plate facing away from the wiring harness.

Step	Procedure
1	Remove the 2 cable ties and 2 clips.
2	Lift the latch and pull off the connectors to the manifold air pressure sensors (MAPS_1, MAPS_2).

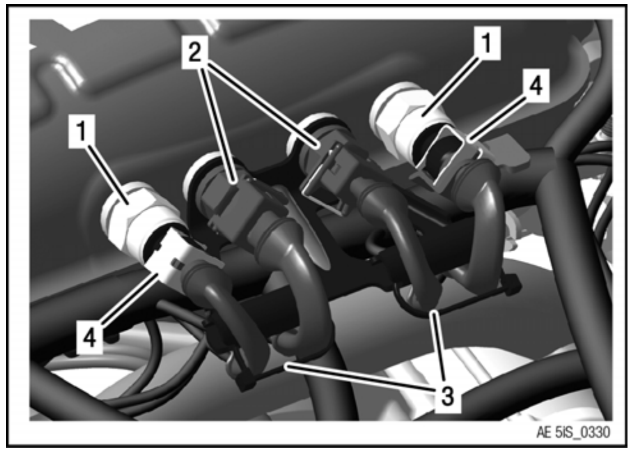


Figure 19.19

1	*Manifold Air Pressure Sensors*	2	*Manifold Air Temperature Sensors*
3	*Cable ties*	4	*Clips*

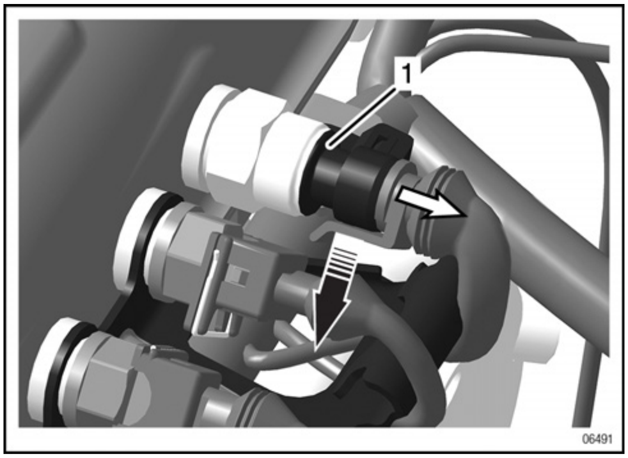


Figure 19.20

1	*Manifold Air Pressure Sensor*

MANIFOLD AIR TEMPERATURE SENSOR (MATS) — DISCONNECTION

Wiring harness designation:

- MATS_1
- MATS_2

NOTICE

Do not damage the wiring harness.
Always cut cable ties on the side of the support plate facing away from the wiring harness.

Step	Procedure
1	Remove the 2 cable ties and 2 clips. Unplug the connectors of the 2 manifold air pressure sensors (MAPS_1, MAPS_2), if necessary.
2	Press the metal spring and pull off the connector to the manifold air temperature sensors (MATS_1, MATS_2). **NOTE** *Do not lose the connector gasket (inside the connector).*

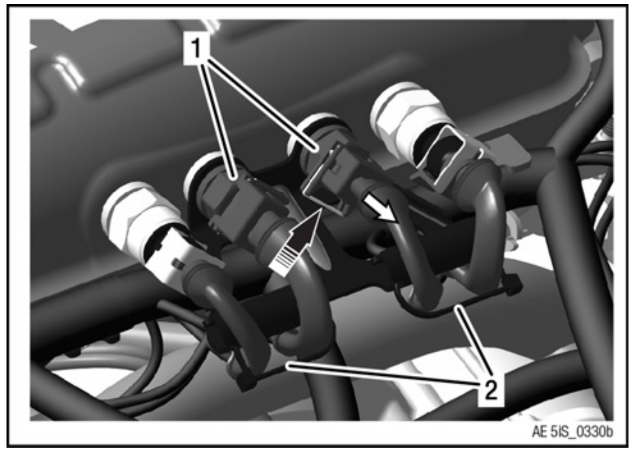


Figure 19.21

1	*Manifold Air Temperature Sensors (MATS_1, MATS_2)*	2	*Cable ties*

Step	Procedure
3	Remove the cable ties from the airbox.
4	If necessary, unscrew clamps and remove it with Allen screws and washers.

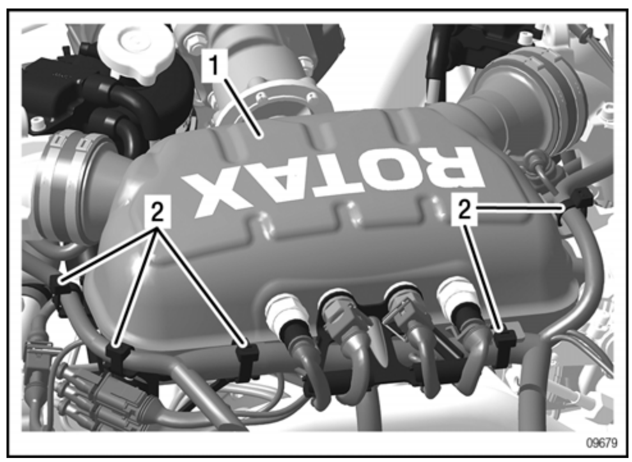


Figure 19.22

1	*Airbox*	2	*Cable ties*

WIRING HARNESS REMOVAL

- The wiring harness can be removed after all clamps and cable ties are removed and connectors disconnected.

INSPECTION

NOTICE

When work is carried out on the components of the engine management system, there is a risk that these might get damaged. Never put measuring probes in plug connectors or use other "aids" to carry out tests in the plug connectors.

NOTICE

All electronic components must be in the original state. Any modification e.g. to the wiring harness can lead to incorrect inputs or operating faults.

General visual inspection.
See Maintenance Manual Line (MML) for the respective engine type, Chapter 05-00-00 and 12–20–00.

NOTE

It must be ensured that all plug-in connections are properly crimped with the cables. (There must be no bent, deformed or loose pins in the plug connections!)

Electric test

The electric test of the wiring harness takes place in the installed state.

Step	Procedure
1	Unplug the wiring harness at the ECU and connect adapter part no. 277012.
2	Wire harness can be tested using an Ohmmeter.

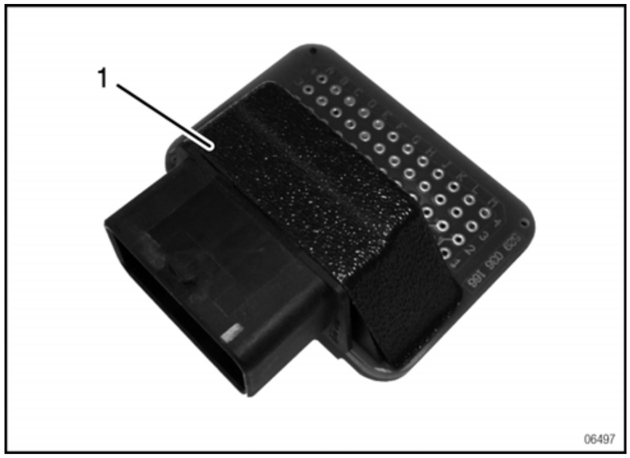


Figure 19.23

1 *Adapter part no. 277012*

INSTALLATION

Preparation

- Check all the wiring harness sections provided.

⚠ WARNING
Non-compliance can result in serious injuries or death! The wiring harness must not be routed through areas or fastened to components in which the maximum permissible temperature of 120 °C (248 °F) can be exceeded during engine operation.

NOTICE
The wire connectors of the ECU must not be opened and closed more than 20 times! This must be shown on the device by a clearly visible label with a printed numerical sequence (1-20) and by documentation conforming to self-monitoring guidelines.

NOTICE
Danger due to damage to the wiring harness! For correct operation of the engine, it is necessary for the wiring harness to be in full working order and protected from scuffing, wear, tearing, extreme bending radii and other types of stress. Do not route the wiring harness in the vicinity of belt drives or rollers without the use of appropriate protective measures.

NOTE

Before connecting a connector, remove the protective covering which may be attached both to the connector and to the connection socket.

NOTE

If necessary, clean the pins of the connector and coat them as follows: AMP/ECU connector with a thin layer of Deoxit contact spray.
All the other connectors with a dielectric silicone-based lubricant or an equivalent lubricant.

Step	Procedure
1	Lay the wiring harness correctly according to the routing plan.

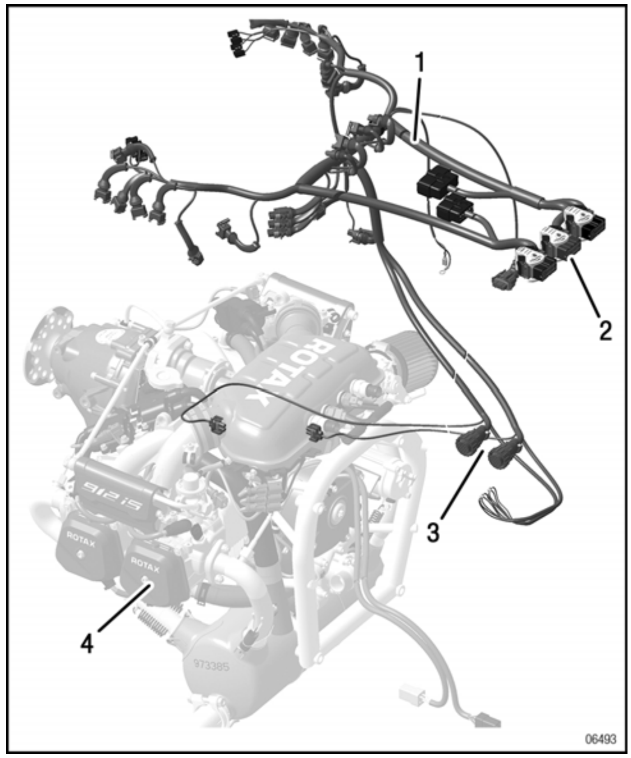


Figure 19.24: TYPICAL

1	*Wiring harness*	2	*ECU connectors*
3	*FUSE BOX round connectors*	4	*Engine*

WIRING HARNESS — INSTALLATION

Wiring harness

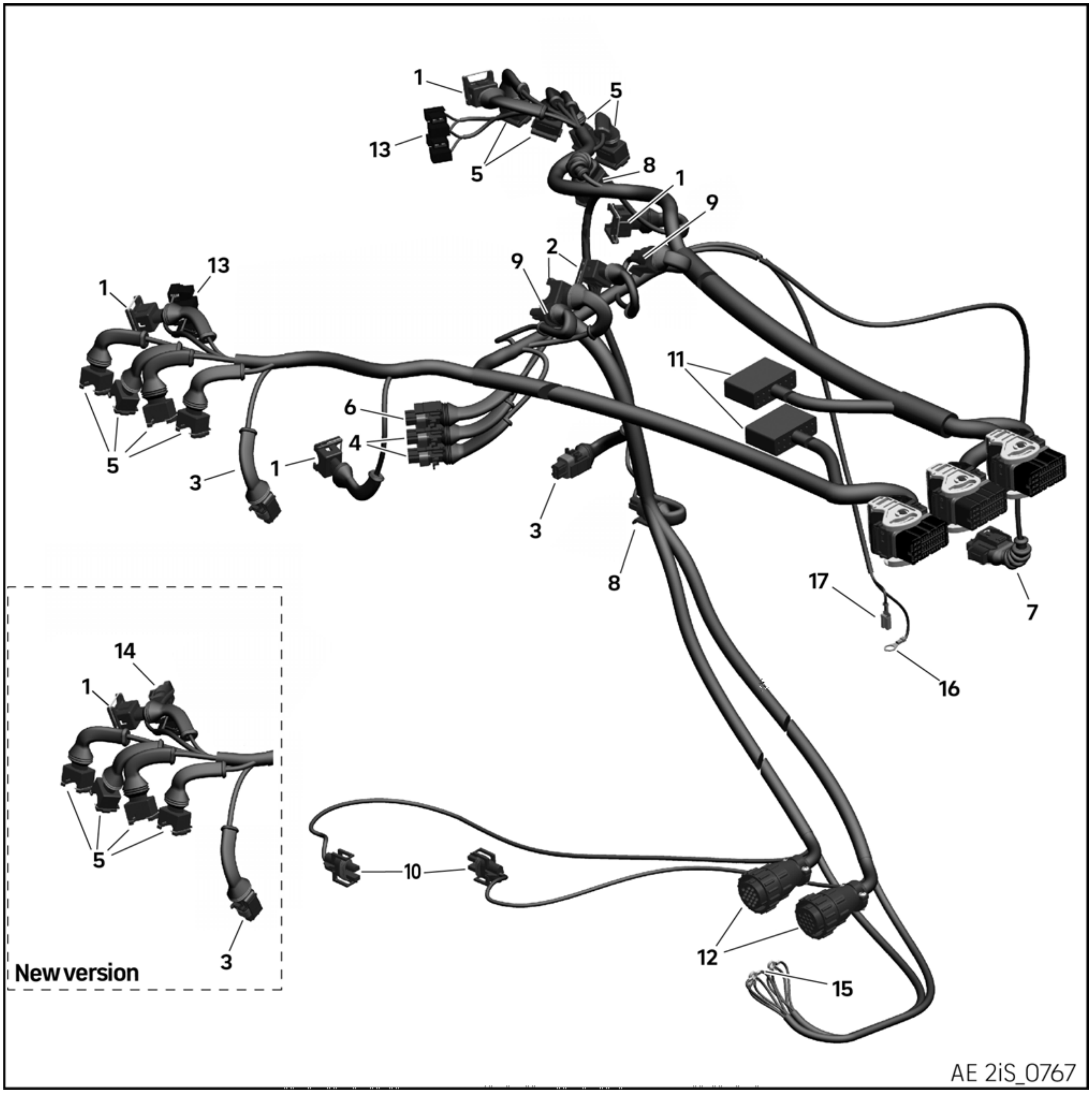


Figure 19.25

NOTE

If the wire is broken or the connector is defective, the damage can be repaired. The cable must be

long enough if the connector is cut off.
Repair with the tools described here must comply with the aircraft standard of the respective country.

NOTE

New version of wiring harness without KNOCK connector.

Pos	Part no. of connector set	Corresponding too
1	881290	Crimping pliers TYCO 539 635-1 Jaws TYCO 539 737-2 Disassembly tool TYCO 1-1579007-6
2	881292	Crimping pliers TYCO 539 635-1 Jaws TYCO 539 737-2 Disassembly tool TYCO 1-1579007-6
3	881296	Crimping pliers TYCO 539 635-1 Jaws TYCO 539 737-2 Disassembly tool TYCO 1-1579007-6
4	881298	Crimping pliers TYCO 539 635-1 Jaws TYCO 539 737-2 Disassembly tool TYCO 1-1579007-6
5	881300	Crimping pliers TYCO 539 635-1 Jaws TYCO 539 737-2 Disassembly tool TYCO 1-1579007-6
6	881296 (old version only)	Crimping pliers TYCO 539 635-1 Jaws TYCO 539 737-2 Disassembly tool TYCO 1-1579007-6
7	881306	Crimping pliers TYCO 539 635-1 Jaws TYCO 539 737-2 7 881308 Disassembly tool DELPHI 12094429
8	881308	Crimping pliers TYCO 539 635-1 Jaws TYCO 539 737-2 7 881308 Disassembly tool DELPHI 12094429
9	881302	Crimping pliers DELPHI 12155975 Disassembly tool DELPHI 12094429
10	881304	Crimping pliers DELPHI 12155975 Disassembly tool DELPHI 12094429
11	881294	Crimping pliers MOLEX 0638114400 Disassembly tool MOLEX 63813-1500
12	881312	Crimping pliers TYCO 58495-1‘ Disassembly tool TYCO 305 183
13	881310 (old version)	Crimping pliers TYCO 180319
14	481452 (new version)	Crimping pliers MOLEX 64016–0035 Disassembly tool MOLEX 63813-1500
15	965701	Crimping pliers MOLEX 64016–0035 Disassembly tool MOLEX 63813-1500
16	964059	Crimping pliers MOLEX 64016–0035 Disassembly tool MOLEX 63813-1500
17	864011	Crimping pliers MOLEX 64016–0035 Disassembly tool MOLEX 63813-1500

MANIFOLD AIR PRESSURE SENSOR (MAPS) — CONNECTION

The sensors are connected and disconnected in the same way. See 76-50-00 section Wiring harness.

NOTE

Do not forget to install the clips and note the positions of them. Check for tight fit and correct position of the clips on sensor and connector.

NOTE

Do not forget to attach the cable ties (strain relief).

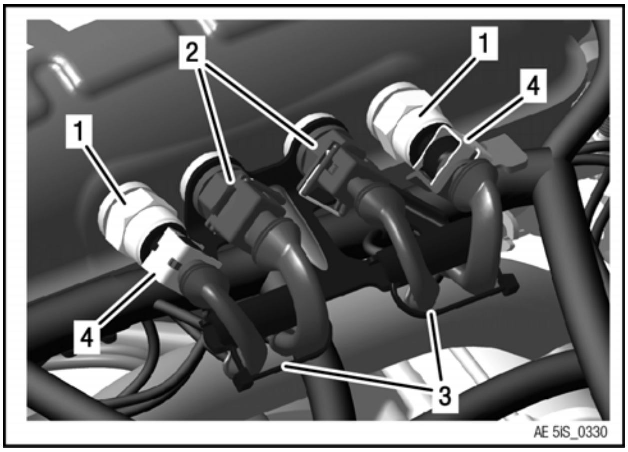


Figure 19.26

1	*Manifold Air Pressure Sensors*	2	*Manifold Air Temperature Sensors*
3	*Cable ties*	4	*Clips*

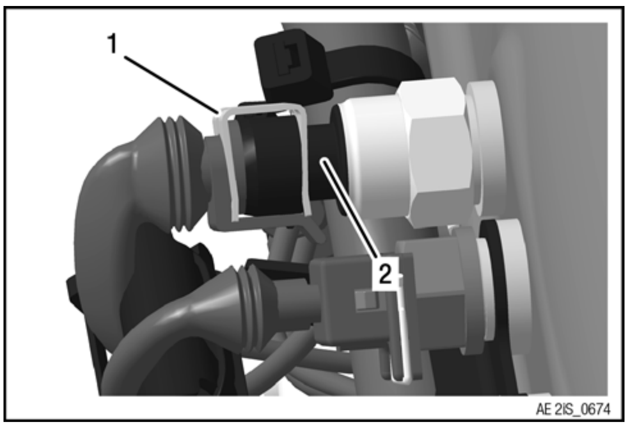


Figure 19.27

1	*Clip*	2	*Manifold Air Pressure Sensor (MAPS)*

MANIFOLD AIR TEMPERATURE SENSOR (MATS_1/MATS_2) — CONNECTION

The sensors are connected and disconnected in the same way. See 76-50-00 section Wiring harness.

NOTE

Check if connector gasket is installed.

NOTE

Do not forget to attach the cable ties (strain relief).

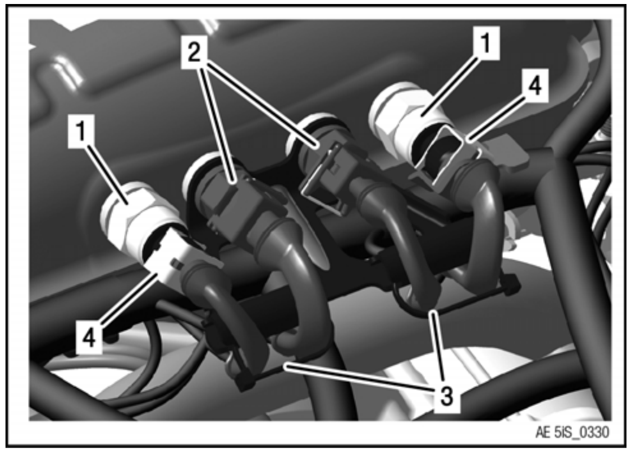


Figure 19.28

1	*Manifold Air Pressure Sensors*	2	*Manifold Air Temperature Sensors*
3	*Cable ties*	4	*Clips*

KNOCK SENSOR (KNOCK) — CONNECTION

NOTE

Only necessary with old wiring harness.
If a new wiring harness (without knock connector) is installed, the knock sensor must be removed. See .

The sensors are connected and disconnected in the same way. See Chapter 76-50-00 section Removal.

CRANKSHAFT POSITION SENSORS (CPS)— CONNECTION

The sensors are connected and disconnected in the same way. See Chapter Chapter 76-50-00 section Removal.

NOTE

The connectors of the sensors are marked with dots:

- *CPS_1 (marked with 1 dot)*
- *CPS_2 (marked with 2 dots)*

NOTE

Do not forget to attach the cable ties (strain relief).

OIL TEMPERATURE (OTS) AND OIL PRESSURE SENSOR (OPS) — CONNECTION

The sensors are connected and disconnected in the same way. See Chapter Chapter 76-50-00 section Removal.

NOTE

Do not forget to attach the cable ties (strain relief).

THROTTLE POSITION SENSOR (TPS) — CONNECTION

The sensor is connected and disconnected in the same way. See Chapter 76-50-00 section Wiring harness – removal.

COOLANT TEMPERATURE SENSOR (CTS) — CONNECTION

NOTICE

Do not clamp the cables for INJ_4 and CTS (Coolant Temperature Sensor) together.

The sensor is connected and disconnected in the same way. See Chapter Chapter 76-50-00 section Removal.

FUEL INJECTOR — CONNECTION

See Chapter 73-10-00, section Fuel rail – installation

DOUBLE IGNITION COIL – CONNECTION

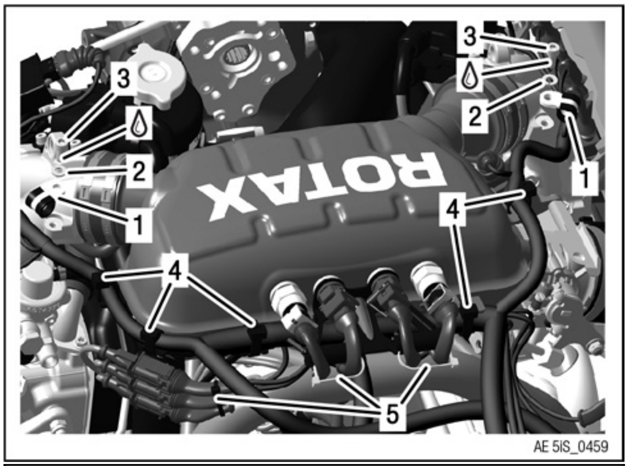
See Chapter 74-20-00, section Double ignition coil (screwed connection) — installation

EXHAUST GAS TEMPERATURE SENSOR (EGT) — CONNECTION

The sensors are connected and disconnected in the same way. See Chapter Chapter 76-50-00 section Removal.

STRAIN RELIEF — CONNECTION

Step	Procedure
1	Attach strain reliefs to the wiring harness with cable ties.
2	Apply LOCTITE 243 to screws. Install cable clamps 12/M6 with Allen screws M6x16 and washers 6.4. Tightening torque 10 Nm (89 in. lb.)



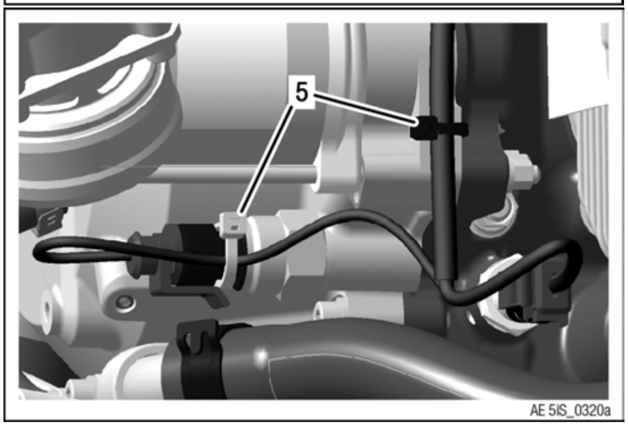


Figure 19.29

1	*Cable clamp 12/M6*	2	*Washer 6.4*
3	*Allen screw M6x16*	4	*Cable tie 203x7.6 mm*
5	*Cable tie 142x3.2 mm*		

ENGINE CONTROL UNIT (ECU) — CONNECTION

The ECU is connected and disconnected in the same way. See Chapter 76-50-00 section Removal.

NOTICE

The wire connectors of the ECU must not be opened and closed more than 20 times! This must be shown on the device by a clearly visible label with a printed numerical sequence (1-20) and by documentation conforming to self-monitoring guidelines.

FUEL PUMP — CONNECTION

The fuel pump is connected and disconnected in the same way. See Chapter 76-50-00 section Removal.

FUSE BOX — CONNECTION

The sensor round connector is connected and disconnected in the same way. See Chapter Chapter 76-50-00 section Removal.

AMBIENT AIR PRESSURE AND TEMPERATURE SENSOR (AAPTS) — CONNECTION

The sensors are connected and disconnected in the same way. See Chapter 76-50-00 section Removal.

STARTER RELAY — CONNECTION

The starter relay is connected and disconnected in the same way. See Chapter 76-50-00 section Removal.

Please observe the instructions of the aircraft manufacturer.

HIC A AND HIC B — CONNECTION

Connect the HIC_A and HIC_B connectors in accordance with the aircraft manufacturer’s specifications.

FINISHING WORK

- Check that all plug connections are secure, contacted and free from corrosion and dirt.
- Check the grounding for good contact and cleanliness.

- Connect the wiring harness to the aircraft frame in accordance with the aircraft manufacturer's specifications.

Carry out an engine test run. See latest Maintenance Manual Line (MML), Chapter 12-20-00.

