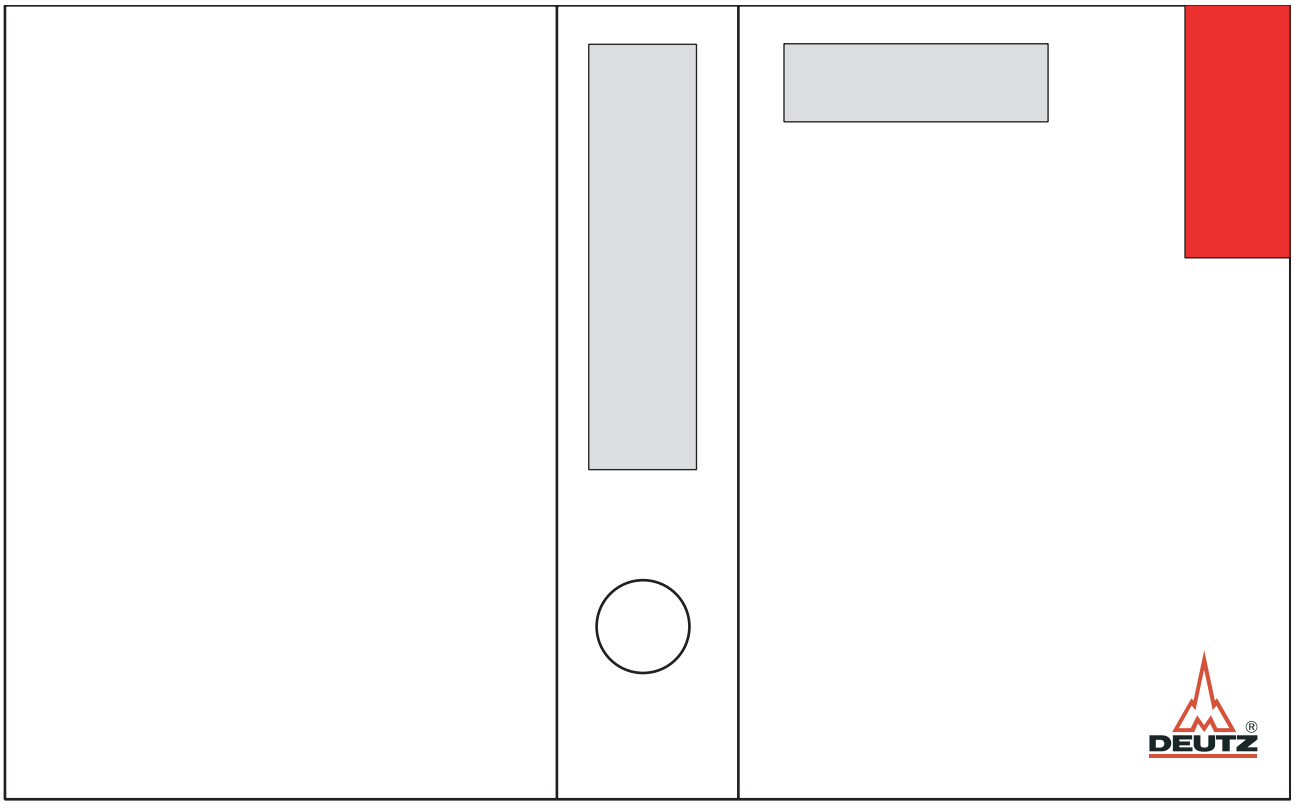

Operating Instructions

TBD 616 OEM

Operating Instructions

TBD 616 OEM

Operating Instructions

TBD 616 OEM

0299 8561 en

Engine Number: | | | | | | | | | | |

Please enter your engine number here. This will help us to serve you better in questions of repairs, spare parts and after-sales service generally.

DEUTZ®

This documentation is intended for the following engine

- Engine type: ☐☐☐☐☐☐☐☐☐☐
- Application: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
- System name: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
- Rating: ☐☐☐☐ kW
- Speed: ☐☐☐☐ min^{-1}
- Commissioning on: ☐☐ ☐☐ ☐☐☐☐

Please enter the relevant data. This will make it easier for us to help you in questions involving repairs, spare parts and after-sales service in general.