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Chapter: 76–70–00
SENSORS AND ACTUATORS

TOPICS IN THIS CHAPTER

SPECIAL TOOLS

Description	Part number	
Multimeter	n.a.	Non certified part
21 mm socket for MAPS and OPS	876075	Non certified part
19 mm socket for CTS and OTS	876130	Non certified part

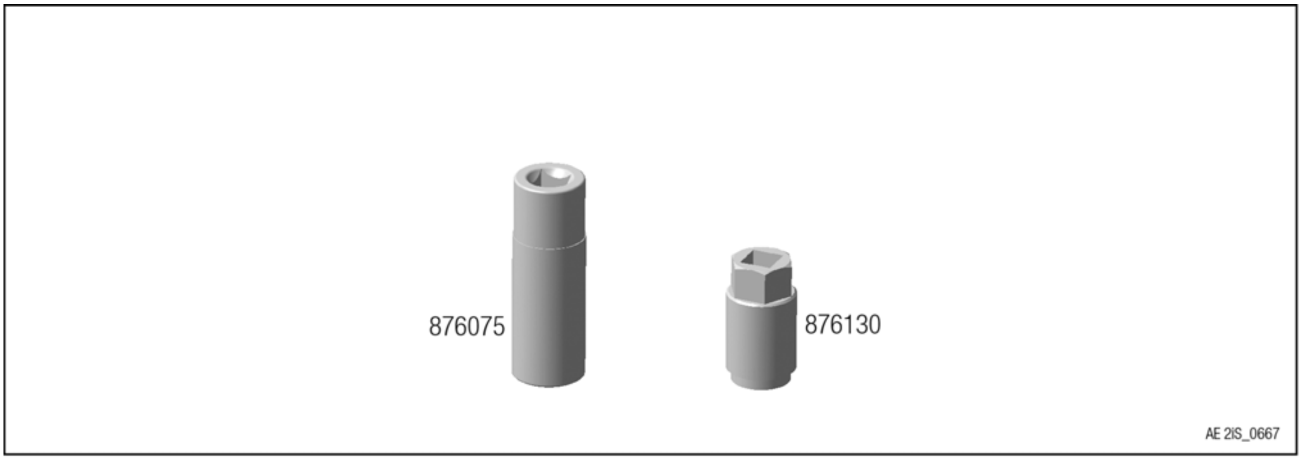


Figure 20.1: Special tools

SERVICE PRODUCTS

Description	Part number
LOCTITE 243	897651
LOCTITE ANTI SEIZE	297434

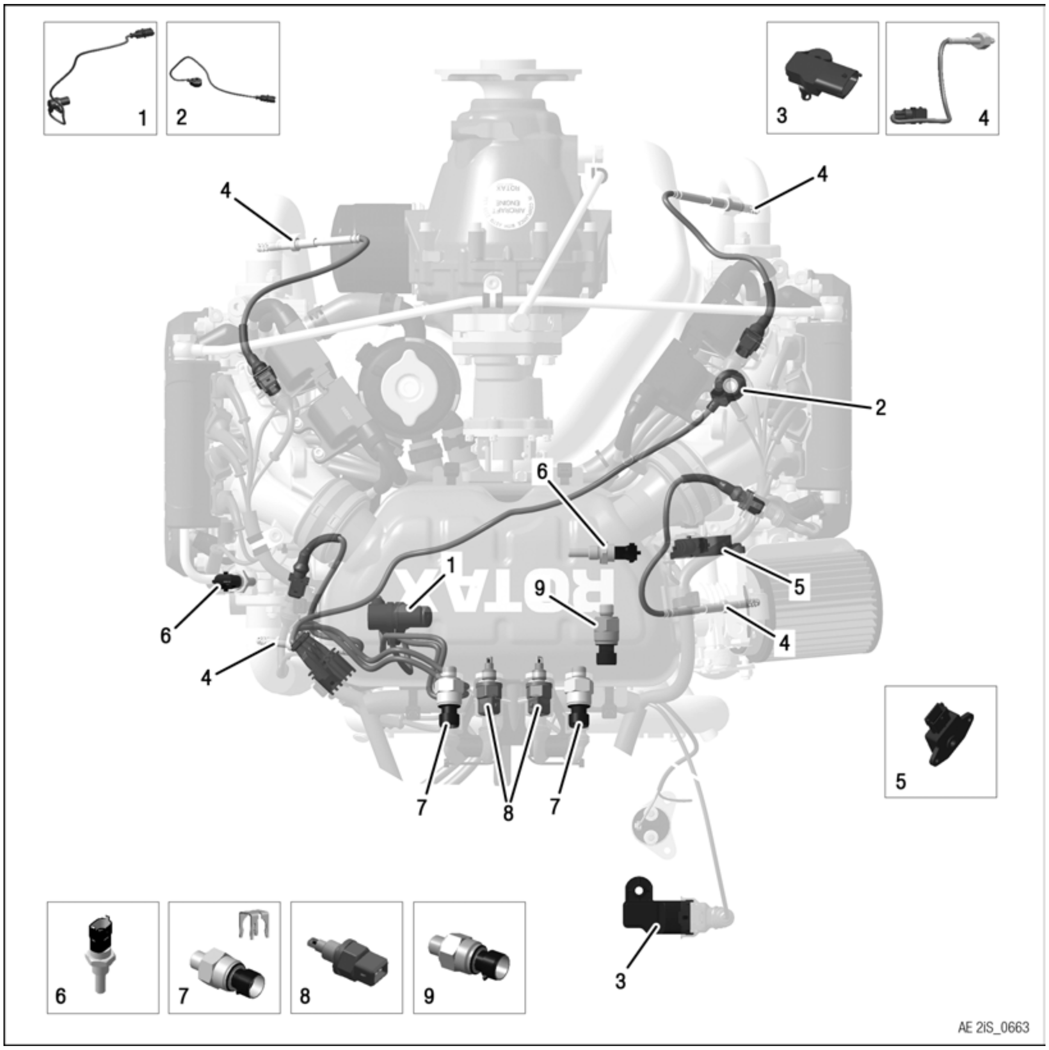


Figure 20.2: Sensors

1	*Crankshaft position sensor (CPS 1 + 2)*	2	*Knock sensor (KNOCK) (only with old Wiring harness)*
3	*Ambient pressure sensor (AAPTS)*	4	*Exhaust Gas Temperature sensor (EGT)*
5	*Throttle position sensor (TPS)*	6	*Coolant Temperature Sensor (CTS) and Oil temperature sensor (OTS)*
7	*Manifold Air Pressure Sensor (MAPS 1 + 2) + clamps*	8	*Manifold Air Temperature Sensor (MAPS 1 + 2)*
9	*Oil Pressure Sensor (OPS)*		

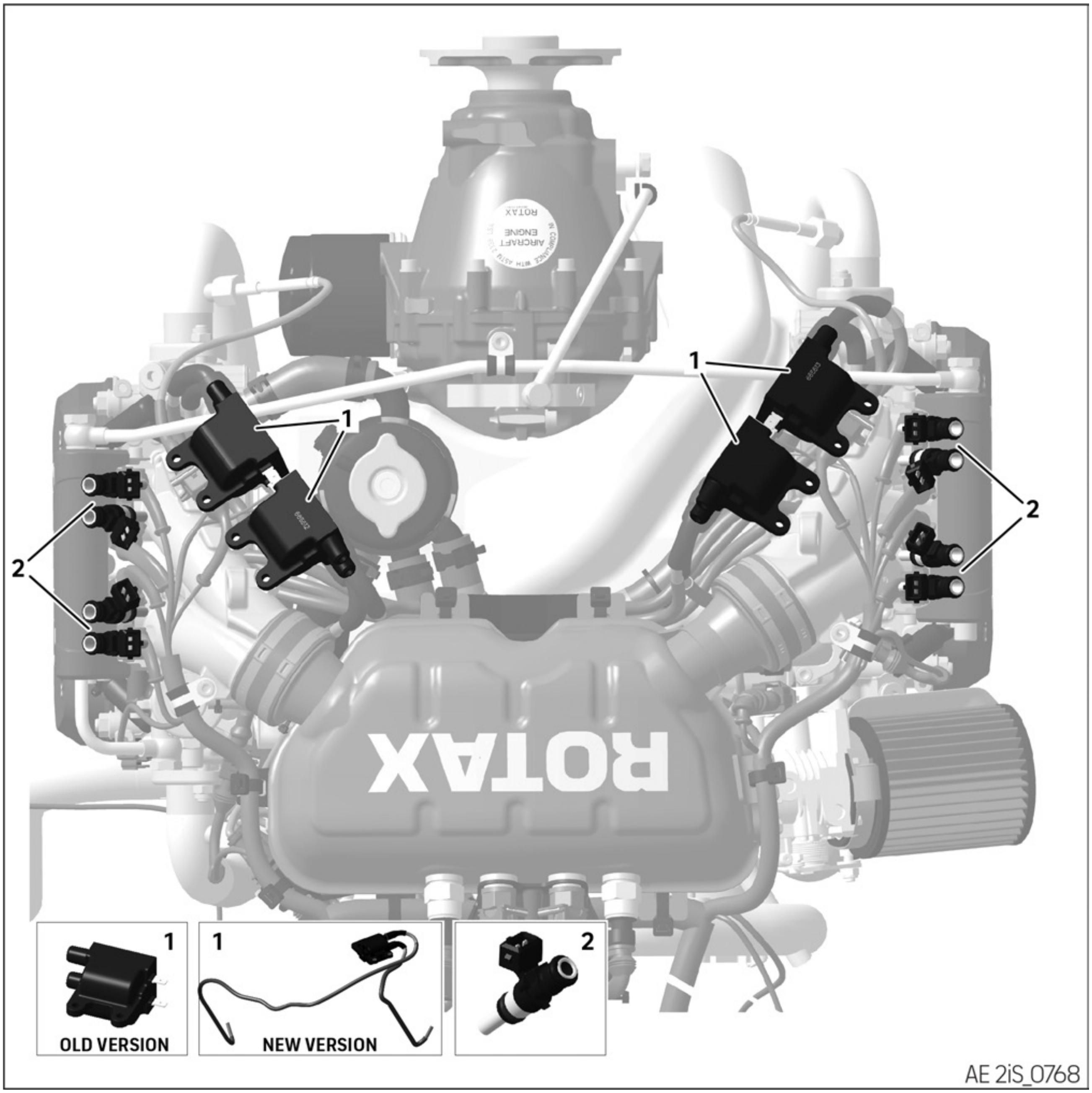


Figure 20.3: Actuators

1 *Double ignition coils*

2 *Fuel injectors*

SYSTEM DESCRIPTION

GENERAL NOTE

In order to ensure that the engine is in the desired operating state and in full working order, a number of sensors are placed on it and used for the Engine Management System (EMS). The information captured by the sensors is transmitted to the ECU where it is processed, and the corresponding signals are sent on to the actuators.

SENSORS

1 Ambient air pressure and temperature sensor
Wiring harness designation: AAPTS
Ambient air pressure and ambient temperature are measured with a combined pressure/temperature sensors. These measurement values are used to compensate for the different altitude and external temperatures.

1 Oil pressure sensor
Wiring harness designation: OPS
The sensor measures the oil pressure of the engine.

2 Manifold air pressure sensors
Wiring harness designation: MAPS_1/MAPS_2
The sensors measure the pressure of the intake air in the airbox.

2 Manifold air temperature sensors
Wiring harness designation: MATS_1/MATS_2
The sensors measure the temperature of the intake air in the airbox.

4 Exhaust gas temperature sensors
Wiring harness designation: EGT_1/EGT_2/ EGT_3/ EGT_4
The sensors measure the temperature of the exhaust gas and are used to regulate the injection quantity.

1 Coolant temperature sensor
Wiring harness designation: CTS
The sensor measures the coolant temperature directly in the cylinder head of cylinder 4.

1 Oil temperature sensor
Wiring harness designation: OTS
The sensor measures the oil temperature.

1 Knock sensor (only with old Wiring harness)
Wiring harness designation: KNOCK
"Knocking" means uncontrolled combustion in petrol engines, which is caused by auto-ignition of the mixture in the combustion chamber. This undesirable combustion results in increased mechanical loads in the engine.
Operation in this condition over a long period can damage or even destroy the piston. Characteristic frequencies are generated during knocking. These frequencies are detected by the knock sensor and sent to the engine control unit (ECU).

1 Throttle position sensor
Wiring harness designation: TPS
The throttle position sensor measures the position of the throttle valve in the throttle body.

4 Double ignition coils
Wiring harness designation: COIL_1/COIL_2/ COIL_3/COIL_4
Each double ignition coil supplies 2 spark plugs with high voltage.

2 Crankshaft position sensors
Wiring harness designation: CPS_1/CPS_2
The engine control unit (ECU) requires the current position of the crankshaft for exact control of the ignition and injection points. The crankshaft position sensors measure the revolutions of the crankshaft and give the ECU information about the position of the pistons and the position of the crankshaft.

ACTUATORS AND INDICATORS

Fuel injectors
Wiring harness designation: INJ_1 to INJ_8
In the engine, eight injection valves (INJ) are used, two for each cylinder.

Double ignition coils
Wiring harness designation: COIL_1 to COIL_4
Four double ignition coils (with one primary coil and one secondary coil each) are attached to the engine. Each end of the secondary coil is connected to a spark plug of different cylinders by ignition cables.

SAFETY INSTRUCTION

⚠ WARNING

Danger of injury when removing hose connections, sensors and actuators! Risk of fire due to flammable substances (e.g. fuel). Open flames and smoking in the installation area is not permitted!

NOTICE

Danger of damage to the fuel distribution system and ignition unit!
Do not touch or pull off ignition cables when the engine is running or at starting speed.

NOTE

The general safety instructions must be followed during all work on the sensors and actuators!

ENVIRONMENTAL NOTE

Please observe the disposal regulations applicable in your area.

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.

MAINTENANCE

For maintenance and special checks, see current Maintenance Manual Line (MML) of the respective engine type.

REMOVAL

Preparation
Before the sensors and actuators are removed, the procedures and checks described below must be carried out to identify any further faults in the cylinder head and rectify them as part of repair work.

NOTE

This work can only be carried out on the whole unit.

General visual inspection. See relevant Maintenance Manual Line (MML) for the respective engine type.

- Use the BUDS diagnostic unit for troubleshooting and to read out the error memory. See Chapter 76-10-00, section ECU – READ OUT AND FLASHING

Plausibility test
BUDS (check the plausibility of the values of the sensors with the aid of the Maintenance Tool):

Step	Procedure
1	Engine standstill (cold engine).
2	Activate ECU.
3	Check the plausibility of the pressure, temperature values.
4	Start the engine.
5	Check the plausibility of the sensors.

Elimination process for manifold air pressure sensors (MAPS), manifold air temperature sensors (MATS) and fuel injection valves (INJ)
In order to identify a component clearly as defective, you should follow the process of elimination, e.g. change around (swap) the wiring harness connectors on the sensors.

- If the error on the LANE remains the same, this means the wiring harness is not in working order.

If the error appears on the other LANE after the changeover, this means the sensor is not in working order.

- Turn the ignition switch OFF.

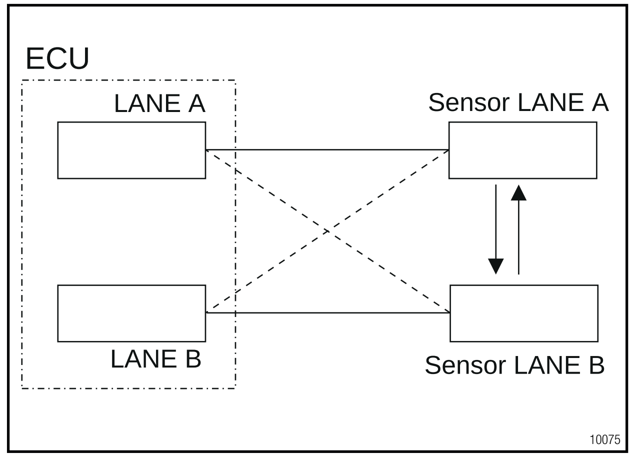


Figure 20.4: Wiring diagram – elimination process

MANIFOLD AIR PRESSURE SENSOR (MAPS_1/MAPS_2) — REMOVAL

Installation position: Airbox

Step	Procedure
1	Disconnect the manifold air pressure sensor (MAPS). See Chapter 76-50-00 section Removal.
2	Loosen the sensor with a 21 mm socket (part no. 876075) and remove it.
3	Close the threaded bore with the appropriate protective covering.

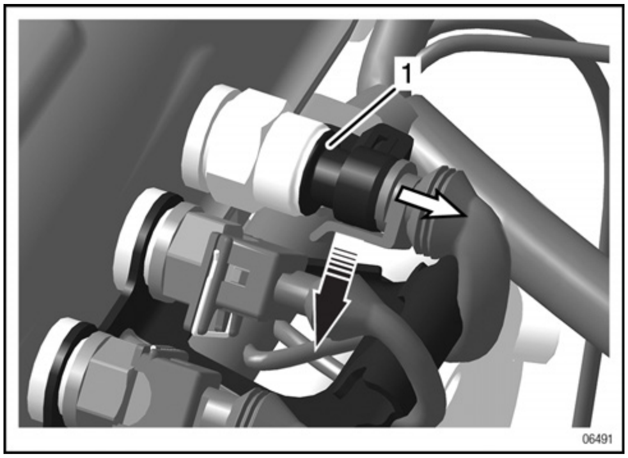


Figure 20.5

1 *Manifold air pressure sensor (MAPS)*

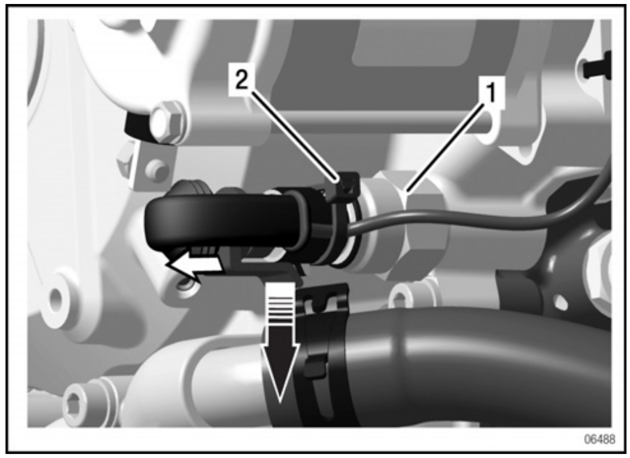


Figure 20.6

1 *Oil pressure sensor (OPS)* 2 *Cable ties*

OIL PRESSURE SENSOR (OPS) — REMOVAL

NOTE

Be prepared! When removing the oil temperature sensor, oil may leak from the bore.

Installation position: Ignition housing

Step	Procedure
1	Disconnect the oil pressure sensor (OPS). See Chapter 76-50-00 section Removal.
2	Loosen the oil pressure sensor with a 19 mm socket (part no. 876130) and remove it.
3	Close the threaded bore with the appropriate protective covering.

AMBIENT AIR PRESSURE AND TEMPERATURE SENSOR (AAPTS) — REMOVAL

Installation position: Aircraft frame

Step	Procedure
1	Disconnect the ambient air pressure and temperature sensor (AAPTS). See Chapter 76-50-00 section Removal.
2	Follow the aircraft manufacturer's instructions for removal.

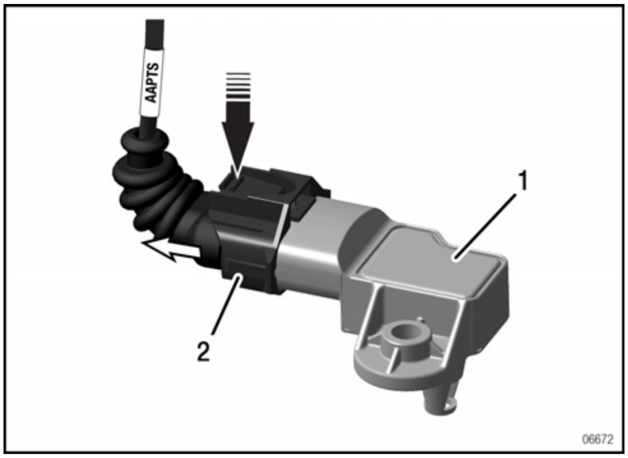


Figure 20.7

1	*Ambient air pressure and temperature sensor (AAPTS)*	*2*	*Connection socket*

MANIFOLD AIR TEMPERATURE SENSOR (MATS_1/MATS_2) — REMOVAL

Installation position: Airbox

Step	Procedure
1	Disconnect the manifold air temperature sensor. See Chapter 76-50-00 section Wiring harness – removal.

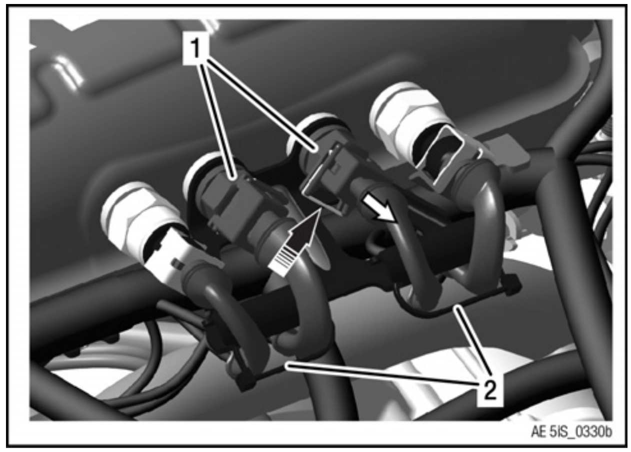


Figure 20.8

1	*Manifold air temperature sensors*	*2*	*Cable ties*

Step	Procedure
2	Unscrew the sensor with a 19 mm socket (part no. 876130) and remove it together with the sealing ring and the connector bracket.
3	Close the threaded bore with the appropriate protective covering.

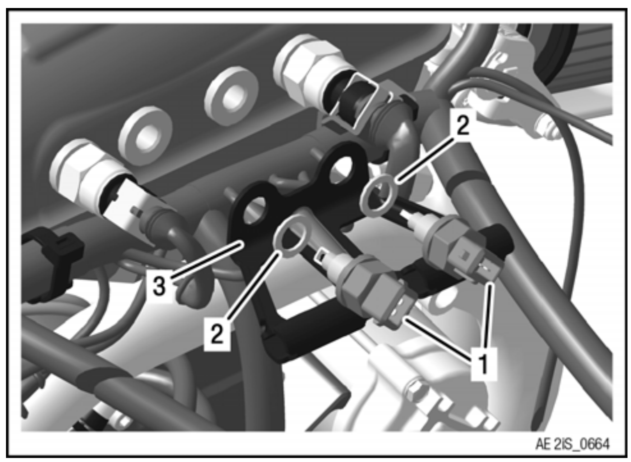


Figure 20.9

1	*Manifold air temperature sensors*	*2*	*Sealing rings*
3	*Connector bracket*		

EXHAUST GAS TEMPERATURE SENSOR (EGT_1, EGT_2, EGT_3, EGT_4) — REMOVAL

Installation position: Exhaust pipes

Step	Procedure
1	Disconnect the exhaust gas temperature sensor (EGT1/EGT2/ EGT3/EGT/4). See Chapter 76-50-00 section Wiring harness – removal.

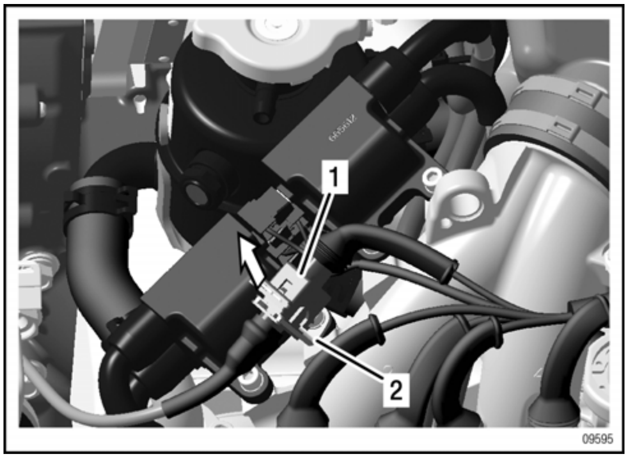


Figure 20.10

1 Exhaust Gas Temperature sensor (EGT) *2 Connector bracket*

Step	Procedure
2	Unscrew the exhaust gas temperature sensor (EGT) and remove it from the exhaust pipe.

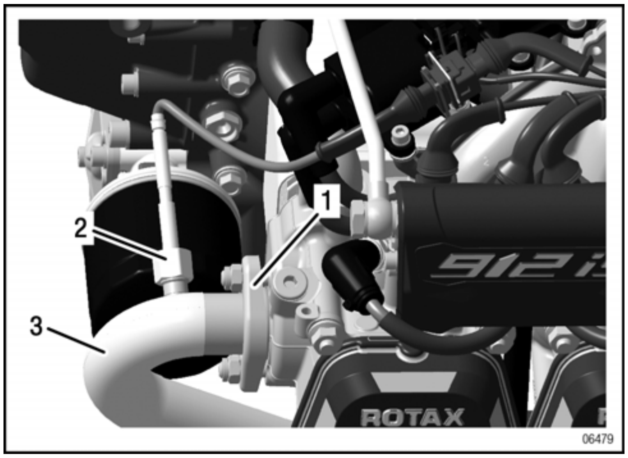


Figure 20.11

1 Exhaust flange *2 Exhaust Gas Temperature sensor (EGT)*

3 Exhaust pipe

OIL TEMPERATURE SENSOR (OTS) — REMOVAL

NOTE

When removing the oil temperature sensor, oil may leak from the bore.

Installation position: Crankcase

Step	Procedure
1	Disconnect the oil temperature sensor (OTS). See Chapter 76-50-00 section Removal.

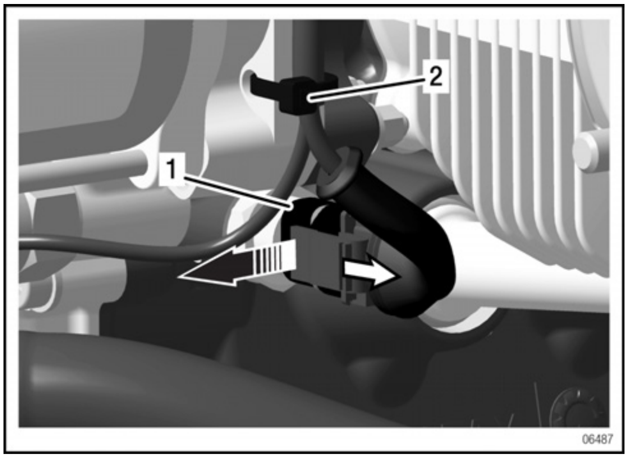


Figure 20.12

1 Oil temperature sensor *2 Cable ties*

Step	Procedure
2	Use a 19 mm socket (part no. 876130) to remove the oil temperature sensor from the crankcase.
3	Close the bore with the appropriate protective covering.

COOLANT TEMPERATURE SENSOR (CTS) — REMOVAL

Preparation

Drain coolant.
See current Maintenance Manual Line (MML) for the respective engine type.

Installation position: Cylinder head (cylinder 4)

Step	Procedure
1	Disconnect the coolant temperature sensor (CTS). See Chapter 76-50-00 section Wiring harness – removal.
2	Use a 19 mm (part no. 876130) to remove the coolant temperature sensor from the cylinder head.

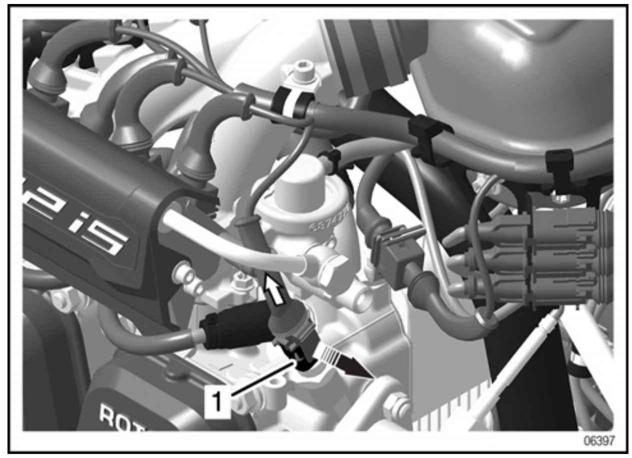


Figure 20.13

1 Coolant temperature sensor (CTS)

KNOCK SENSOR (KNOCK) — REMOVAL

Preparation

- Remove cooling air baffle. See Chapter 75-00-00, section Cooling air baffle - removal.

Installation position: Cylinder head 1

NOTE

Only necessary with old wiring harness.
If a new wiring harness (without knock connector) is installed, the knock sensor must be removed as follows.

Step	Procedure
1	Disconnect the knock sensor. See Chapter 76-50-00 section Wiring harness – removal.
2	Pull the connector out of the connector bracket.

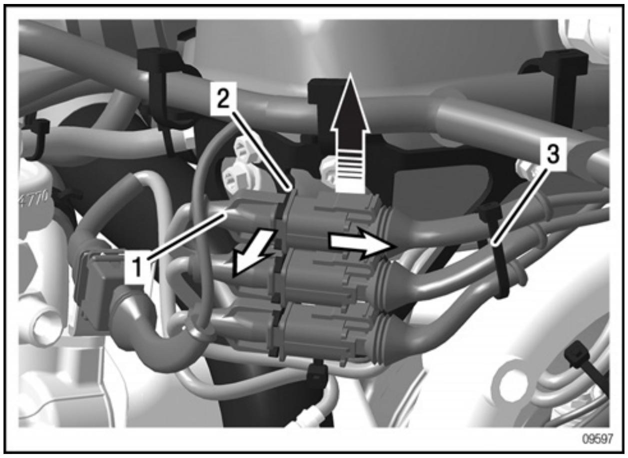


Figure 20.14

1 Connector *2 Connector bracket*
3 Cable tie

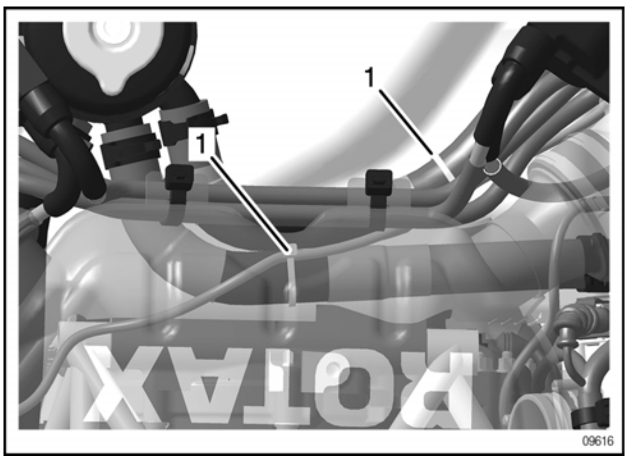


Figure 20.15

1 Cable ties

NOTE

Mark the position of the sensor.

Step	Procedure
3	Loosen the Hex. screw.
4	Remove the knock sensor.

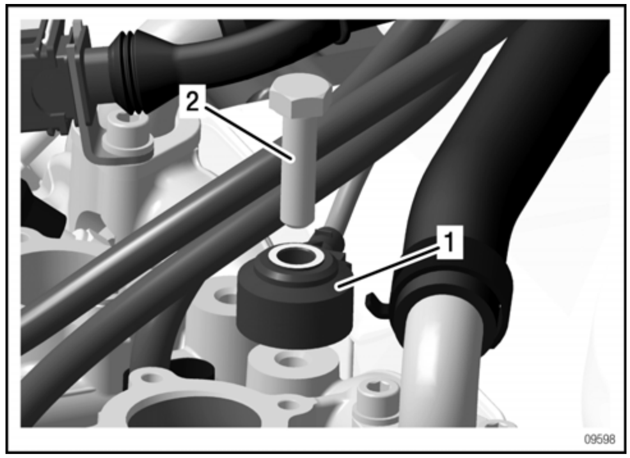


Figure 20.16

1 Knock sensor *2 Hex. screw*

CRANKSHAFT POSITION SENSOR (CPS_1/CPS_2) — REMOVAL

NOTE

When removing the crankshaft position sensor, oil may leak from the bore.

Installation position: Ignition housing

NOTICE

Do not damage the cables.
Always cut cable ties on the side of the support plate facing away from the cables.

Step	Procedure
1	Disconnect the crankshaft position sensor (CPS). See Chapter 76-50-00 section Wiring harness – removal.
2	Remove cable ties.
3	Pull the connector out of the connector bracket.

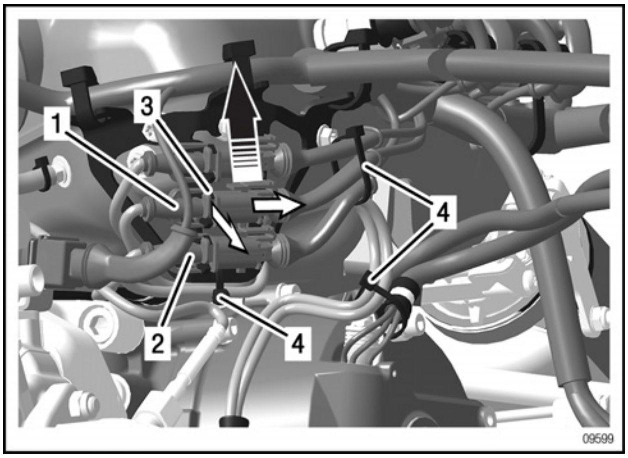


Figure 20.17

1	*Connector CPS_1*	*2*	*Connector CPS_2*
3	*Connector bracket*	*4*	*Cable ties*

Step	Procedure
4	Remove the Allen screw with washer and remove the cable clamp.
5	Loosen the Allen screw with lock washer and remove the crankshaft position sensor (CPS).
6	Close the opening with the appropriate protective plug.

NOTE

Ensure that the O-ring is positioned on the crankshaft position sensor.

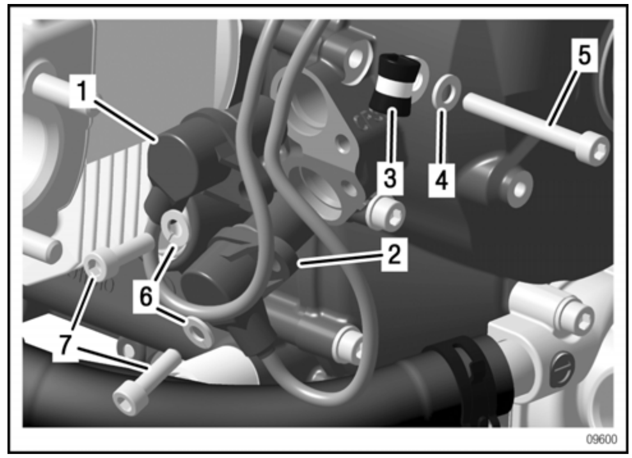


Figure 20.18

1	*Crankshaft position sensor CPS_1*	*2*	*Crankshaft position sensor CPS_2*
3	*Cable clamp*	*4*	*Washer*
5	*Allen screw M6x50*	*6*	*Lock washer*
7	*Allen screw M6x20*		

THROTTLE POTENTIOMETER (TPS) — REMOVAL

Installation position: Throttle body

NOTE

The throttle potentiometer is not available as a spare part.

Step	Procedure
1	Disconnect the throttle position sensor (TPS). See Chapter 76-50-00 section Wiring harness – removal.

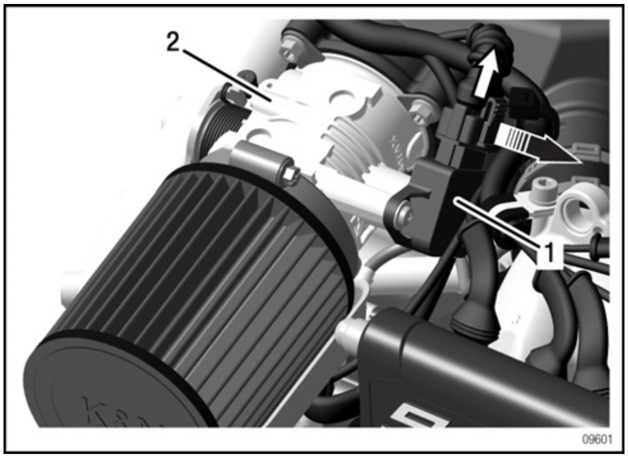


Figure 20.19

1	*Throttle position sensor (TPS)*	*2*	*Throttle body assy.*

FUEL INJECTOR (INJ) — REMOVAL

For removal of the fuel injection, see Chapter 73-10-00, section Fuel rail — removal.

DOUBLE IGNITION COIL — REMOVAL

For removal of the double ignition coils, see Chapter 74-20-00, section Double ignition coil – removal

INSPECTION

SENSORS AND ACTUATORS

NOTICE

Replace parts in the event of physical damage or resistance readings out of the wear limits.

Preparation

NOTE

Before starting to inspect the sensors and actuators, ensure that the whole aircraft system is fully functional!

Observe the instructions of the aircraft manufacturer.

Aircraft components to be checked:

- Battery
- Fuses
- Grounding connections
- Cable connections

GENERAL TEST PROCEDURE

NOTICE

During work on the components of the engine management system, there is a risk of damage. Never put measuring probes in plug connectors or use paper clips to carry out tests in the plug connectors.

NOTE

The MAINTENANCE TOOL BUDS software must be used for diagnostics!

- After a problem has been solved, any error entries in the ECU must be documented with the MAINTENANCE TOOL and then deleted.

Functional test

The function of the sensors and actuators must be checked with the ECU activated.

GENERAL RESISTANCE MEASUREMENT

Before checking the resistance, ensure that there is no voltage present at the component to which the ohmmeter is connected. Always pull out the connectors beforehand. Switch off the ignition. Disconnect the battery. Otherwise the measurement unit can be damaged.

The ohmmeter is connected to the 2 connections of a consumer or to the 2 ends of an electric line. It doesn't matter which cable (+/-) of the measurement unit is clamped to which contact. Exceptions are resistance measurements on components which contain diodes.

The resistance measurement on the engine usually covers 2 areas:

- Resistance or component check
- Continuity check of an electric cable, a switch etc. This checks whether an electric cable is disconnected so that the connected electric device cannot function. The ohmmeter is connected to the two ends of the electric cable in question for the measurement. If the resistance is close to 0 (zero) then there is continuity. This means the electric cable is in working order. If the cable is broken, the measurement unit displays infinity.

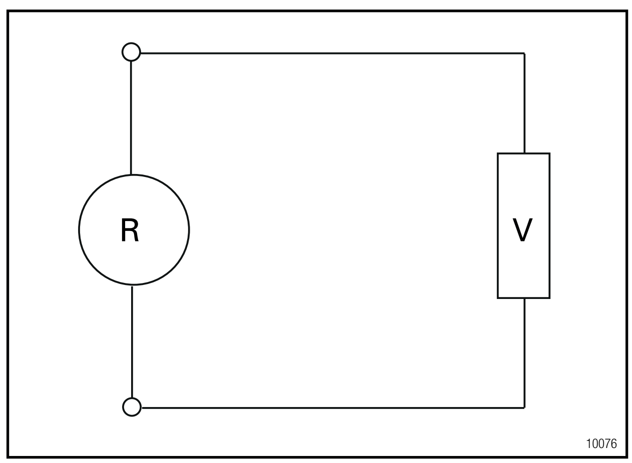


Figure 20.20

R Ohmmeter *V Consumer*

RESISTANCE MEASUREMENT (TEMPERATURE SENSOR)

General note

If resistance values are measured with an ohmmeter, all values are given at a temperature of approx. 20 ° C. A resistance value changes with temperature.
The temperature sensors which are mostly used in the engine are NTC (Negative Temperature Coefficient) and operate in the opposite manner i.e. the resistance value essentially falls when the temperature rises. This must be taken into account when measuring at temperatures which differ from the specified values. The relationship between the resistance and the temperature can be found in the respective diagram of the relevant sensor.
The resistance value of a temperature sensor can appear to be in working order at ambient temperature but defective at other temperatures. If in doubt, replace the sensor.

NOTE

It should be remembered that the static measurement is only meaningful for the determined temperature ranges. Exact information can be obtained if the sensor has been tested over a wider temperature range.

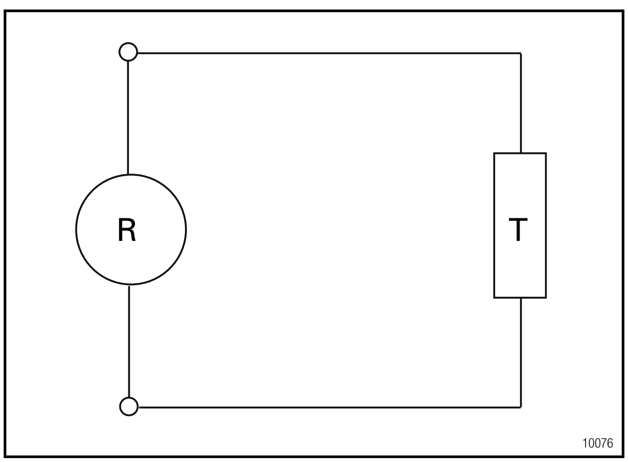


Figure 20.21

R Ohmmeter *T Temperature sensor*

VOLTAGE MEASUREMENT

General note

NOTICE

Voltage supply: The secondary side of the ignition unit is an exception to the following instructions! The ignition voltage can be up to 30 000 volts! This high voltage must only be measured with a special measurement unit or an oscilloscope with a special test probe.

Voltage can be detected with a simple test lamp or a voltage tester. However, this only indicates whether voltage is connected at all. To check the level of the voltage present, a voltmeter (= multimeter) must be connected.

Step	Procedure
1	The voltmeter must first be adjusted to the measurement range of the voltage to be measured. Voltages on the engine are generally no higher than approx. 28 volts.
2	Connect the cables of the measurement unit parallel to the consumer.

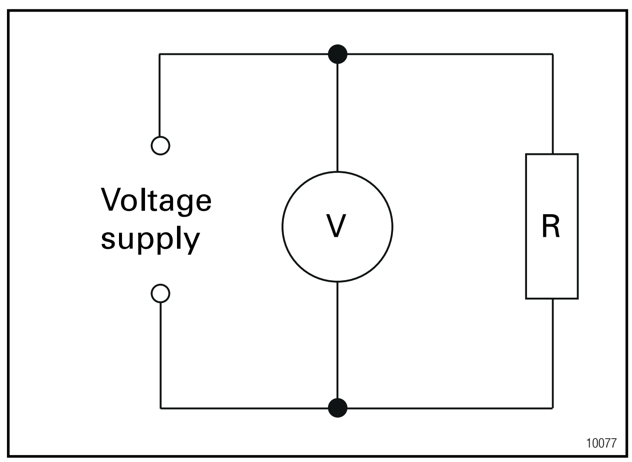


Figure 20.22

V Parallel-connected voltmeter *R Consumer*

CURRENT MEASUREMENT

General note

It is not often necessary to measure the amperage on the engine. This requires an ammeter, which is usually integrated in a multimeter.

NOTICE

Amperage: Never measure the amperage in the cable to the starter with a normal ammeter! The measurement unit can be destroyed by the high currents which occur here. A current clamp can be used for measuring such high amperages.

Step	Procedure
1	Before the current measurement, the measurement unit is adjusted to the measurement range in which the amperage you are measuring is likely to be found. If this is not known, set the highest measurement range, and if there is no display, switch down to the next measurement range, and so on.
2	If not using a clamp-on ammeter, the circuit must be disconnected in order to measure the amperage. The measurement unit (ammeter) is connected in between.

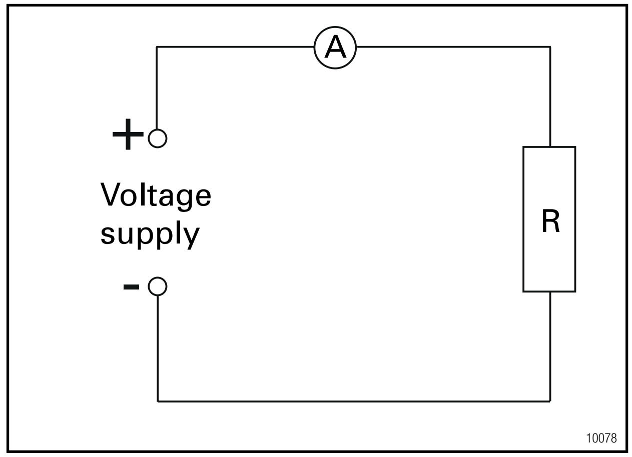


Figure 20.23

A *Series-connected ammeter*

R *Consumer*

MANIFOLD AIR PRESSURE SENSOR (MAPS_1/MAPS_2) — INSPECTION

Step	Procedure
1	Inspect for physical damage.
2	Measure the amps between pin B and C.

Manifold air pressure sensor (MAPS_1, MAPS_2)			
Signal	**PIN**	**Voltage [in V]**	**Remarks**
Supply voltage	B	5 V ± 0.5	
OUT	C	0.5 .... 4.5 V	corresponds to 0 to 2 bar
GROUND	A	0 V	
Measurement			
Pressure (bar/psi)	**Current [in V]**		
2 bar / 29 psi	4.5 V		
0	0V		

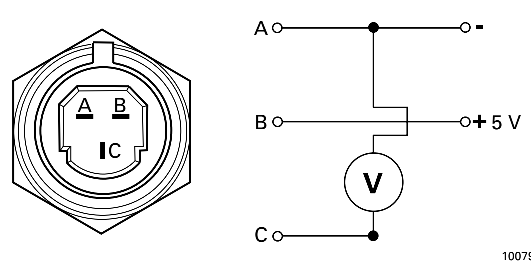


Figure 20.24

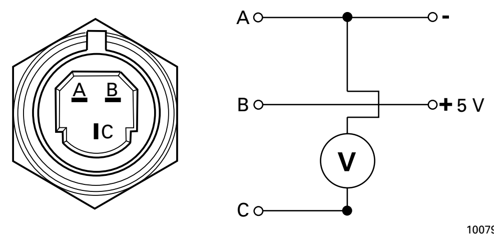
OIL PRESSURE SENSOR (OPS) — INSPECTION

NOTE

The range of the sensor is from 0 to 10 bar (0 to 145 psi). These values are also indicated on the sensor.

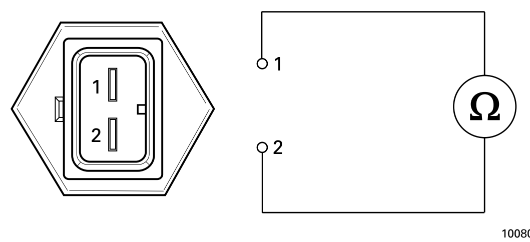
Step	Procedure
1	Inspect for physical damage.
2	Measure the amps between pin B and C.

Oil pressure sensor (OPS)			
Signal	**PIN**	**Voltage [in V]**	**Remarks**
Supply voltage	B	5 V ± 0.5	
OUT	C	0.5 .... 4.5 V	corresponds to 0 to 10 bar
GROUND	A	0 V	

Oil pressure sensor (OPS)			
Signal	**PIN**	**Voltage [in V]**	**Remarks**
Measurement		 Figure 20.25	
Pressure (bar/psi)	**Current [in V]**		
10 bar / 145 psi	4.5 V		
0	0V		

MANIFOLD AIR TEMPERATURE SENSOR (MATS_1/MATS_2) — INSPECTION

Step	Procedure
1	Inspect for physical damage.
2	Measure the resistance between the two pins.

Manifold air temperature sensor (MATS_1, MATS_2)		
Measurement		 Figure 20.26
Temperature [°C/°F]	**Resistance [Ω]**	
- 10 °C / 14 °F	9217 +/- 9 %	
0 °C / 38 °F	5808 +/- 7%	
20 °C / 68 °F	2500 +/- 5 %	
80 °C / 176 °F	331 +/- 10 %	

OIL TEMPERATURE SENSOR (OTS) — INSPECTION

Step	Procedure
1	Inspect for physical damage.
2	Measure the resistance between the two pins. **NOTE** *Grounding connection of the temperature sensor need to be set to measure the resistance correctly. The ground connection of the oil temperature sensor is established directly via the ignition housing.*
3	The max. operating temperatures must not be exceeded. In the event of temperature rise above the limit check the oil system, see current Maintenance Manual Line (MML) for the respective engine type.

Oil temperature sensor (OTS)	
Measurement	
Temperature [°C/°F]	**Resistance [Ω]**
- 10 °C / 14 °F	9395 +/- 7 %
0 °C / 32 °F	5895 +/- 7 %
20 °C / 68 °F	2499 +/-6 %
80 °C / 176 °F	323 +/-3 %
100 °C / 212 °F	187 +/- 2 %

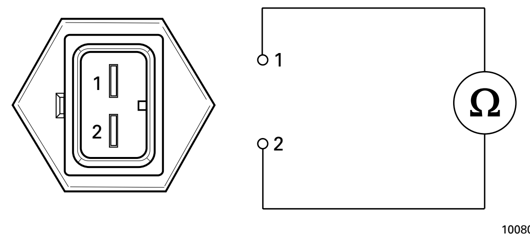


Figure 20.27

COOLANT TEMPERATURE SENSOR (CTS) — INSPECTION

Step	Procedure
1	Inspect for physical damage.
2	Measure the resistance between the two pins.

Coolant temperature sensor (CTS)	
Measurement	
Temperature [°C/°F]	**Resistance [Ω]**
- 10 °C / 14 °F	9395 +/- 7 %
0 °C / 32 °F	5895 +/- 7 %
20 °C / 68 °F	2499 +/-6 %
80 °C / 176 °F	323 +/-3 %
100 °C / 212 °F	187 +/- 2 %

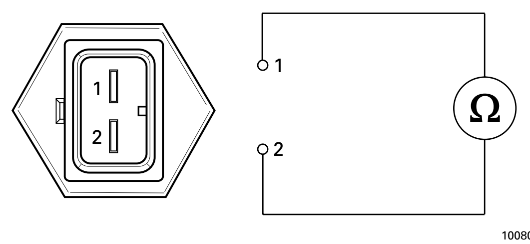
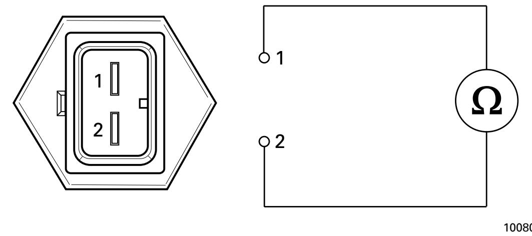


Figure 20.28

EXHAUST GAS TEMPERATURE SENSOR (EGT 1, EGT 2, EGT 3, EGT 4) - INSPECTION

Step	Procedure
1	Inspect for physical damage.
2	Measure the resistance between the two pins.

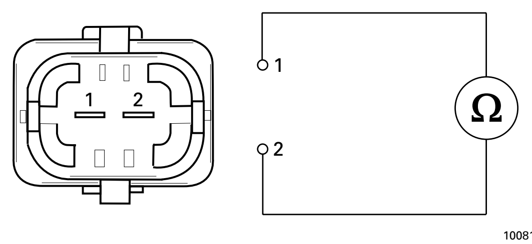
Exhaust gas temperature sensor (EGT 1, EGT 2, EGT 3, EGT 4)		
Measurement		 Figure 20.29
Temperature [°C/°F]	Resistance [Ω]	
-40 °C/-40 °F	169.7	
0/32 °F	200.5	
50 °C/122 °F	238.5	
100 °C/212 °F	275.9	
200 °C/392 °F	349	
300 °C/572 °F	419.7	
500 °C/932 °F	534.1	

KNOCK SENSOR (KNOCK) — INSPECTION

NOTE

Only necessary with old wiring harness.

Step	Procedure
1	Inspect for physical damage.
2	Measure the resistance between the two pins.

Knock sensor		
Measurement		 Figure 20.30
Measuring points	Resistance [Ω]	
Between PIN 1 and PIN 2	4 to 10 MΩ	
Between PIN and housing	≥ 1 MΩ	

NOTE

If a new wiring harness (without knock connector) is installed, the knock sensor is not required! If a knock sensor is installed, it must be removed, see Knock sensor - removal

CRANKSHAFT POSITION SENSOR (CPS_1/CPS_2) — INSPECTION

General visual inspection

- Check that the sensors are fitted securely
- Corrosion or damage to the wiring, connector contacts or connections

- Check the O-ring on the crankshaft position sensor
- Check the thread
- Check the crankshaft position sensor surface
- Check the crankshaft position sensor bore

NOTE

CPS sensors cannot be tested for voltage and/or resistance. If the function is not given and/or an error occurs, please renew the sensor.