This documentation package is to be presented to the Service Partner responsible every time a service job is carried out.

Imprint:
DEUTZ AG
Service Information Systems
Deutz-Mülheimer-Straße 147–149
D-51063 Cologne
Tel.: (02 21) 8 22-0
Fax: (02 21) 8 22-53 58
http://www.deutz.de

Printed in Germany

Ordering No 0299 8561 en

0 Introduction

Please read all ...

- Please read all the information contained in this manual, and follow the instructions carefully. You will avoid accidents, retain the manufacturer's warranty, and will be able to use a fully functional and operational engine.
- This engine has been built solely for the purpose appropriate to the scope of delivery concerned, as defined by the equipment manufacturer (intended use). Any other use shall be construed as not intended. The manufacturer shall not be liable for any damage resulting therefrom; all risks involved shall be borne solely by the user.
- The term "intended use" shall also include compliance with the operating, maintenance and repair conditions specified by the manufacturer. The engine may be used, maintained and repaired only by persons who are familiar with the work concerned and who have been properly informed of the risks involved.
- Make sure that these operating instructions are available to everyone involved in operating, maintaining, and repairing the engine, and that they have all understood the contents.
- Non-compliance with these operating instructions may result in engine malfunctions and even damage or injury to persons; the manufacturer will accept no liability in such cases.
- Proper maintenance and repair work depends on the availability of all requisite equipment, tools and special implements, all of which must be in perfect condition.
- Engine parts like springs, brackets, elastic holding rings, etc., involve increased risk of injury if not handled properly.
- The relevant accident prevention regulations and other generally recognized rules relating to safety engineering and health and safety at work must all be complied with.
- Maximized cost-efficiency, reliability and long lifetime are assured only if original parts from DEUTZ AG are used.
- Engine repairs must correspond to the intended use. In the event of modification work, only parts approved by the manufacturer for the purpose concerned may be used. Unauthorized changes to the engine will preclude any liability of the manufacturer for resultant damage.

Careful when the engine is running!

Carry out maintenance or repair jobs only when the engine is at a standstill. If you remove any protective features, fit them back in position after completing your work. Always wear tight-fitting clothing if you are working on the engine while it is running.

Safety

You will find this symbol next to all safety instructions. Follow these meticulously. Pass on all safety instructions to your operating staff as well. In addition, comply with the statutory general safety and accident prevention regulations applying in your country.

Instruction

You will find this symbol next to instructions of a general nature.

Follow these instructions carefully.

Asbestos

The seals and gaskets used in this engine are asbestos-free. Please use the appropriate spare parts for maintenance and repair jobs.

Forword

Dear customer,

The engines of the DEUTZ brand have been developed for a broad spectrum of applications. A comprehensive range of different variants ensures that special requirements can be met for the individual case involved.

Your engine has been equipped to suit your own particular installation, and accordingly not all of the devices and components described in these operating instructions will actually be fitted to your engine.

We have endeavoured to present the differences involved as clearly as possible, to make it easier for you to find the operating and maintenance instructions you need for your own particular engine.

Please read this manual before you start up your engine, and follow the operating and maintenance instructions meticulously.

If you have any questions, just get in touch with us, and we will be pleased to answer them for you.

Yours sincerely,

DEUTZ AG

DEUTZ engines

are the culmination of long years filled with research and development work. The in-depth know-how thus acquired, in conjunction with high standards of quality, is your guarantee for engines manufactured for long lifetime, high reliability and low fuel consumption. And of course, stringent criteria of environment-friendliness are met as well.

Care and maintenance

are crucial factors in ensuring that your engine satisfactorily meets the requirements involved. Compliance with the specified maintenance intervals and meticulous performance of care and maintenance work are therefore absolutely essential. Special attention must be paid to any more critical operating conditions deviating from the norm.

DEUTZ Service

In the event of malfunctions, or if you need spare parts, please contact one of our responsible service agencies. Our trained and qualified staff will ensure fast, professional rectification of any damage, using original parts.