THROTTLE POSITION SENSOR (TPS) — INSPECTION

General visual inspection

- Check the setting of the throttle valve actuation and travel (are both stops reached yes/ no)
- Corrosion or damage to the connector and contacts
- Check that the sensor shaft moves freely
- Check that the sensors are fitted securely
- Check the parameters of the throttle valve setting with B.U.D.S.

Step	Procedure
1	Measure the voltage between pin 2 and 3.

Throttle position sensor (TPS)			
Signal	**PIN**	**Voltage [in V]**	**Remarks**
Supply voltage	1	+ 5 V	
Earth offset	2	0 V	
Signal	3	0.25 to 4.7 V	

Measurement	
Position	**Voltage [in V]**
Closed	0.25 V
Max. opened	4.7 V

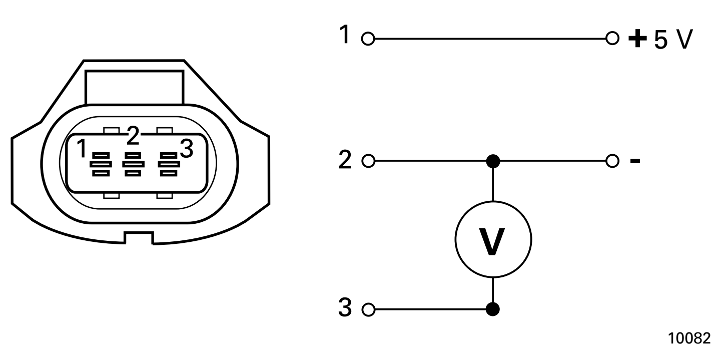


Figure 20.31

AMBIENT AIR PRESSURE AND TEMPERATURE SENSOR (AAPTS) — INSPECTION

Step	Procedure
1	Inspect for physical damage.
2	Measure the resistance for the temperature reading between pin 1 and 2.
3	Measure the voltage for the pressure reading between pin 1 and 4.

Ambient air pressure and temperature sensor (AAPTS)			
Signal	**PIN**	**Voltage [in V]**	**Remarks**
Supply voltage	3	5 V +/- 0.25 V	
Earth offset	1	0 V	
Signal temperature	2	45 kΩ - 89 Ω	
Pressure	4	0.25 V - 4.75 V	

Measurement	
Pressure (bar/psi)	**Voltage [in V]**
0.35 bar / 5.08 psi	1.41 V +/- 0.065 V
0.95 bar / 13.78 psi	3.84 V +/- 0.065 V
Temperature (°C / °F)	**Resistance [Ω]**
- 10 °C / 14 °F	9395 Ω +/- 4 %
0 °C / 32 °F	5895 Ω +/- 3.8 %
20 °C / 68 °F	2499 Ω +/- 3.4 %
30 °C / 86 °F	1706 Ω +/- 3.1 %
50 °C / 122 °F	833.8 Ω +/- 2.8 %
80 °C / 176 °F	322.5 Ω +/- 2.3 %
100 °C / 212 °F	186.6 Ω +/- 2.0 %

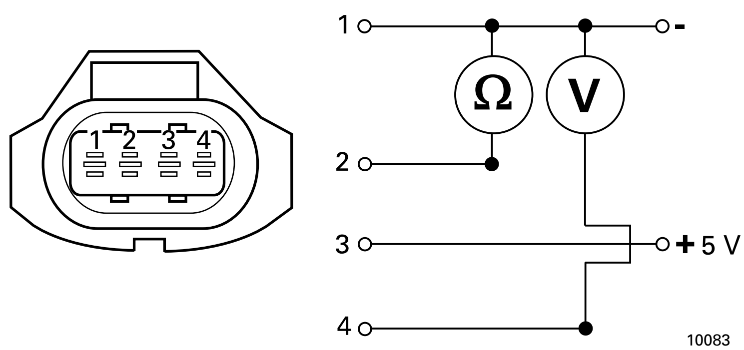


Figure 20.32

FUEL INJECTORS — INSPECTION

General visual inspection

- Corrosion or damage to the wiring, connector contacts or connections
- Check the labeling of the injection valves

Functional test

- Check flow rate
- Conduct leakage check

- Check the "spray pattern" using the map

NOTICE
Risk of damage to engine management system components! There is a risk of a permanent bypass (fuel pressure surge).

Voltage and resistance test

The internal resistance between pin 1 and 2 is about 12 Ω

DOUBLE IGNITION COIL — INSPECTION

General visual inspection:

- Corrosion or damage to the wiring, connector contacts or connections
- Check the labelling of the connector

Double ignition coil	
Measurement	
Measuring points	**Resistance**
Primary side	0.5 Ω +/- 0.5 Ω
Secondary side	9 kΩ +/- 0.9 kΩ
Between Primary side and Secondary side	Infinite

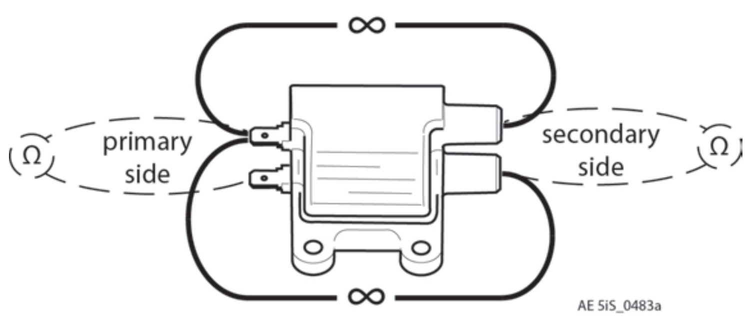


Figure 20.33

Double ignition coil	
Measurement	
Measuring points	**Resistance**
Primary side	0.6 Ω +/- 0.6 Ω
Secondary side	8.2 kΩ +/- 0.82 kΩ
Between Primary side and Secondary side	Infinite

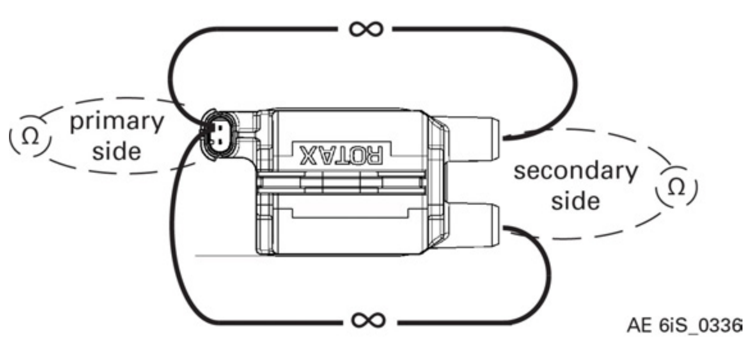


Figure 20.34

IGNITION CABLES — INSPECTION

NOTICE
Cracking and other obvious damage to the ignition cables are not permitted! If in doubt, always replace the cables and connectors.

General visual inspection

- Check for corrosion or damage to the ignition cables

Continuity check

- Use a multimeter with continuity check function and test the ignition cables to ensure there is continuity.

INSTALLATION

Preparation

- Clean all parts carefully
- Remove protective coverings

OIL PRESSURE SENSOR (OPS) — INSTALLATION

Step	Procedure
1	Clean the thread of the oil pressure sensor.
2	Apply LOCTITE 243 to the thread of the pressure sensor and use an 21 mm socket wrench part no. 876075 to tighten it. Tightening torque 15 Nm (133 in. lb.).

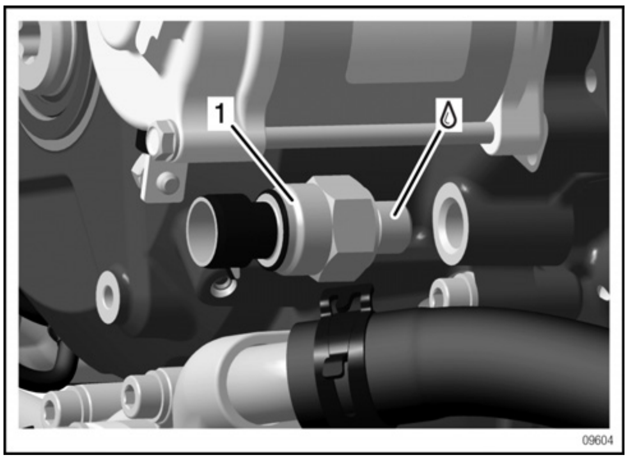


Figure 20.35

1 *Oil pressure sensor (OPS)*

Step	Procedure
3	The sensor is connected and disconnected in the same way. See Chapter 76-50-00 section Wiring harness – removal.
4	Attach cable ties (strain relief).

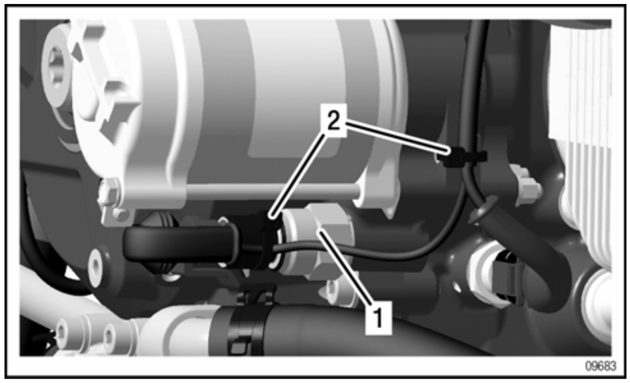


Figure 20.36

1 *Oil pressure sensor (OPS)* 2 *Cable ties*

MANIFOLD AIR PRESSURE SENSOR (MAPS_1/MAPS_2) — INSTALLATION

Step	Procedure
1	Clean the thread of the manifold air pressure sensor.
2	Tighten the manifold air pressure sensor with a 21 mm socket (part no. 876075). Tightening torque 15 Nm (133 in. lb.).
3	The sensors are connected and disconnected in the same way. See Chapter 76-50-00 section Wiring harness – removal.
4	Install the clip. Check for tight fit and correct position of the clip on sensor and connector.
5	Attach cable ties (strain relief).

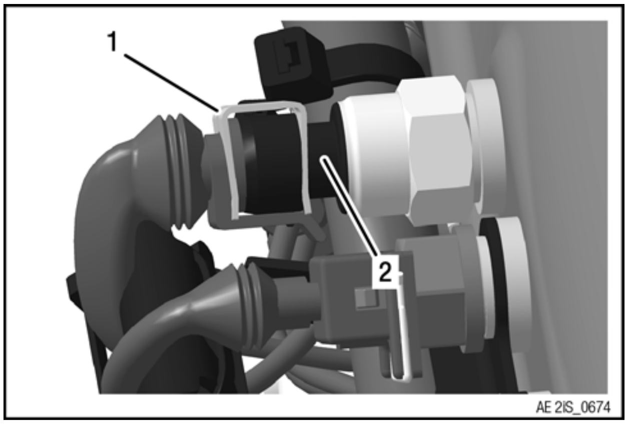


Figure 20.37

1	*Clip*	2	*Manifold air pressure sensor (MAPS_1/ MAPS_2)*

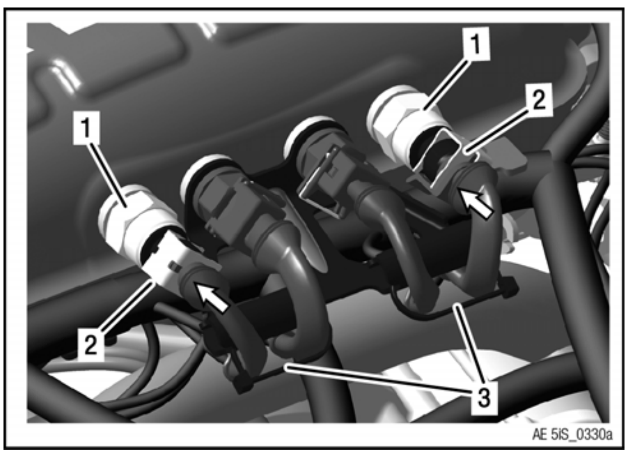


Figure 20.38

1	*Manifold air pressure sensors (MAPS_1/ MAPS_2)*	2	*Clip*
3	*Cable ties*		

AMBIENT AIR PRESSURE AND TEMPERATURE SENSOR (AAPTS) — INSTALLATION

For installation of the ambient air pressure and temperature sensor (AAPTS) follow the instructions of the aircraft manufacturer.

Step	Procedure
1	The sensor is connected and disconnected in the same way. See .

COOLANT TEMPERATURE SENSOR (CTS) — INSTALLATION

Step	Procedure
1	Clean the thread of the coolant temperature sensor.
2	Apply LOCTITE 243 to the thread of the coolant temperature sensor and use a 19 mm socket (part no. 876130) to tighten it. Tightening torque 15 Nm (133 in. lb.).
3	The sensor is connected and disconnected in the same way. See Chapter 76-50-00 section Wiring harness – removal.

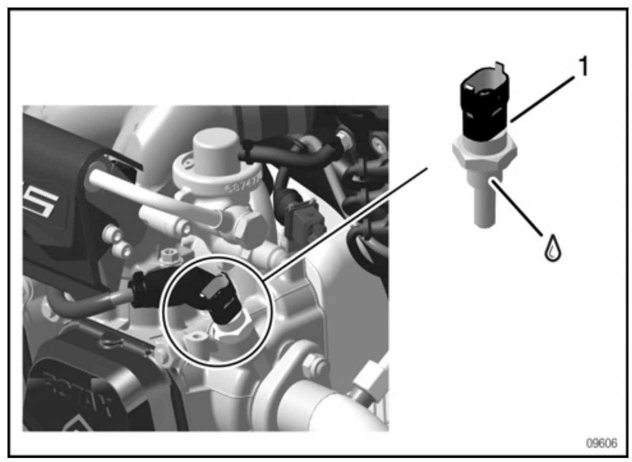


Figure 20.39

1	*Coolant temperature sensor (CTS)*

MANIFOLD AIR TEMPERATURE SENSOR (MATS_1/MATS_2) — INSTALLATION

Step	Procedure
1	Clean the thread of the manifold air temperature sensor.
2	Install manifold air temperature sensor with the connector bracket and new sealing ring A12x18 using a 19 mm socket (part no. 876130). Tightening torque 10 Nm (89 in. lb.).

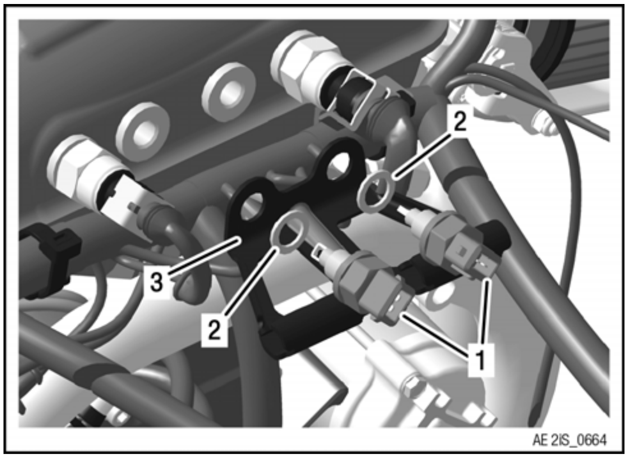


Figure 20.40

1	*Manifold air temperature sensor (MATS)*	2	*Sealing ring A12x18*
3	*Connector bracket*		

Step	Procedure
3	The sensors are connected and disconnected in the same way. See Chapter 76-50-00 section Wiring harness – removal
4	Attach cable ties (strain relief).

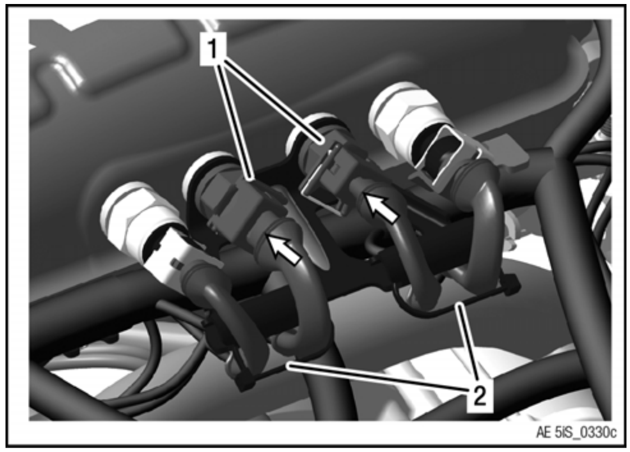


Figure 20.41

1	*Manifold air temperature sensor (MATS)*	2	*Cable ties*

OIL TEMPERATURE SENSOR (OTS) — INSTALLATION

Step	Procedure
1	Clean the thread of the oil temperature sensor.
2	Apply LOCTITE 243 to the thread of the oil temperature sensor and use a 19 mm socket (part no. 876130) to tighten it. Tightening torque 15 Nm (133 in. lb.).
3	The sensor is connected and disconnected in the same way. See Chapter 76-50-00 section Wiring harness – removal.

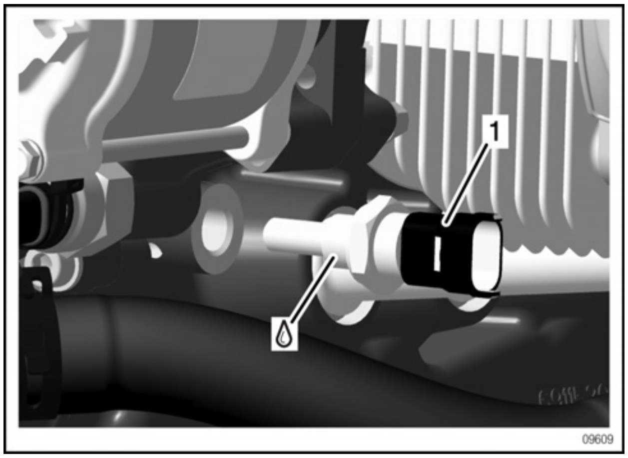


Figure 20.42

1	*Oil temperature sensor (OTS)*

Step	Procedure
4	Attach cable ties.

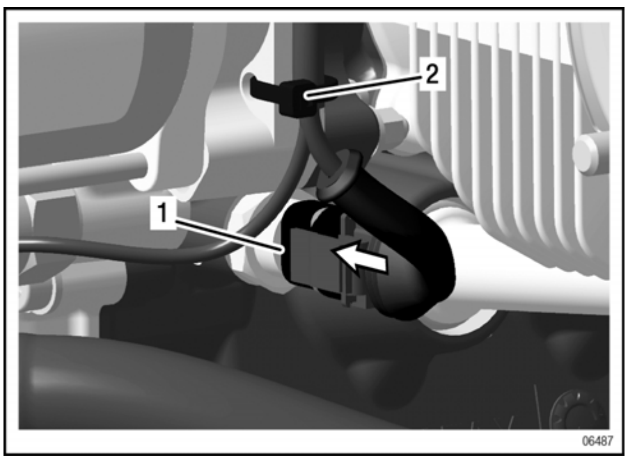


Figure 20.43

1	*Oil temperature sensor (OTS)*	2	*Cable ties*

EXHAUST GAS TEMPERATURE SENSOR — INSTALLATION

Step	Procedure
1	Clean the thread of the temperature sensor.
2	Apply LOCTITE ANTI SEIZE to the thread of the exhaust gas temperature sensor.
3	Tighten the exhaust gas temperature sensors on the exhaust pipes. Tightening torque 25 Nm (18 ft.lb.).

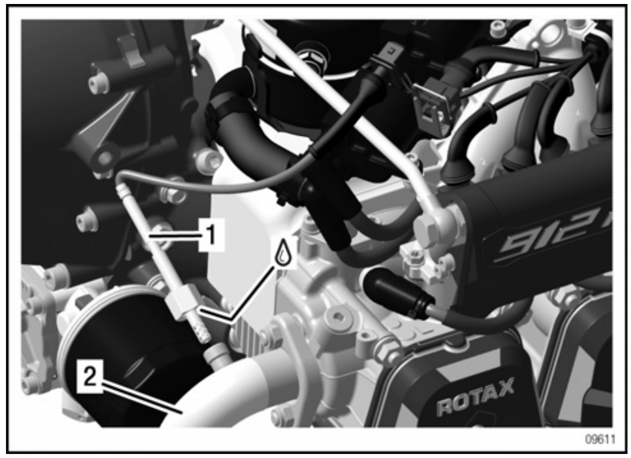


Figure 20.44

1	*Exhaust gas temperature sensor (EGT)*	2	*Exhaust pipe*

Step	Procedure
4	The sensors are connected and disconnected in the same way. See Chapter 76-50-00 section Removal
5	Carefully push the connector (EGT) in to the connector bracket.

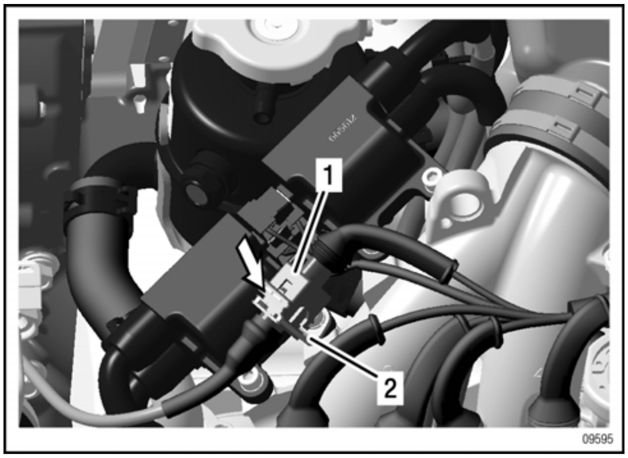


Figure 20.45

1 Connector (EGT) *2 Connector bracket*

KNOCK SENSOR (KNOCK) — INSTALLATION

NOTE

Only necessary with old wiring harness.
If a new wiring harness (without knock connector) is installed, the knock sensor is not required.
If a knock sensor is installed, it must be removed, see knock sensor – removal.

Step	Procedure
1	Clean the end face of the knock sensor.
2	Hand-tighten the knock sensor with hex. screw M8x30 on the cylinder head 3.
3	Adjust the knock sensor, do not let it come into contact with the intake manifold.
4	Tighten the knock sensor. Tightening torque 20 Nm (15 ft .lb.).

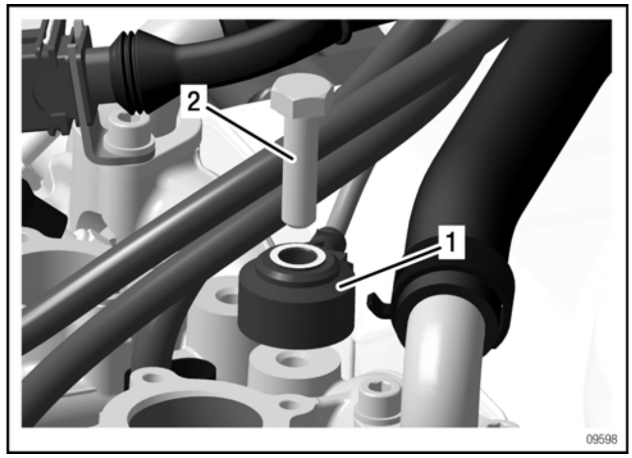


Figure 20.46

1 Knock sensor (KNOCK) *2 Hex. screw M8x30*

Step	Procedure
5	Connect the respective wiring harness connector (KNOCK) to the knock sensor.
6	Carefully push the connector in the upper position of the connector bracket and attach with cable tie.

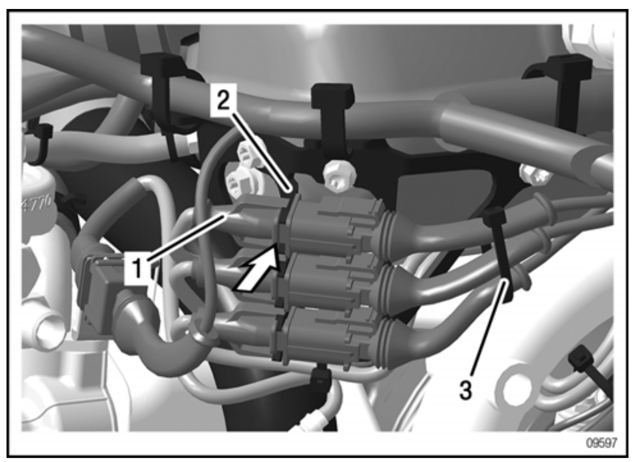


Figure 20.47

1 Connector (KNOCK) *2 Connector bracket*
3 Cable tie

Step	Procedure
7	Attach the cables of the knock sensor with 2 cable ties.

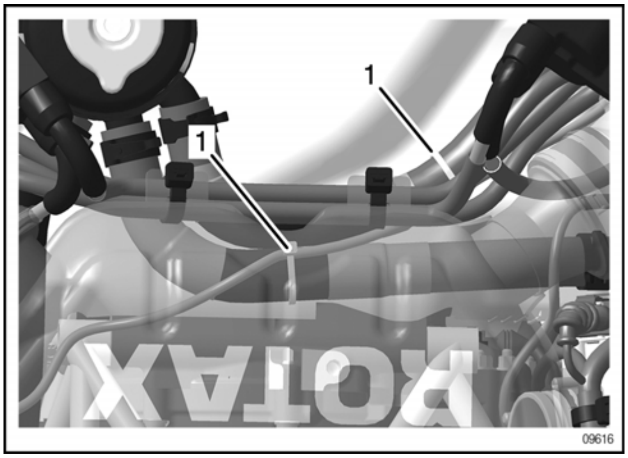


Figure 20.48

1 *Cable ties*

Finishing work:

Install the cooling air baffle, see Chapter 75-00-00, section Cooling air baffle – installation

CRANKSHAFT POSITION SENSOR (CPS_1/CPS_2) — INSTALLATION

NOTE

Check O-ring for damage, before installation.

NOTE

Avoid cross-threading screws into ignition housing! Align the sensor body with the screw hole and hand tighten the screws before torquing.

NOTE

Lubricate O-rings with LITHIUM BASE GREASE.

Step	Procedure
1	Place CPS_1 into the upper sensor position and CPS_2 into lower position. Tighten crankshaft position sensors using Allen screws M6x20 with lock washers A6 and secure with LOCTITE 243. Tightening torque 10 Nm (89 in. lb.)