Original parts from DEUTZ AG have always been manufactured to the very latest state-of-the-art.

You will find details of our after-sales service at the end of these operating instructions.

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Contents

0 Introduction

1 User Guide

2 Description

5 Maintenance

6 Troubleshooting

7 Conservation

8 Technical particulars

1 User Guide

General

The maintenance and service work prescribed in the operating instructions and the workshop manual must be performed on schedule and in full.

The maintenance and service personnel must have the necessary technical knowledge to perform the work. Safety and protection devices which may have to be removed during maintenance and service work must be replaced afterwards.

The rules for the prevention of accidents and the safety regulations must be observed at all times during maintenance and service work.

Please also observe the special safety regulations for the various service groups which are listed in detail as job cards in the job cards chapter (cf. also chapter 1 Safety Regulations / Rules for Accident Prevention).

The maintenance and service intervals are listed in the maintenance and service schedules. These also provide information about the work to be performed.

The job cards provide technical hints for performing the work.

Regulations

Safety Regulations / Rules for Accident Prevention

Detailed safety instructions have been compiled for various service groups in the form of job cards, these precede the job cards of the respective service groups.

The legally prescribed rules for accident prevention (available from the appropriate associations or technical publishers) must be observed. These depend on the installation site, the mode of operation and the operating and auxiliary media being used.

Special safety measures dependent on the respective work are specified and highlighted in the work description.

It generally applies among other things:

- **for personnel:**
  - **Only instructed personnel may operate or maintain the engine. Unauthorised persons may not enter the engine room.**
  - **Wear tight fitting clothing and ear protectors in the engine room when engines are running.**
  - **Only employ qualified personnel for repairs or service work.**
- **for the engine room:**
  - **Ensure adequate fresh air and ventilation (do not cover ventilation shafts).**
  - **Provide first aid kits and suitable fire extinguishers. Check the filling and proper functioning regularly.**
  - **Only store inflammable materials in the engine room which are necessary for operating the system.**
  - **Smoking and naked lights are prohibited in the engine room.**

- **for operation and maintenance of the engine:**
  - **Only start the engine when all safety devices have been fitted and the turning gear has been removed. Make sure there is no-one in the danger zone.**
  - **Only perform cleaning, maintenance and repair work when the engine is switched off and secured against starting up.**

Rules for disposal

The work described in the operating instructions and workshop manual necessitates the renewal of parts and expendables among other things. These renewed parts / expendables must be properly stored, transported and disposed of. The owner is responsible for this.

Disposal includes recycling and disposal of parts / expendables whereby recycling has priority.

The details of disposal and its supervision are governed by regional, national and international laws and decrees which the plant owner is responsible for observing.

Operating Instructions and Workshop Manual

The service documentation is divided into the operating instructions and the workshop manual for a user-oriented organisation of the information content.

The **Operating Instructions** contain a general description as well as instructions for the necessary maintenance and service work which can be performed by a trained operator.

It contains the following chapters:

0 Introduction

Contents

1 User guide

2 Description (description of the engine and components)

3 Operation (operating the engine)

4 Expendables (operating media specifications and auxiliary materials)

5 Maintenance

6 Troubleshooting

7 Conservation (conservation of the engine)

8 Technical particulars

9 Job cards (in order of job card numbers)

10 Sundry other instructions (if not in the appendix or separate folders)

Index

Service

The **Workshop Manual** assumes knowledge of the content of the operating instructions, this applies especially to the safety regulations. Minor repairs and emergency measures on components are described which require a greater effort and appropriately qualified personnel.

It contains the chapters:

0	Introduction
	Contents
1	User guide
2-4	See operating instructions
5	Tools for service
6-7	See operating instructions
8	Technical particulars
9	Job cards (in order of job card numbers)
10	Sundry other instructions (if not in the appendix or separate folders)
	Service

Job cards

The **Job cards** are divided into Job cards of the **operating instructions**, e.g. B 1-1-1 and job cards of the **workshop manual**, e.g. W 4-5-1.