NOTICE

Arrange the cable so that it does not rest against the engine suspension frame or other components.

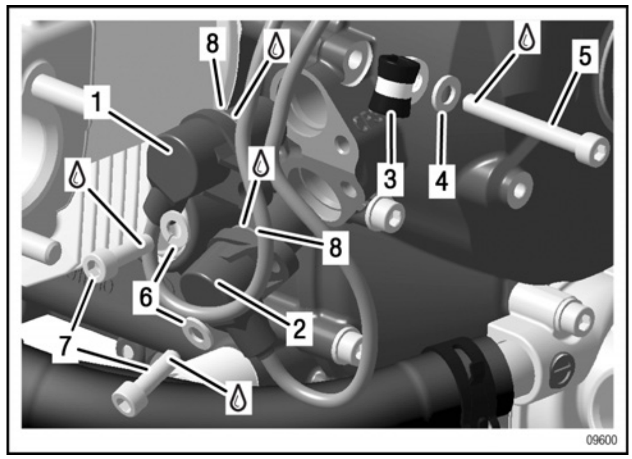


Figure 20.49

1 *Crankshaft position sensor CPS_1*
2 *Crankshaft position sensor CPS_2*
3 *Cable clamp*
4 *Washer 6.4*
5 *Allen screw M6x50*
6 *Lock washer A6*
7 *Allen screw M6x20*
8 *O-ring*

NOTICE

The thread of the Allen screw M6x50 reaches into the crankcase and is therefore glued in with LOCTITE 243. Improper installation can cause an oil leakage!

Step	Procedure
2	Push the cable clamp over both cables and tighten with Allen screw M6x50 and washer 6.4 with LOCTITE 243 to the ignition housing. Tightening torque 10 Nm (89 in. lb.)
3	Plug the respective wiring harness connector into the corresponding crankshaft position sensor CPS_1 / CPS_2. **NOTE** *The connectors of the sensors are marked with dots: CPS_1 (marked with 1 dot) and CPS_2 (marked with 2 dots)*
4	Carefully push each connector (CPS_1/ CPS_2) into the connector bracket. Secure the connectors with 2 cable ties.

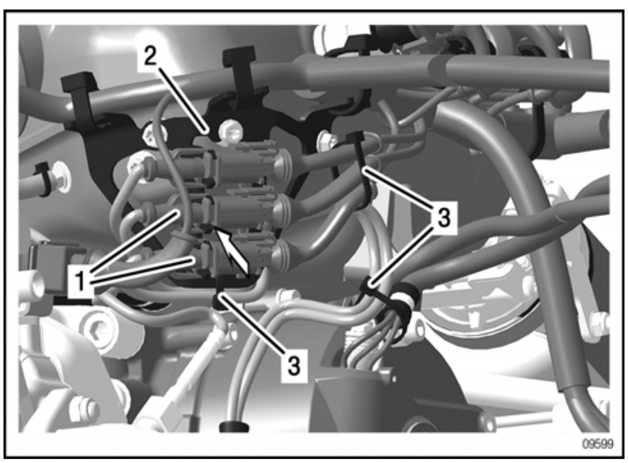


Figure 20.50: TYPICAL

1	*Connector (CPS_1/ CPS_2)*	2	*Connector bracket*
3	*Cable ties*		

THROTTLE POTENTIOMETER (TPS) — INSTALLATION

NOTE

The throttle position is not available as a spare part.

Step	Procedure
1	Install the throttle body assy. To do this, see Chapter 73-10-00, section Throttle body assy. — installation.
2	The sensors are connected and disconnected in the same way. See Chapter 76-50-00 section Wiring harness – removal.

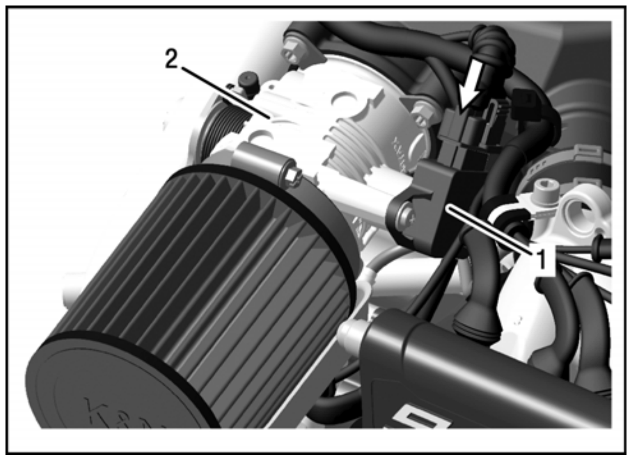


Figure 20.51

1	*Throttle position sensor (TPS)*	2	*Throttle body assy.*

FUEL INJECTOR (INJ) — INSTALLATION

For installation of the fuel injection, see Chapter 73-10-00, section Fuel rail – installation.

DOUBLE IGNITION COIL — INSTALLATION

For installation of the double ignition coils, see Chapter 74-20-00, section Double ignition coil (screwed connection) — installation or Double ignition coil (plugged connection) — installation.

FINISHING WORK

- Complete the engine

Fill with operating fluids (coolant, oil or fuel). See current Maintenance Manual Line (MML) for the respective engine type.

Flush the engine cooling system.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Flushing the engine cooling system.

Purge the oil system. See current Installation Manual (IM) for the respective engine type, Chapter 79-00-00, section "Purging the lubrication system".

Carry out an engine test run. See current Maintenance Manual Line (MML) for the respective engine type.

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Chapter: 78–00–00
EXHAUST SYSTEM

TOPICS IN THIS CHAPTER

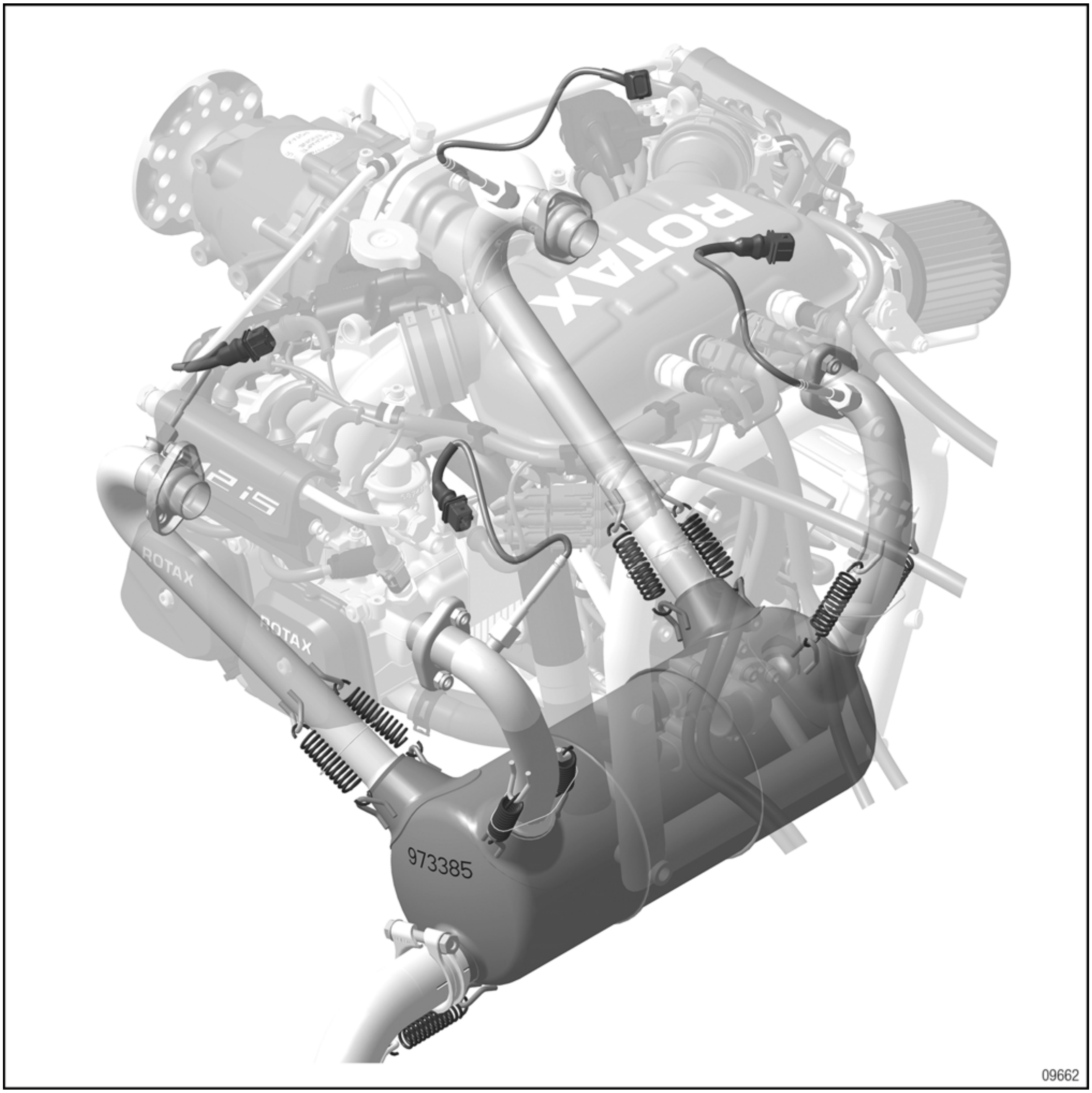

Figure 21.1: Location on the engine

SYSTEM DESCRIPTION

The exhaust system of the ROTAX® 912 i Series engine is optional. If it was not ordered when the engine was purchased, only the 4 exhaust sockets on the cylinder head are supplied.
The exhaust system must be designed and manufactured by the aircraft or aircraft frame manufacturer.

EXHAUST FLOW

The Exhaust gases are pushed out of the cylinders through the exhaust pipes and are brought together in the muffler assy.. From there the exhaust gases leave the engine through the exhaust elbow.

NOTICE

The muffler assy. with part no. 973385 is also used in series 912 S/ULS engines and can optionally be used in series 912 UL/F/A engines.

EXHAUST GAS TEMPERATURE SENSORS (EGT)

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

SAFETY INSTRUCTION

⚠ WARNING

Danger of severe burns and scalds! Allow the engine and exhaust system to cool to ambient temperature before starting work.

CONNECTIONS FOR DISPLAY SYSTEMS

NOTICE

Follow the instructions in the Installation Manual (IM) regarding connections for instrumentation.

EXHAUST GAS TEMPERATURE DISPLAY

The engine is equipped with 4 EGT temperature sensors for regulating the optimal fuel/air mixture. These can be installed in various ways depending on the exhaust system.

NOTICE

Corrosion damage on sensors! The sensors must be installed vertically from the pipe.

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Chapter: 78–10–00
EXHAUST

TOPICS IN THIS CHAPTER

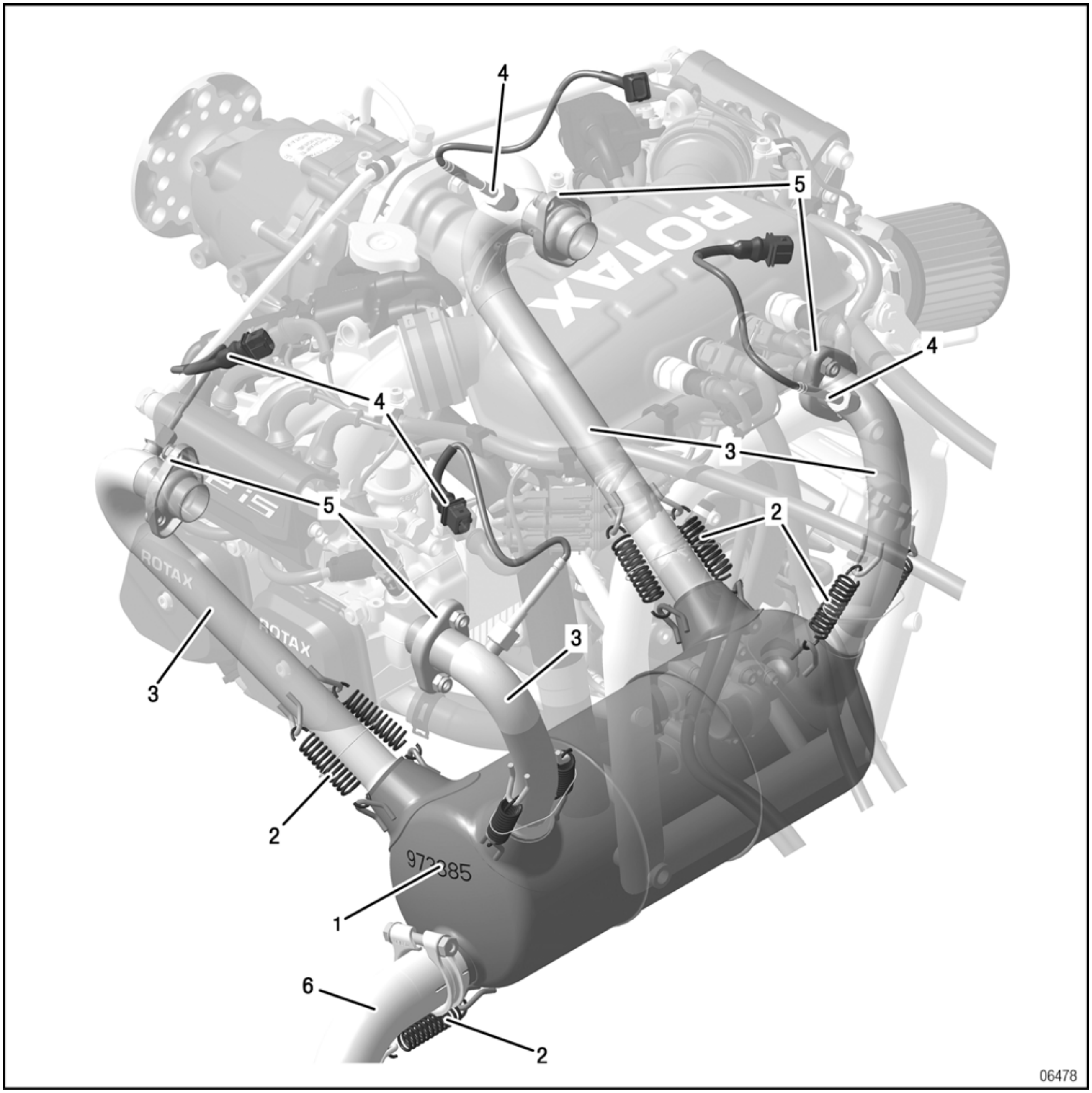

Figure 22.1: Exhaust system

1	*Muffler assy.*	2	*Tension spring*
3	*Exhaust pipe*	4	*Exhaust Gas Temperature Sensors (EGT)*
5	*Exhaust flange*	6	*Outflow pipe / exhaust elbow / tailpipe*

SERVICE PRODUCTS

Description	Part number
LOCTITE 648	899788
LOCTITE ANTI SEIZE	297434

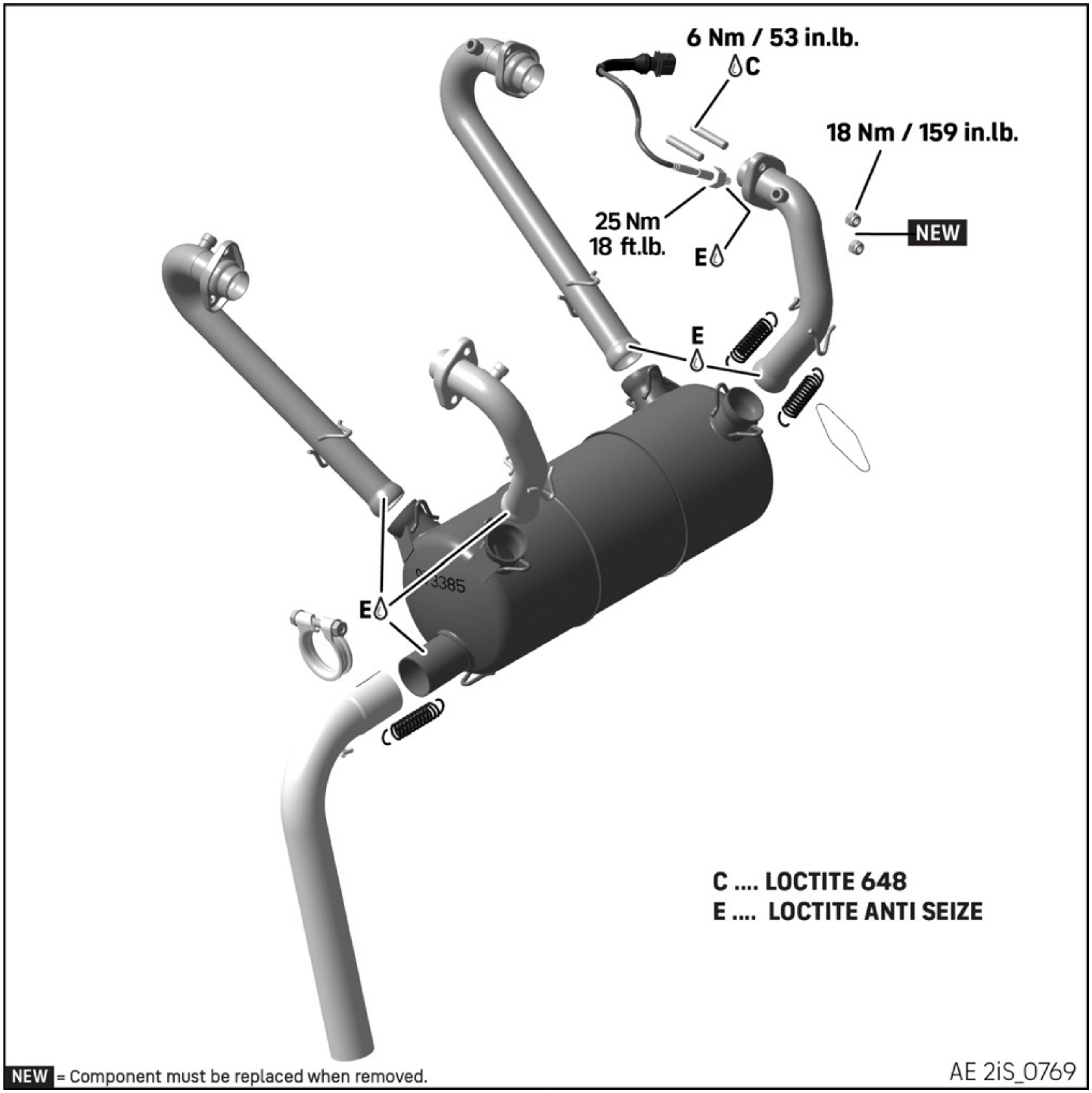

Figure 22.2: Exhaust system

SYSTEM DESCRIPTION

The exhaust gases are pushed out of the cylinders through the exhaust pipes and are brought together in the muffler assy.. From there the exhaust gases leave the engine through the exhaust elbow.

MAINTENANCE

As well as the maintenance and special checks, see current Maintenance Manual Line (MML) for the respective engine type.

REMOVAL

⚠ WARNING
Danger of severe burns and scalds! Allow the engine and exhaust system to cool to ambient temperature before starting work.

Follow the aircraft manufacturer's instructions for removal.

EXHAUST ASSY. — REMOVAL

Preparation

- Remove the Exhaust Gas Temperature Sensor (EGT).

See Chapter 76-70-00 section Exhaust Gas Temperature Sensor (EGT1/EGT2/EGT3/EGT4 – removal

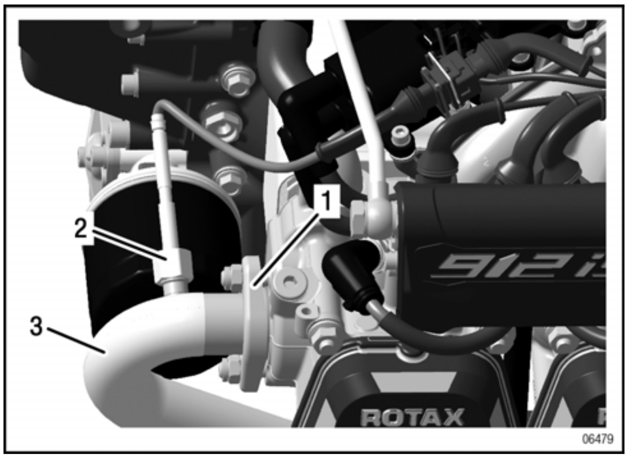

Figure 22.3

1	*Exhaust flange*	2	*Exhaust Gas Temperature Sensor (EGT)*
3	*Exhaust pipe*		

EXHAUST PIPE — REMOVAL

Step	Procedure
1	Remove 2 lock nuts.

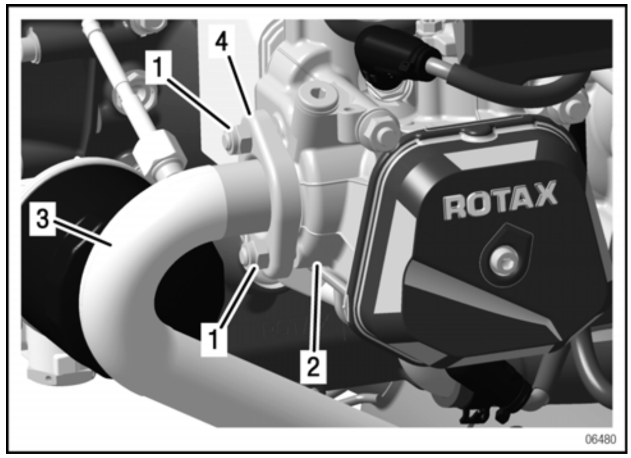

Figure 22.4: Typical

1	*Lock nut*	2	*Cylinder head*
3	*Exhaust pipe*	4	*Exhaust flange*

Step	Procedure
2	Remove exhaust pipes with muffler assy. and exhaust elbow.

INSPECTION

Preparation

Clean all parts carefully.
See current Maintenance Manual Line (MML) of the respective engine type, Chapter 05-00-00 section Procedure.

EXHAUST ASSY. — INSPECTION

Follow the aircraft manufacturer's instructions for inspection.

Step	Procedure
1	Check the exhaust for cracks, dents and leaks.
2	Check all welds for cracks and contamination.

EXHAUST PIPE AND CYLINDER HEAD — INSPECTION

NOTICE

A deformed exhaust flange must be replaced!

Step	Procedure
1	Check the conical sealing surfaces in the cylinder head and on the exhaust pipe for deformation.

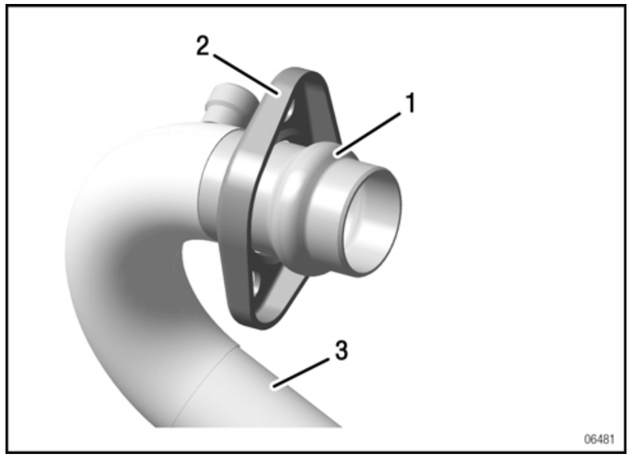

Figure 22.5: Typical

1 Conical seal *2 Exhaust flange*
3 Exhaust pipe

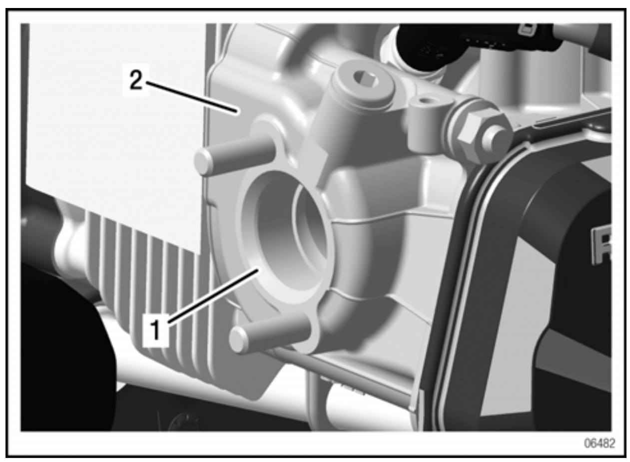

Figure 22.6

1 Conical seal *2 Cylinder head*

INSTALLATION

Follow the aircraft manufacturer's instructions for installation.

EXHAUST ASSY. — INSTALLATION

Step	Procedure
1	Check that the studs are firmly in place. Secure them with LOCTITE 648 if necessary and tighten them. Tightening torque 6 Nm (53 in. lb.)
2	Mount exhaust pipes 3 and 4 into the muffler assy. and fix them with 4 springs 66 mm (Stainless). **NOTE** *The open side of the spring must be on the inside of the muffler assy.*
3	Install the preassemble muffler with the exhaust pipes to the stud of the cylinder heads 3 and 4 with new lock nuts M8 (Hand-tighten). **NOTE** *The exhaust elbow of the muffler should be on the right, seen from the magneto side.*
4	Install the exhaust pipes 1 and 2 on the cylinder heads 1 and 2 with new lock nuts M8 (Hand-tighten).
5	Mount exhaust pipe 1 and 2 into the muffler assy. and fix them with 4 springs 66 mm (Stainless). **NOTE** *The open side of the spring must be on the inside of the muffler assy.*

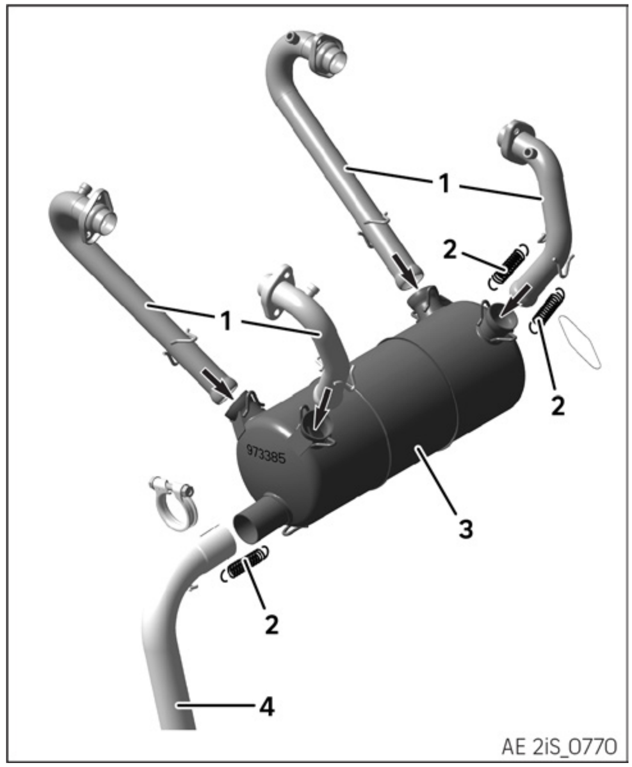

Figure 22.7

1	*Exhaust pipe*	2	*Spring 66 mm (Stainless)*
3	*Muffler assy.*	4	*Exhaust elbow*

Step	Procedure
6	Fasten the exhaust flange to the cylinder head. Tightening torque 18 Nm (159 in. lb.). **NOTE** *The exhaust flange must be parallel to the screw face on the cylinder head but must not rest against it.*

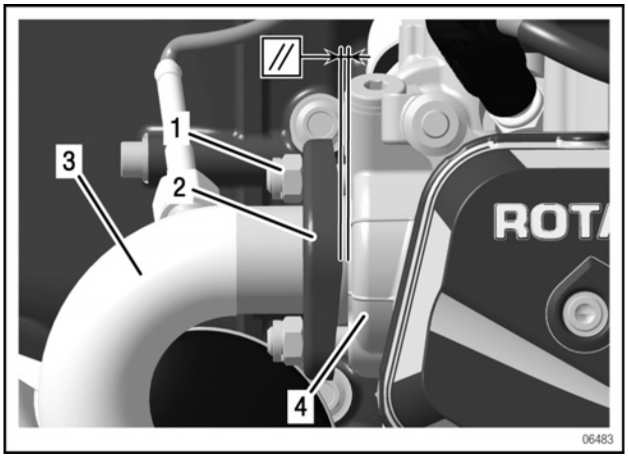

Figure 22.8

1 *Lock nut M8*	2 *Exhaust flange*
3 *Exhaust pipe*	4 *Cylinder head*

Step	Procedure
7	Attach the safety wire of the springs.
8	Install exhaust elbow, follow the aircraft manufacturer's instructions for installation.

FINISHING WORK

Install the Exhaust Gas Temperature Sensor (EGT).
See Chapter 76-70–00 section Exhaust Gas Temperature Sensor (EGT1/EGT2/EGT3/EGT4 – installation).

Carry out an engine test run.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Planned maintenance

Chapter: 79–00–00
LUBRICATION SYSTEM

TOPICS IN THIS CHAPTER

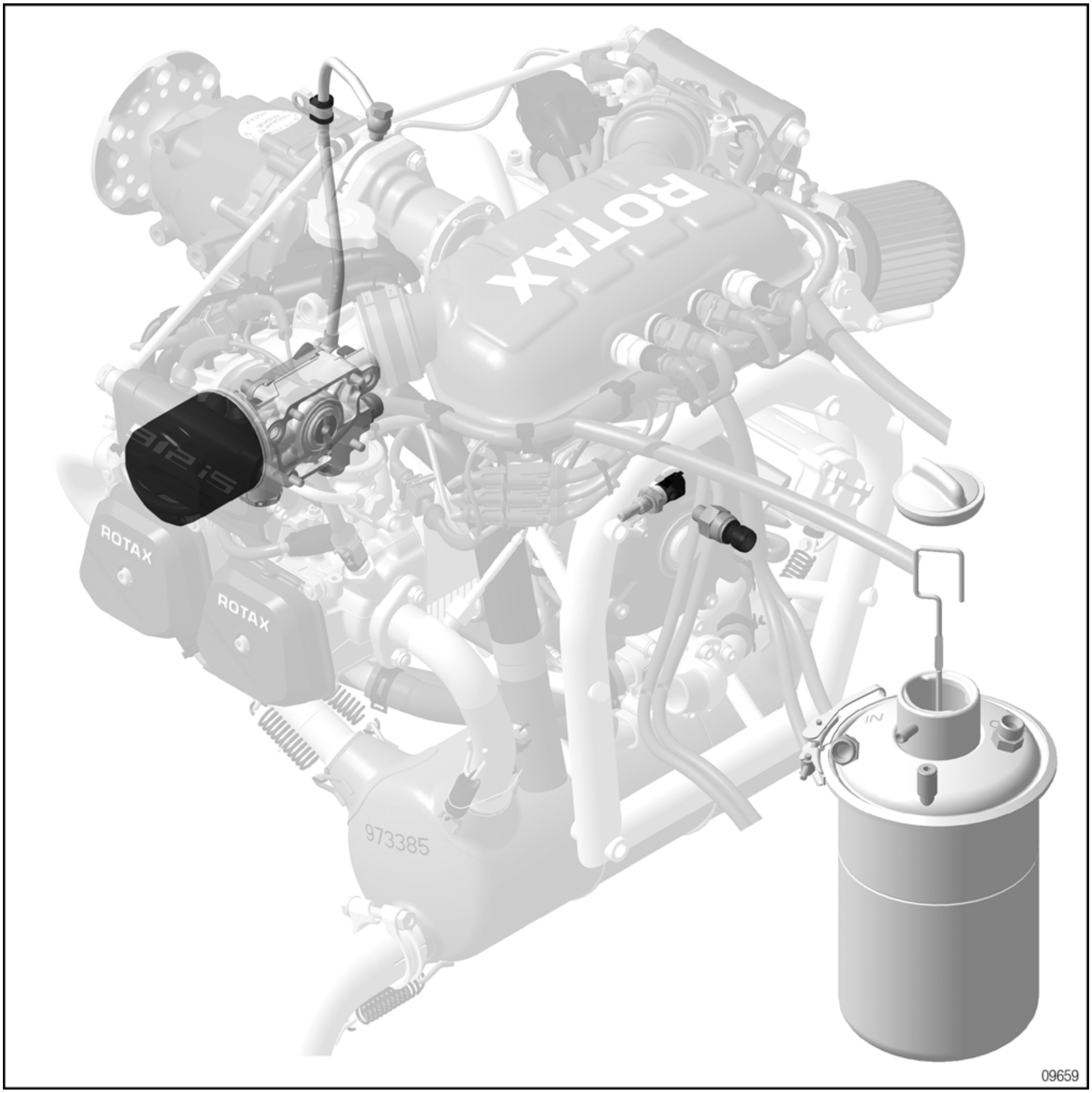

Figure 23.1: Location on the engine

SPECIAL TOOLS

Description	Part number
Oil filter wrench	877620
Socket wrench	876075
Socket wrench	876130

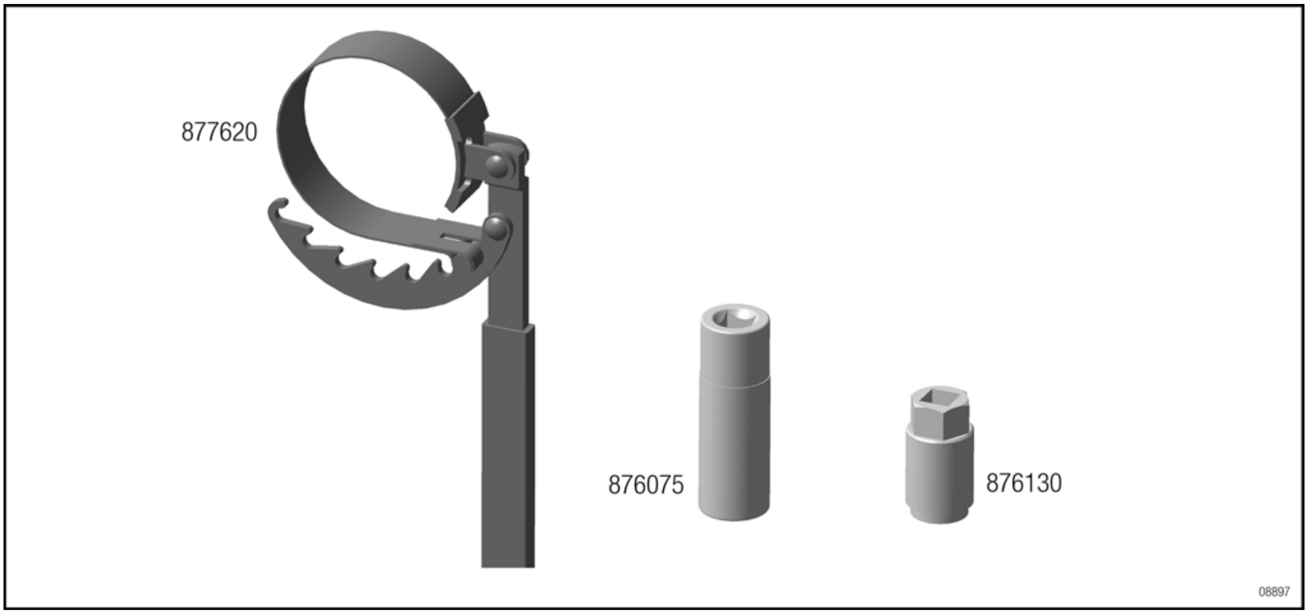

Figure 23.2: Special tools

SERVICE PRODUCTS

Description	Part number
LOCTITE ANTI SEIZE	898351
LOCTITE 5910	899791
LOCTITE 243	897651
LOCTITE 648	899788
Engine oil	n.a.
Insulating tape	n.a.
LOCKING PAINT	898570

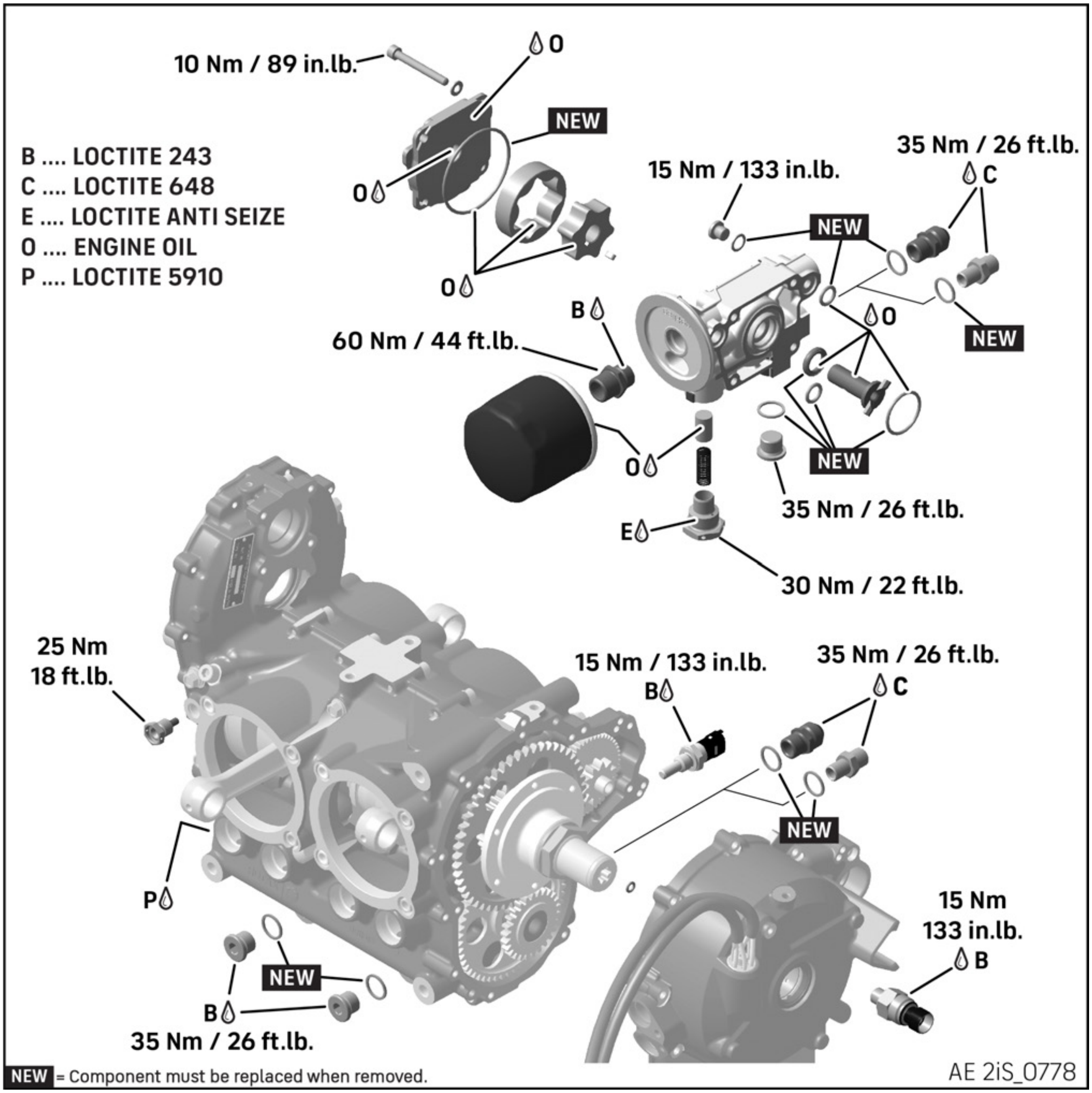

Figure 23.3: Lubrication system

SYSTEM DESCRIPTION

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

OIL FLOW

The oil pump (driven by the camshaft) sucks the motor oil from the oil tank through the oil cooler and forces it through the oil filter to the points of lubrication in the engine. 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 fitting on the oil tank.

CRANKCASE

The engine oil emerging from the lubrication points accumulates on the bottom of crankcase and is forced back to the oil tank by the constant pressure in the crankcase (blow-by gases).

OIL PUMP

The oil pump is driven by the camshaft.

SAFETY INSTRUCTION

⚠ WARNING

Danger of severe burns and scalds! Always allow the engine to cool down to ambient temperature before starting any work.

⚠ WARNING

Danger of serious injury! During work on the lubrication system there is a risk of injury due to pressure!

- Ensure that the engine is in the horizontal position!
- Ensure that the lubrication system is no longer pressurized!

ENVIRONMENTAL NOTE

Please observe the disposal regulations applicable in your area.

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.

CONNECTIONS FOR DISPLAY SYSTEMS

Follow the instructions in the Installation Manual (IM) for respective engine type regarding connections for instrumentation.

OIL TEMPERATURE SENSOR (OTS)

The oil temperature sensor (OTS) is situated on the crankcase and measures the oil inlet temperature.
For removal, inspection and installation see Chapter 76-70-00 Sensors and actuators.

OIL PRESSURE SENSOR (OPS)

The oil pressure sensor (OPS) is situated on the ignition housing and measures the oil pressure.
For removal, inspection and installation see Chapter 76-70-00 Sensors and actuators.

MAINTENANCE

As well as the maintenance and special checks, see current Maintenance Manual Line (MML) for the respective engine type.

NOTE

Whenever the lubrication system is removed or disassembled, O-rings and other sealing elements must be replaced with new parts.

OIL PUMP

OIL PUMP ASSY. REMOVAL

⚠ WARNING

Danger of severe burns and scalds! Always allow the engine to cool down to ambient temperature before starting any work.

ENVIRONMENTAL NOTE

Dispose of used oil according to local environmental regulations.

ENVIRONMENTAL NOTE

Ensure that no oil gets into the waste water system or the ground – risk of contaminating drinking water!

NOTICE

Prevent the ingress of debris particles into all disconnected lines and connections.
Use appropriate protective coverings.

Preparation

- Switch the ignition key "OFF"!

Drain the oil, see current Maintenance Manual Line (MML) for the respective engine type.

Remove the oil hoses, clamps and surrounding assemblies. Follow the instructions in the aircraft manufacturer's manual.

NOTE

The assemblies and lines are only to be removed if necessary and only as far as is necessary!

NOTICE

All gaskets, O-rings and oil seals must be replaced!

Step	Procedure
1	Disconnect the pressure oil lines. Remove banjo bolt and take off sealing rings. See Chapter 61–20–00 Governor.
2	Remove the safety wire of the plug screw (oil pressure regulator).
3	Loosen the plug screw (oil pressure regulator), otherwise it is very difficult to unscrew when the oil pump is removed.

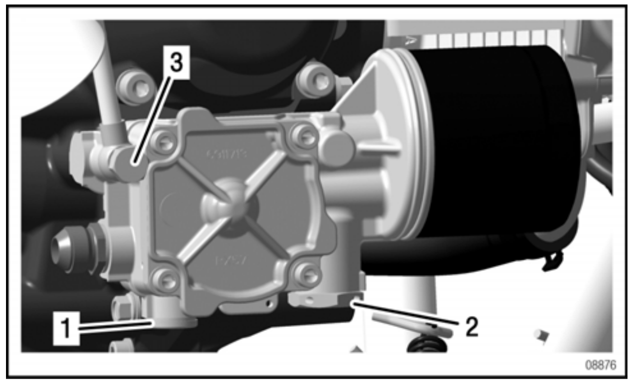

Figure 23.4

1 *Plug screw*	2 *Plug screw (oil pressure regulator)*
3 *Pressure oil line (Governor)*	

Step	Procedure
4	Unscrew the oil filter with oil filter wrench part no. 877620.

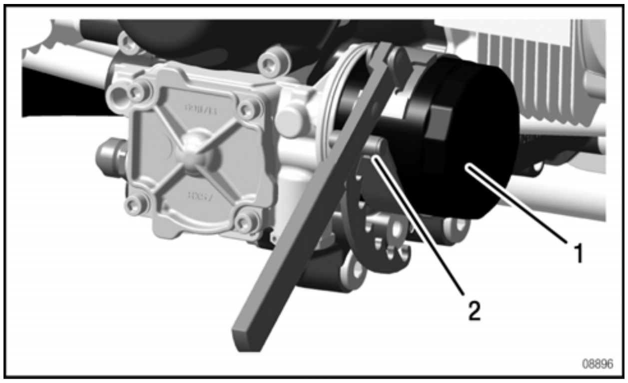

Figure 23.5

1 Oil filter	*2 Filter wrench part no. 877620*

Step	Procedure
5	Loosen 4 Allen screws with washers.
6	Remove the whole oil pump unit and O-rings.

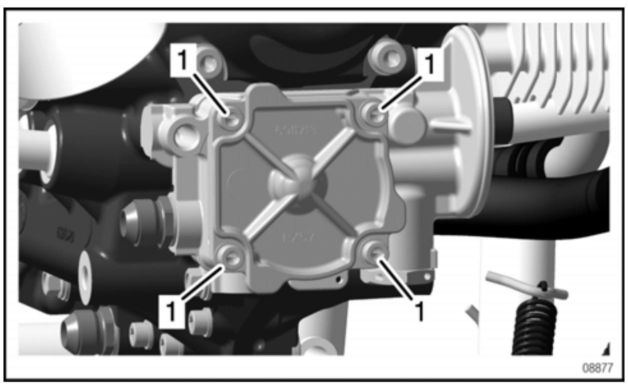

Figure 23.6

1 Allen screws with washers

OIL PUMP — DISASSEMBLY

Step	Procedure
1	Remove the plug screw, compression spring and regulating piston.

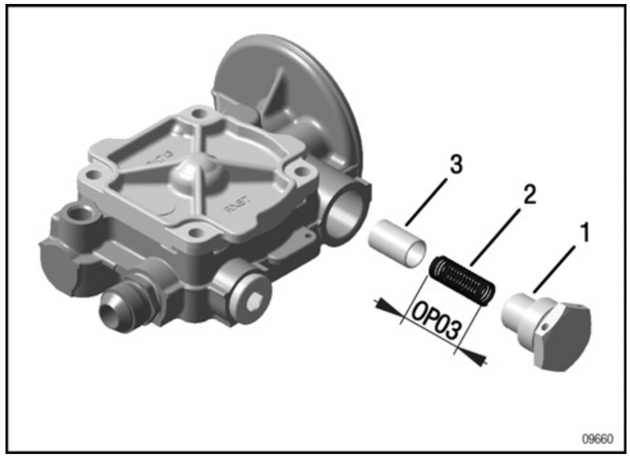

Figure 23.7

1 Plug screw	*2 Compression spring*
3 Regulating piston	

Step	Procedure
2	Remove the oil pump cover. **NOTE** *If the cover sticks, carefully release it with a soft-faced hammer.*

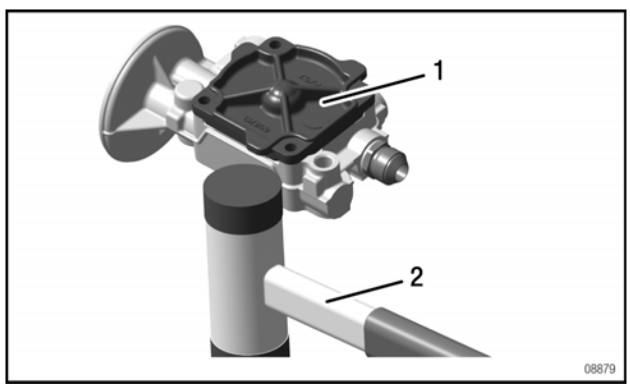

Figure 23.8

1 Oil pump cover	*2 Soft-faced hammer*

NOTICE

The rotary piston and rotor are marked.

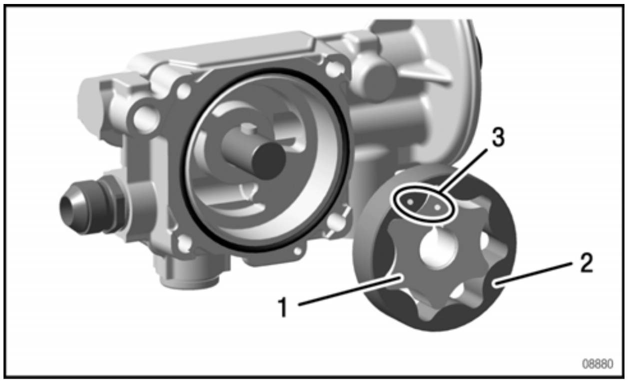

Figure 23.9

1	*Rotor (inner rotor)*	*2*	*Rotary piston (outer rotor)*
3	*Mark*		

Step	Procedure
3	Pull out the rotor and rotary piston.
4	Remove the feather key.
5	Pull out the oil pump shaft.

NOTICE

The sealing lip of the oil seal is damaged when the oil pump shaft is pulled out and must be replaced.

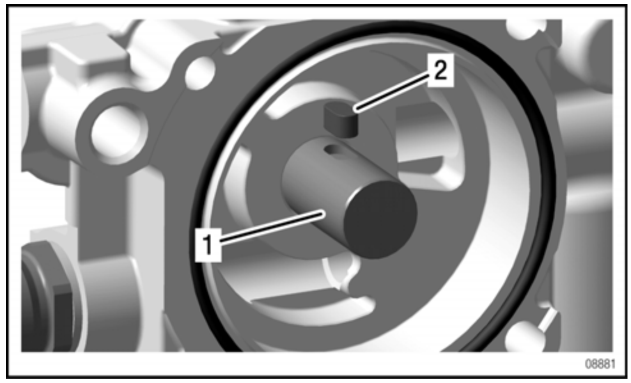

Figure 23.10

1	*Oil pump shaft*	*2*	*Feather key*

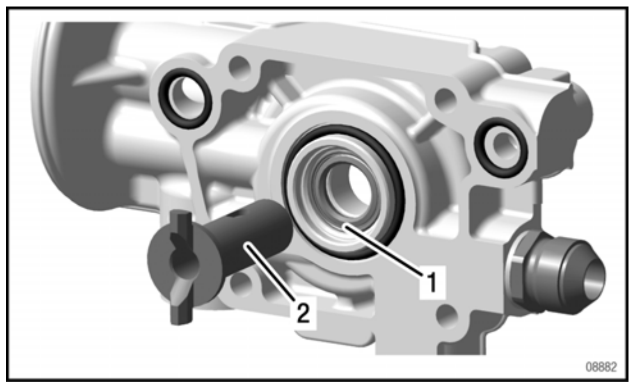

Figure 23.11

1	*Oil seal*	*2*	*Oil pump shaft*

Step	Procedure
6	Carefully lever the oil seal out of the oil pump housing with a screwdriver.

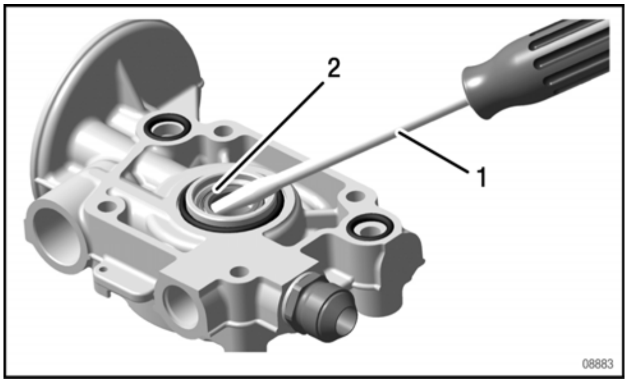

Figure 23.12

1	*Screwdriver*	*2*	*Oil seal*

OIL PUMP SINGLE PARTS — INSPECTION

Preparation

Clean all parts carefully.
See current Maintenance Manual Line (MML) for the respective engine type Chapter 05-00-00 section Procedures.

Carry out a visual inspection.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 05-00-00 section Procedures.

OIL PUMP HOUSING — INSPECTION

NOTICE

The sealing surfaces on oil pump components must not be repaired! If damage to these sealing surfaces is found, the corresponding component must be replaced with a new part.

Step	Procedure
1	Visually inspect all the components of the oil pump.
2	All the O-rings must be replaced.
3	Check the oil pump cover for wear on the inside using a straight-edge.

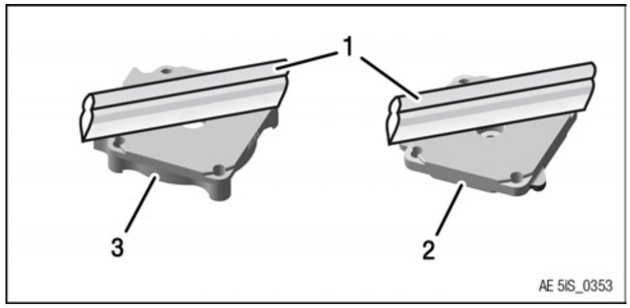

Figure 23.13

1	*Straight-edge*	*2*	*Oil pump cover*
3	*Oil pump center housing*		

Step	Procedure
4	Check the sealing faces of the oil pump housing and pump cover for striations. Dress them out on a surface plate if necessary.

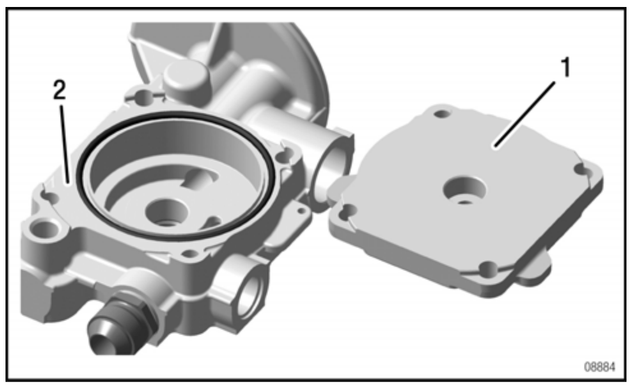

Figure 23.14: Typical

1	*Oil pump cover*	*2*	*Oil pump housing*

Step	Procedure
5	Place the oil pump rotor and rotary piston into the oil pump housing, oil pump center housing and measure main pump spacing (OP01). See Wear limits.

ROTARY PISTON/ROTOR — INSPECTION

Step	Procedure
1	Check the rotary piston and rotor for grooves.

NOTE

If there are noticeable grooves on the outer side of the rotor or inner side of the rotary piston, they must both be replaced.

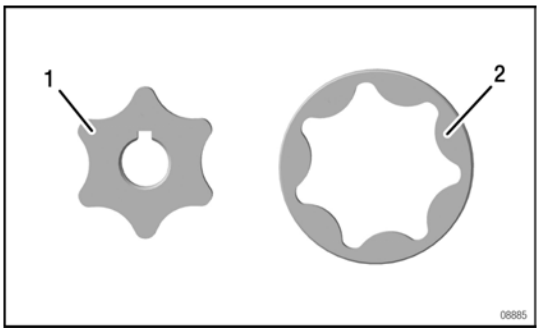

Figure 23.15

1 Rotor *2 Rotary piston*

OIL PUMP SHAFT — INSPECTION

Step	Procedure
1	Check the oil pump shaft at the bearing points.
2	Check the feather key groove and feather key for wear.
3	Measure width of the feather key (OP02). See Wear limits.

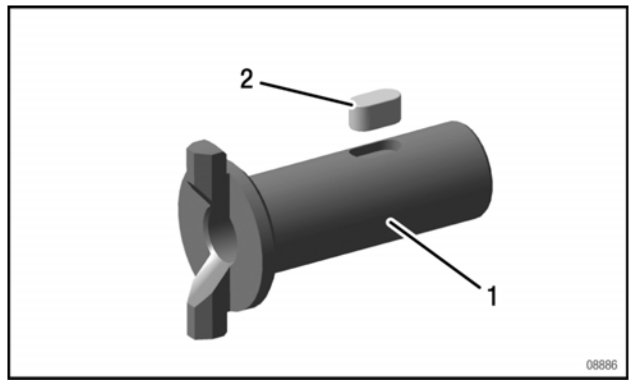

Figure 23.16

1 Oil pump shaft *2 Feather key*

OIL PRESSURE REGULATOR — INSPECTION

Step	Procedure
1	Check the regulator piston and plug screw for wear or damage.
2	Measure the free length of the pressure spring (OP03). See Wear limits.

WEAR LIMITS

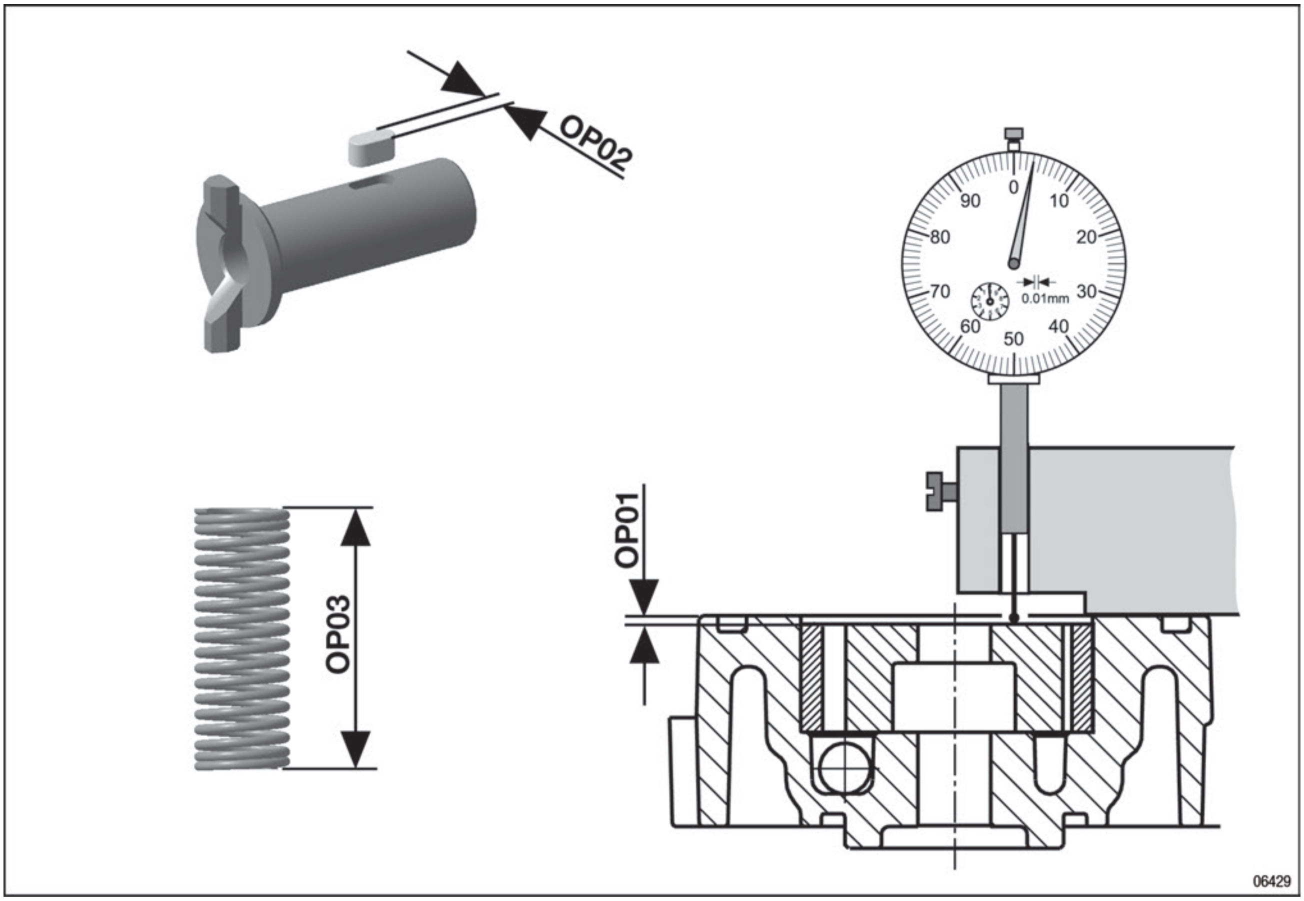

Figure 23.17: Oil pump

Description	Code	Current measurement value		Tolerance limit	Tolerance limit		Measure-ments
		min	max	100 %	50 %		
Main pump spacing (pump cover/rotor)	OP01	0.02 mm 0.00079 in.	0.07 mm 0.0027 in.	0.20 mm 0.0079 in.	0.14 mm 0.0053 in.	current replaced	
Width of feather key in shaft	OP02	4 mm 0.1575 in.	4.085 mm 0.1604 in.	4.150 mm 0.163 in.	4.11 mm 0.1619 in.	current replaced	
Compression spring length	OP03	65.6 mm (2.58 in.)		62.6 mm 2.46 in.	64.1 mm 2.52 in.	current replaced	

OIL PUMP — ASSEMBLY

Step	Procedure
1	Apply LOCTITE ANTI SEIZE on the thread of the plug screw.
2	Install oiled regulating piston and compression spring in the oil pump housing and hand-tighten the plug screw M22x1.5.

NOTE

The plug screw is self sealing and does not require a gasket ring.

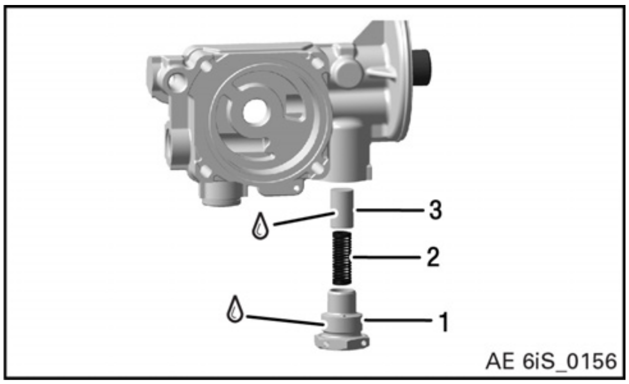

Figure 23.18

1 Plug screw M22x1.5
2 Compression spring DM9.1 D 1.0 L65.6
3 Regulating piston

Step	Procedure
3	Wrap insulating tape over the feather key groove.

NOTICE

Press in the oil seal so that the closed side points towards the oil pump housing.

Step	Procedure
4	Apply engine oil to the oil pump shaft and push new oil seal A 14x22x4 onto the oil pump shaft while turning slightly.

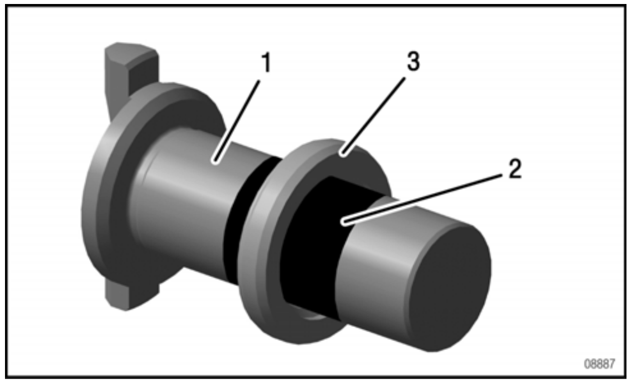

Figure 23.19

1 Oil pump shaft
2 Insulating tape
3 Oil seal A 14x22x4

Step	Procedure
5	Place the oil pump housing on a firm surface.
6	Remove the insulating tape from the oil pump shaft.
7	Insert the oil pump shaft with the oil seal and press it in as far as it will go with a soft-faced hammer.

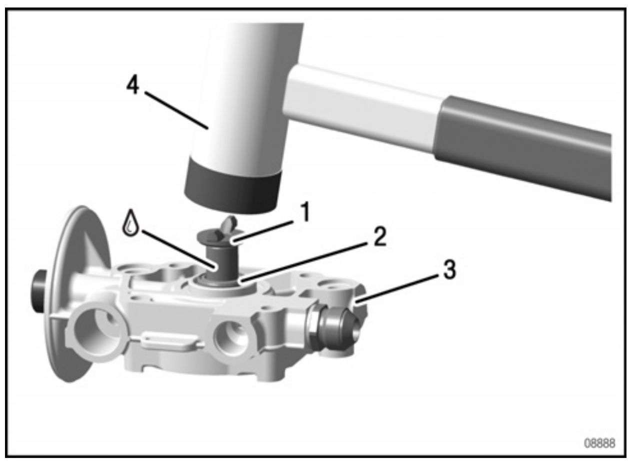

Figure 23.20: TYPICAL

1 Oil pump shaft
2 Oil seal A14x22x4
3 Oil pump housing
4 Soft-faced hammer

NOTICE
If the oil pump shaft is pulled out again, replace the oil seal (unusable).

Step	Procedure
8	Insert the feather key A4x4x8 in the oil pump shaft.

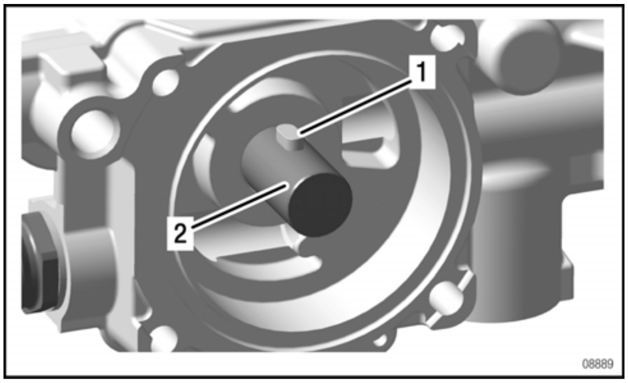

Figure 23.21

1 Feather key A4x4x8
2 Oil pump shaft

NOTICE
The rotor and rotary piston have a mark (dot). The mark must be visible after inserting both rotors.

Step	Procedure
9	Push on the rotor (inner rotor).
10	Insert the rotary piston (outer rotor).
11	Install new O-ring 63–2.5.

NOTE

Apply Engine oil to the rotor, rotary piston and O-ring.

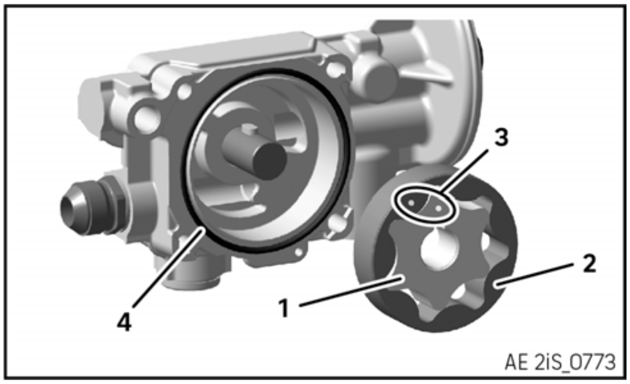

Figure 23.22

1 Rotor (inner rotor)
2 Rotary piston (outer rotor)
3 Mark
4 O-ring 63–2.5

NOTICE
Hold the oil pump shaft when installing the oil pump cover on it. Otherwise the oil pump shaft is pushed out by the air cushion.

NOTICE
Make sure the oil pump cover is in the correct position when installing it.

Step	Procedure
12	Place the oil pump cover on the oil pump housing. **NOTE** *Apply engine oil to the oil pump shaft and bearing bore of the oil pump cover.*

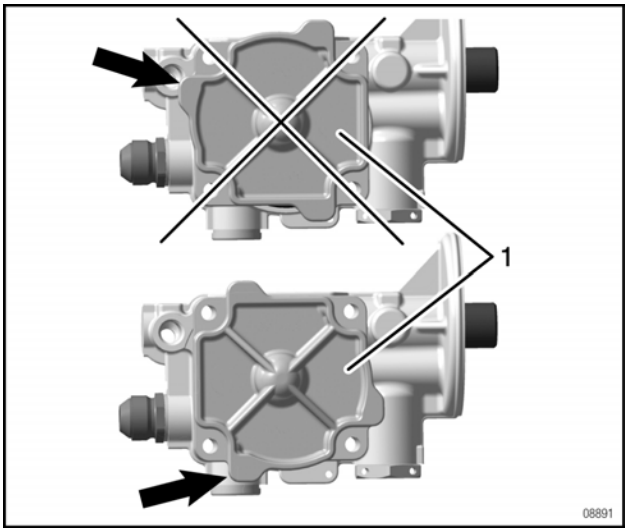

Figure 23.23

1 Oil pump cover

OIL PUMP HOUSING O-RINGS

NOTICE

All the O-rings must be replaced!

Step	Procedure
1	Insert new O-rings in the oil pump housing.

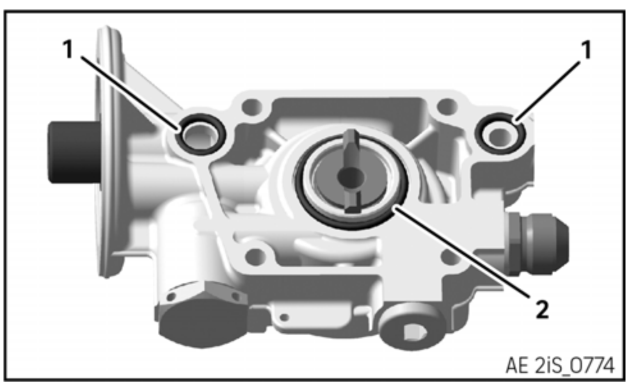

Figure 23.24

1 11x2.7 O-ring   *2 30x2.5 O-ring*

OIL PUMP — INSTALLATION

Preparation

- Check the fit of the O-rings on the oil pump housing.

NOTICE

Ensure that the oil pump shaft is in the correct installation position.

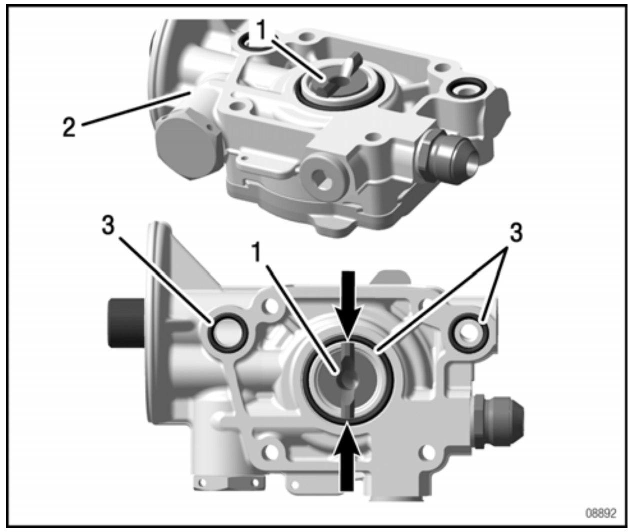

Figure 23.25: TYPICAL

1 Oil pump shaft   *2 Oil pump housing*

3 O-rings

Step	Procedure
1	Apply LOCTITE 5910 to the contact area on the crankcase.

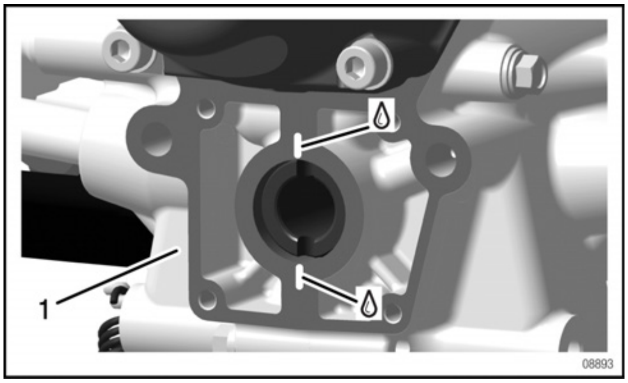

Figure 23.26

1 Crankcase

Step	Procedure
2	Install the oil pump housing with Allen screws M6x50 and washers 6.4 crosswise and by hand. Then tighten the Allen screws crosswise. Tightening torque 10 Nm (89 in. lb.).
3	Tighten plug screw M22x1.5. Tightening torque 30 Nm (22 ft. lb.).
4	Attach the safety wire of the plug screw (regulator piston).

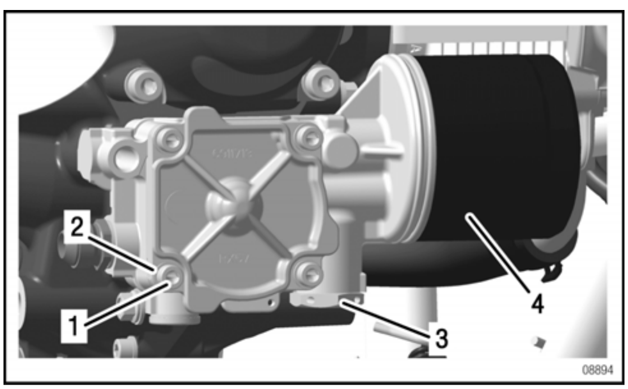

Figure 23.27: TYPICAL

1 Allen screws M6x50 *2 Washers 6.4*
3 Plug screw M22x1.5 *4 Oil filter*

Step	Procedure
5	If necessary install oil filter nipple. Tightening torque 60 Nm (44 ft. lb.).
6	If necessary install plug screw A M16x1.5 with new sealing ring A 16x22. Tightening torque 35 Nm (26 ft. lb.).
7	If necessary apply LOCTITE 648 on the Adapter metric or UNF (Oil inlet) and install with new sealing ring A 16x22. Tightening torque 35 Nm (26 ft. lb).

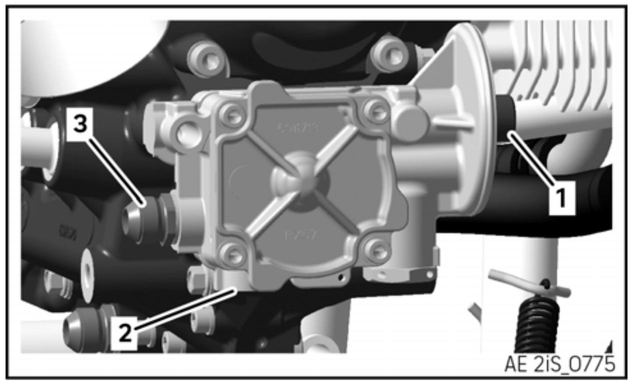

Figure 23.28

1 Oil filter nippel *2 Plug screw M22x1.5*
3 Adapter metric or UNF (Oil inlet)

OIL FILTER - INSTALLATION

Step	Procedure
1	Install the oil filter.

See Maintenance Manual Line (MML) for the respective engine type.

NOTE

Oil the gasket of the oil filter.

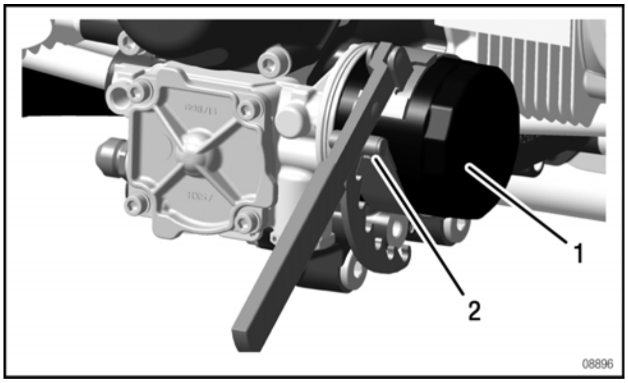

Figure 23.29

1	*Oil filter*	*2*	*Oil filter wrench part no. 877620*

FINISHING WORK

- Install pressure oil lines with banjo bolt M10x1x23 and 2 new sealing rings A10x14. Tightening torque 15 Nm (133 in. lb.).
  See Chapter 61–20–00 Governor or plug screw M10x1 with new sealing ring A10x14.
  Tightening torque 15 Nm (133 in. lb.).

Install the oil hoses, clamps and surrounding assemblies.
Follow the instructions in the aircraft manufacturer's manual.

Fill with operating fluids or check filling levels.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12–10–00 section Adding operating fluids.

Purge the oil system.
See current Installation Manual (IM) for the respective engine type, Chapter 79-00-00 section Purging the lubrication system..

Carry out an engine test run.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Planned maintenance..

NOTE

Then check that the oil filter is securely fitted after the test run.

OIL TANK

OIL TANK — REMOVAL

⚠ WARNING

Danger of severe burns and scalds!
Always allow the engine to cool down to ambient temperature before starting any work.

ENVIRONMENTAL NOTE

Dispose of used oil according to local environmental regulations.

ENVIRONMENTAL NOTE

Ensure that no oil gets into the waste water system or the ground – risk of contaminating drinking water!

NOTICE

Prevent the ingress of debris particles into all disconnected lines and connections.
Use appropriate protective coverings.

Preparation

- Switch the ignition key OFF

Drain oil.
See current Maintenance Manual Line (MML) for the respective engine type.

Removal of the oil tank according to the instructions in the aircraft manufacturer's manual.

NOTE

The assemblies, hoses and lines are only to be removed if necessary and only as far as is necessary.

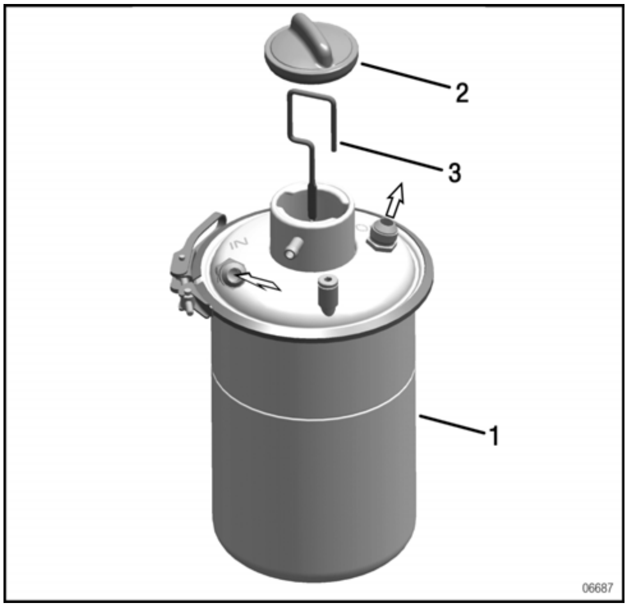

Figure 23.30

1 Oil tank
2 Oil tank cover
3 Oil dipstick

OIL TANK — DISASSEMBLY

Step	Procedure
1	Open profile clamp.
2	Remove the oil tank cover assy. and O-ring.

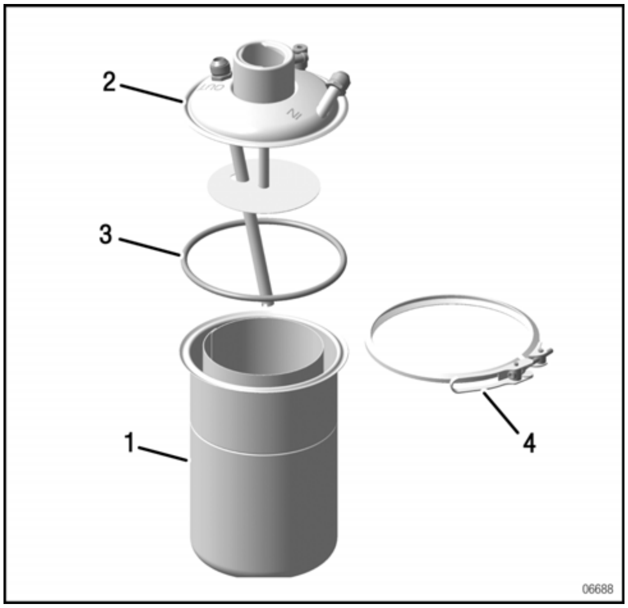

Figure 23.31

1	*Oil tank*	2	*Oil tank cover assy.*
3	*O-Ring*	4	*Profile clamp 163*

Step	Procedure
3	Remove the baffle insert (screen) and partition from the oil tank.
4	Remove the hex. screw with gasket ring from the oil tank.

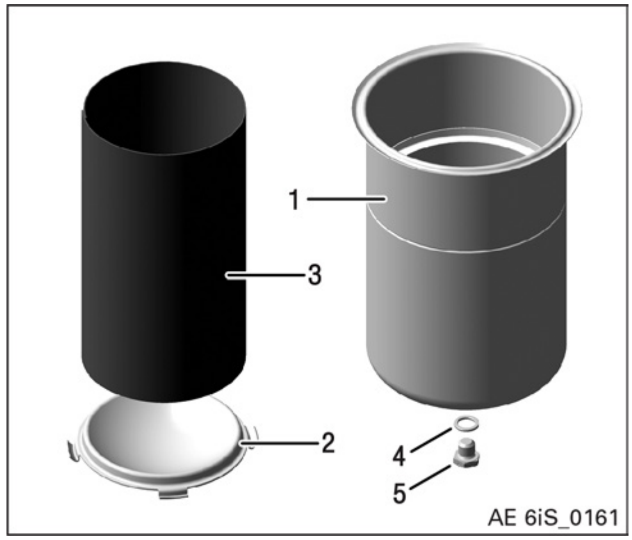

Figure 23.32

1	*Oil tank*	2	*Partition*
3	*Baffle insert (screen)*	4	*Gasket ring*
5	*Hex. screw*		

OIL TANK SINGLE PARTS — INSPECTION

Clean all parts carefully.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 05-00-00 section Procedures.

General visual inspection.
See current Maintenance Manual Line (MML) for the respective engine type.

OIL TANK – ASSEMBLY

Step	Procedure
1	Assemble the oil tank in the reverse.
2	Install the hex. screw M12x12 with a new gasket ring C 12x18. Tightening torque 25 Mn (18ft. lb.).
3	Attach the safety wire.

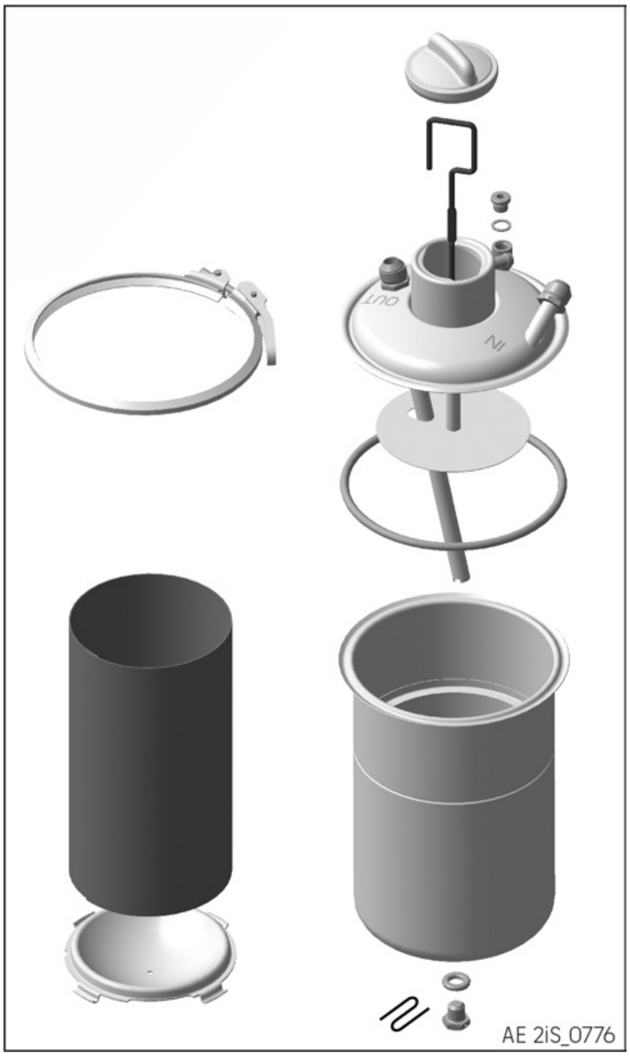

Figure 23.33: Typical

OIL TANK — INSTALLATION

Install the oil tank according to the instructions in the aircraft manufacturer’s manual.

FINISHING WORK

Fill with operating fluids or check filling levels.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-10-00 section Adding operating fluids.

Purge the oil system.
See current Installation Manual (IM) for the respective engine type, Chapter 79-00-00 section Purging the lubrication system.

Carry out an engine test run.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Planned maintenance

OIL LINES

⚠ WARNING

Danger of severe burns and scalds!
Always allow the engine to cool down to ambient temperature before starting any work.

ENVIRONMENTAL NOTE

Dispose of used oil according to local environmental regulations.

ENVIRONMENTAL NOTE

Ensure that no oil gets into the waste water system or the ground – risk of contaminating drinking water!

NOTICE

Prevent the ingress of debris particles into all disconnected lines and connections.
Use appropriate protective coverings.

Preparation

- Switch the ignition key OFF

Drain oil.
See current Maintenance Manual Line (MML) for the respective engine type.

OIL HOSES — REMOVAL

NOTICE

The oil hoses are not included in the delivery of the engine and must be maintained according to the aircraft manufacturer's instructions.

Remove the oil hoses and clamps according to the instructions in the aircraft manufacturer's manual.

OIL LINE (STEEL LINE) – REMOVAL

NOTICE

The steel oil lines (scope of delivery) must be removed only, if they are damaged or for maintenance and/or cleaning.

Step	Procedure
1	For disconnection of the pressure oil line. See Chapter 61-20-00 section Governor.

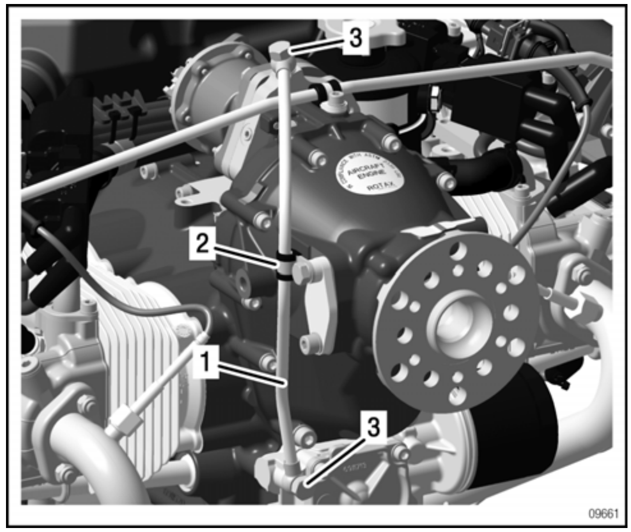

Figure 23.34

1 Pressure line *2 Cable clamp*
3 Banjo bolt

OIL LINE— INSPECTION

Clean all parts carefully.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 05-00-00 section Procedures.

General visual inspection.
See current Maintenance Manual Line (MML) for the respective engine type.

OIL LINE (STEEL LINE) INSTALLATION

Step	Procedure
1	For installation of the pressure oil line. See Chapter 61-20-00 section Governor.

OIL HOSES — INSTALLATION

NOTICE

Ensure that the hoses are installed without tension and are not kinked. Observe minimum distances, e.g. 2 mm (0.0787 in.) from the housing.

NOTICE

The oil hoses are not included in the delivery of the engine and must be maintained according to the aircraft manufacturer's instructions.

Install the oil hoses and clamps according to the instructions in the aircraft manufacturer's manual.

NOTE

Only use suitable clamps, or crimp connections to fasten the hoses.

FINISHING WORK

Fill with operating fluids or check filling levels. See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12–10–00 section Adding operating fluids.

Purge the oil system.
See current Installation Manual (IM) for the respective engine type, Chapter 79–00–00 section Purging the lubrication system.

Carry out an engine test, see current Maintenance Manual Line (MML) for the respective engine type, Chapter 12–20–00 section Planned maintenance.

CHECK VALVE

For information of the check valve, see the current documentation of the aircraft manufacturer.

OIL COOLER

For information of the check valve, see the current documentation of the aircraft manufacturer.

THREAD REPAIR

Magnetic drain plug

See current Maintenance Manual Line (MML) for the respective engine type.

NOTE

It is possible to repair the thread of the magnetic drain plug in the crankcase with a HeliCoil.

Drain plug

See current Maintenance Manual Line (MML) for the respective engine type.

Chapter: 80–00–00
ELECTRIC STARTER

TOPICS IN THIS CHAPTER

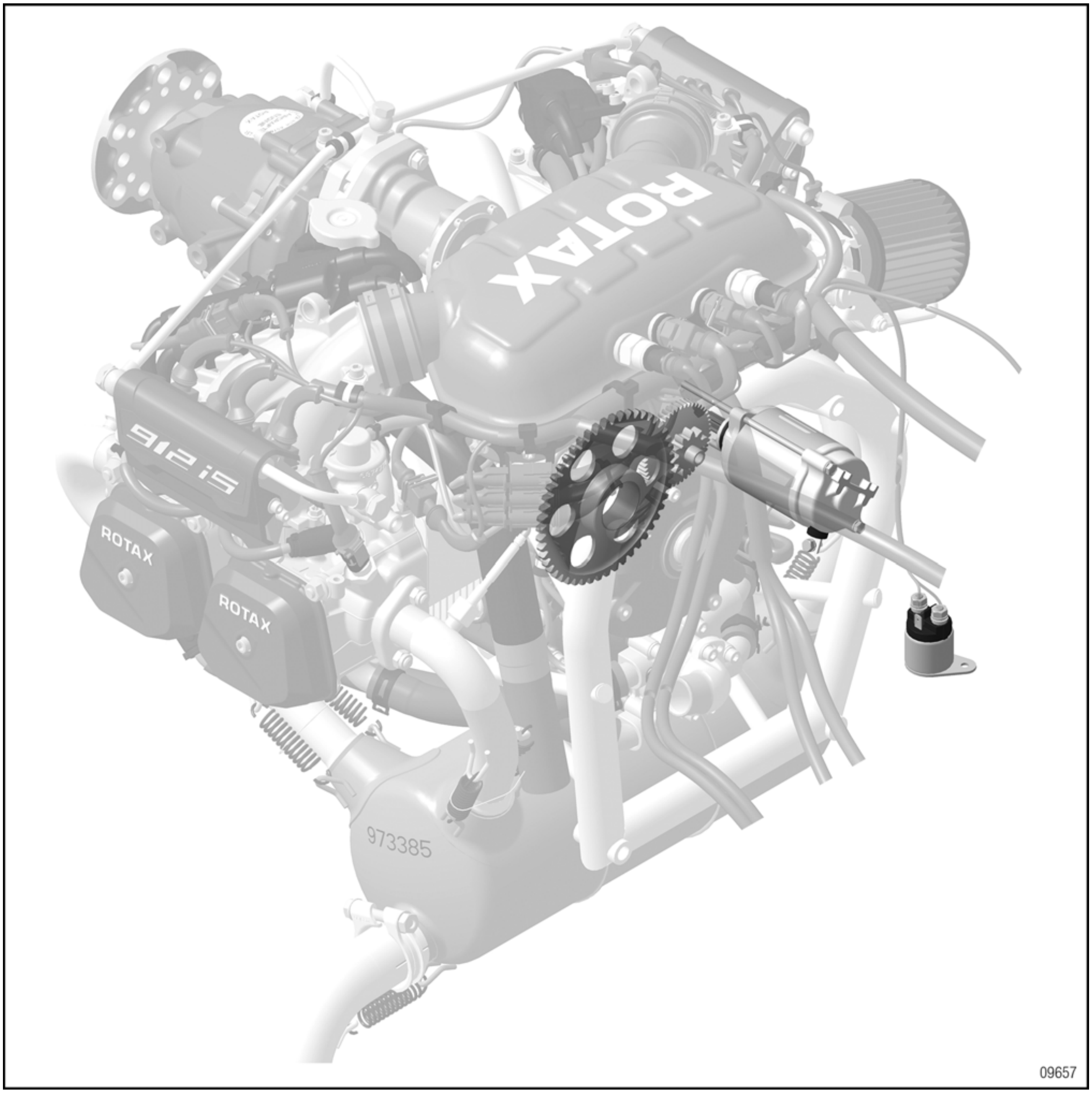

Figure 24.1: Location on the engine

SERVICE PRODUCTS

Description	Part number
LOCTITE ANTI SEIZE 8151	297434
LOCKING PAINT	898570

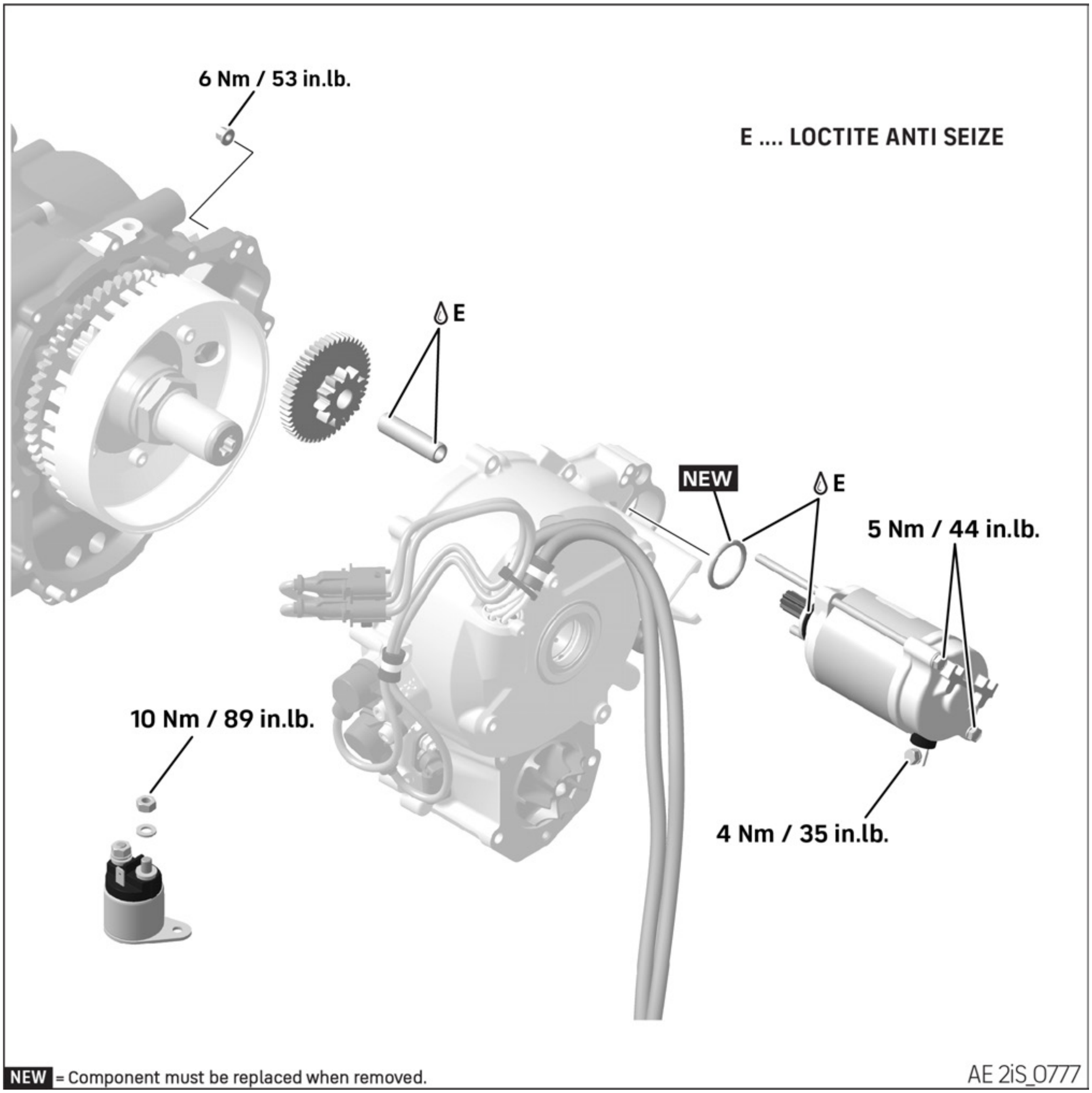

Figure 24.2: Electric starter

SYSTEM DESCRIPTION

The electric starter is a DC motor with a permanent magnet and carbon brushes. The geartooth system of the armature shaft is permanently engaged in the idler gear. During the starting process the sprag clutch forms a connection to the crankshaft via the idler gear and free wheel gear. As soon as the engine speed is higher than the speed generated by the electric starter, the sprag clutch breaks the connection.

SAFETY INSTRUCTION

⚠ WARNING

Danger of severe burns and scalds!
Always allow the engine to cool down to ambient temperature before starting any work.

⚠ WARNING

Non-compliance can result in serious injuries or death!
All installation work on the electric starter assy. must be carried out with engine switched OFF and the battery (negative pole) disconnected.

NOTICE

Danger of damage to engine! There is a risk of short circuits and cable fires during work on the electric starter!

ENVIRONMENTAL NOTE

Please observe the disposal regulations applicable in your area.

ENVIRONMENTAL NOTE

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

MAINTENANCE

As well as the maintenance and special checks, see current Maintenance Manual Line (MML) for the respective engine type.

ELECTRIC STARTER

NOTE

For idle gear and idle gear shaft. See Chapter 72–20–00 Sprag clutch housing – removal .

Preparation

- Starter, Master and Lane selector switches must be “OFF”!

Disconnect the negative terminal of the aircraft battery, according to the instructions in the aircraft manufacturer's manual.

ELECTRIC STARTER — REMOVAL

NOTE

When removing the electric starter, oil may leak from the bore.

Step	Procedure
1	Disconnect the positive pole on the electric starter.

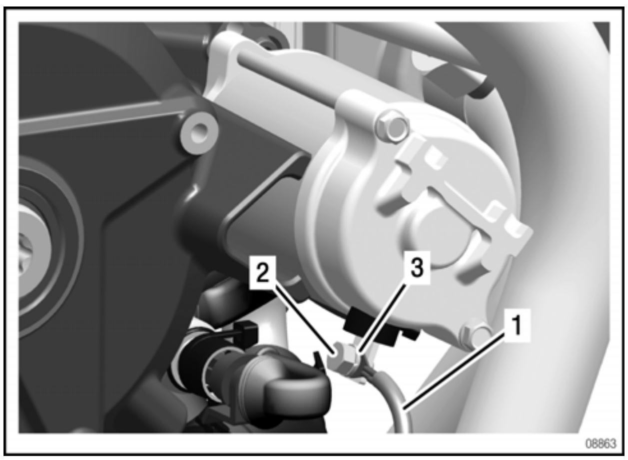

Figure 24.3

1	*Positive (+) cable*	2	*Terminal screw*
3	*Lock washer*		

NOTICE

Hold the Mx145 hex. screw still with a suitable tool!
Do not unscrew or remove the long M5 screws!

Step	Procedure
2	Loosen the 2 hex. nuts M5 on the rear of the crankshaft housing and remove electric starter from ignition housing.

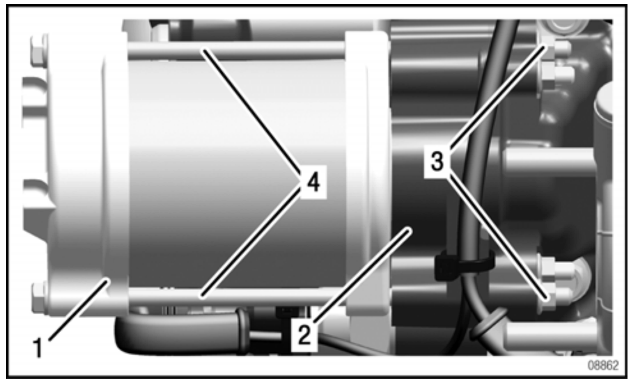

Figure 24.4

1	*Electric starter*	2	*Ignition housing*
3	*Hex. nuts M5*	4	*Hex. screw M5 x 145*

NOTICE

Do not tap the electric starter with a hammer, the adhering magnets can come off.

NOTE

If the O-ring sticks, first press the electric starter gently down with a screwdriver and then pull off the starter by hand.

ELECTRIC STARTER INSPECTION

Preparation

Clean all parts carefully.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 05-00-00 section Procedure.

NOTICE
Disassembly of starter assy. is not allowed!

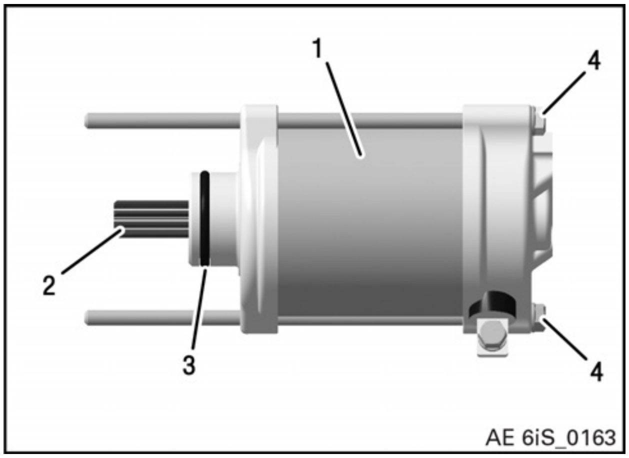

Figure 24.5

1 Electric starter *2 Rotor*
3 O-Ring *4 Hex. screw M5x145*

Step	Procedure
1	Check the teeth of the spined drive shaft for damage and wear.
2	Check surface of the electric starter flange for damage and wear.
3	Check the two hex. screws M5x145 for correct torque: 5 Nm (44 in. lb.).

ELECTRIC STARTER — INSTALLATION

Preparation

- Lightly grease O-ring on the bearing flange and centring bore in the ignition housing with LOCTITE ANTI SEIZE.

NOTICE
Ensure that the electric starter is in the correct installation position.

Step	Procedure
1	Install new O-ring 24.4x3x1 onto the electric starter flange greased with LOCTITE ANTI SEIZE.
2	Push the whole electric starter into the ignition housing. **NOTE** *Splined drive shaft may need to be slowly rotate to align gears. This can also be achieved by slowly rotating the propeller.*
3	Install the hex. nuts M5 equally. Tightening torque 6 Nm (53 in. lb.). Mark with locking paint.

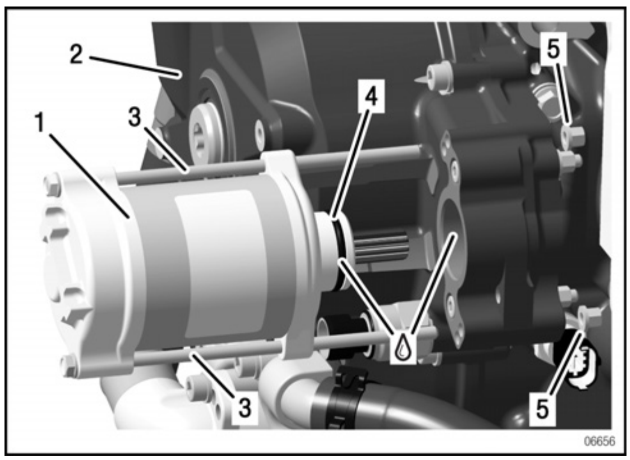

Figure 24.6

1 Electric starter *2 Ignition housing*
3 Hex. screw M5x145 *4 O-Ring 24.4x3.1*
5 Hex. nut M5

Step	Procedure
4	Connect the positive pole on the electric starter. Tightening torque 4 Nm (35 in. lb.).

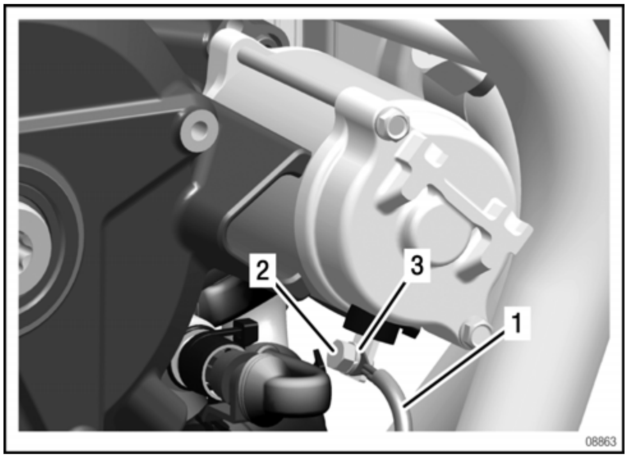

Figure 24.7

1 Positive (+) cable
2 Terminal screw M5x8
3 Lock washer A5

FINISHING WORK

- Connect the negative terminal of the onboard battery according to the aircraft manufacturer's instruction.

Fill with operating fluids or check filling levels.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-10-00 section Adding operating fluids..

Carry out an engine test run.
See current Maintenance Manual Line (MML) for the respective engine type, Chapter 12-20-00 section Planned maintenance.

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Engine serial no.

Type of aircraft

Aircraft registration no.

Rotax® authorized distributor

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