- Please see Figure 1-1 for explanations of the numbering.
- The structure of the job card is shown in Figure 1-2.

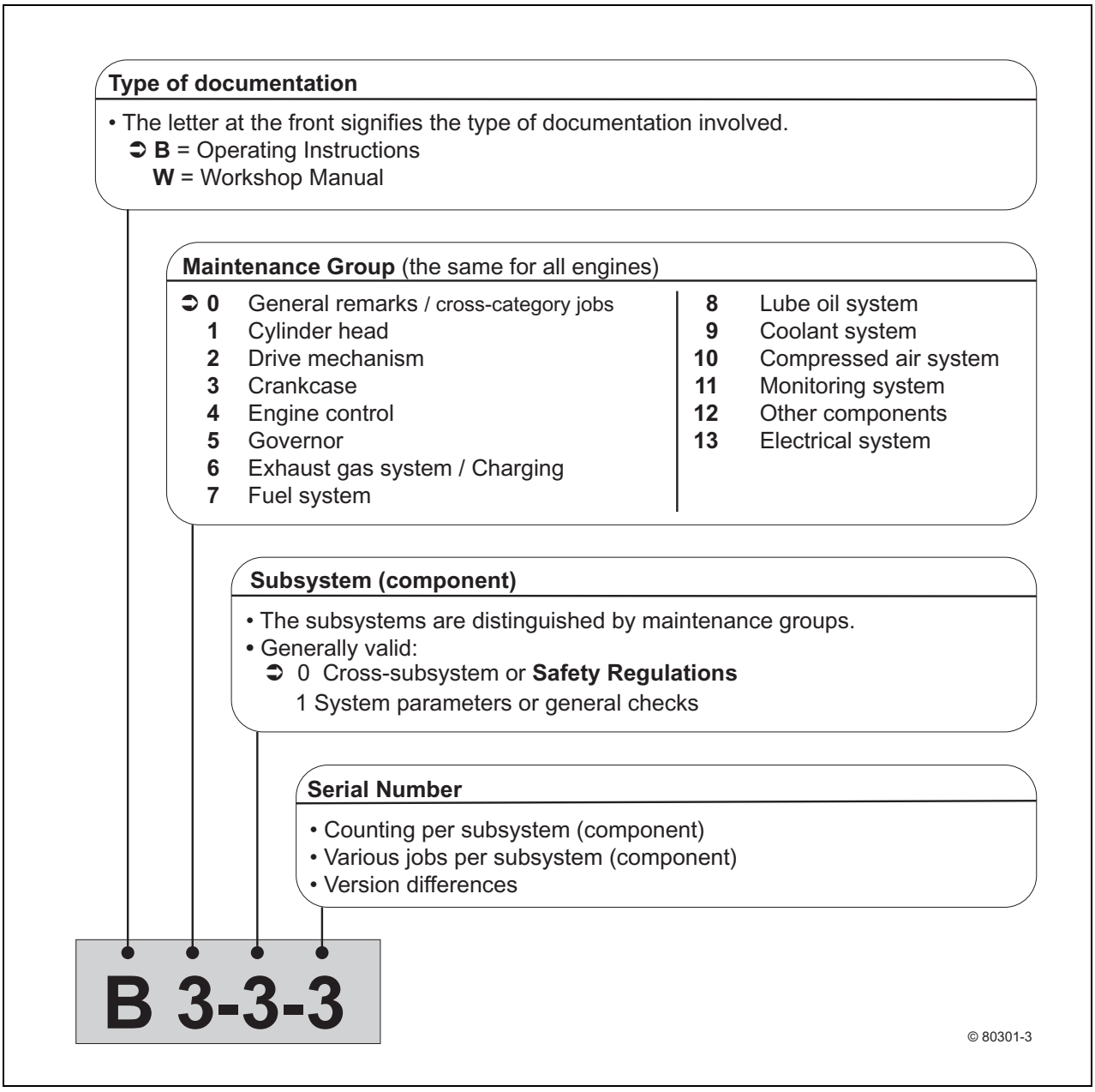


Figure 1-1 Numbering of the job cards

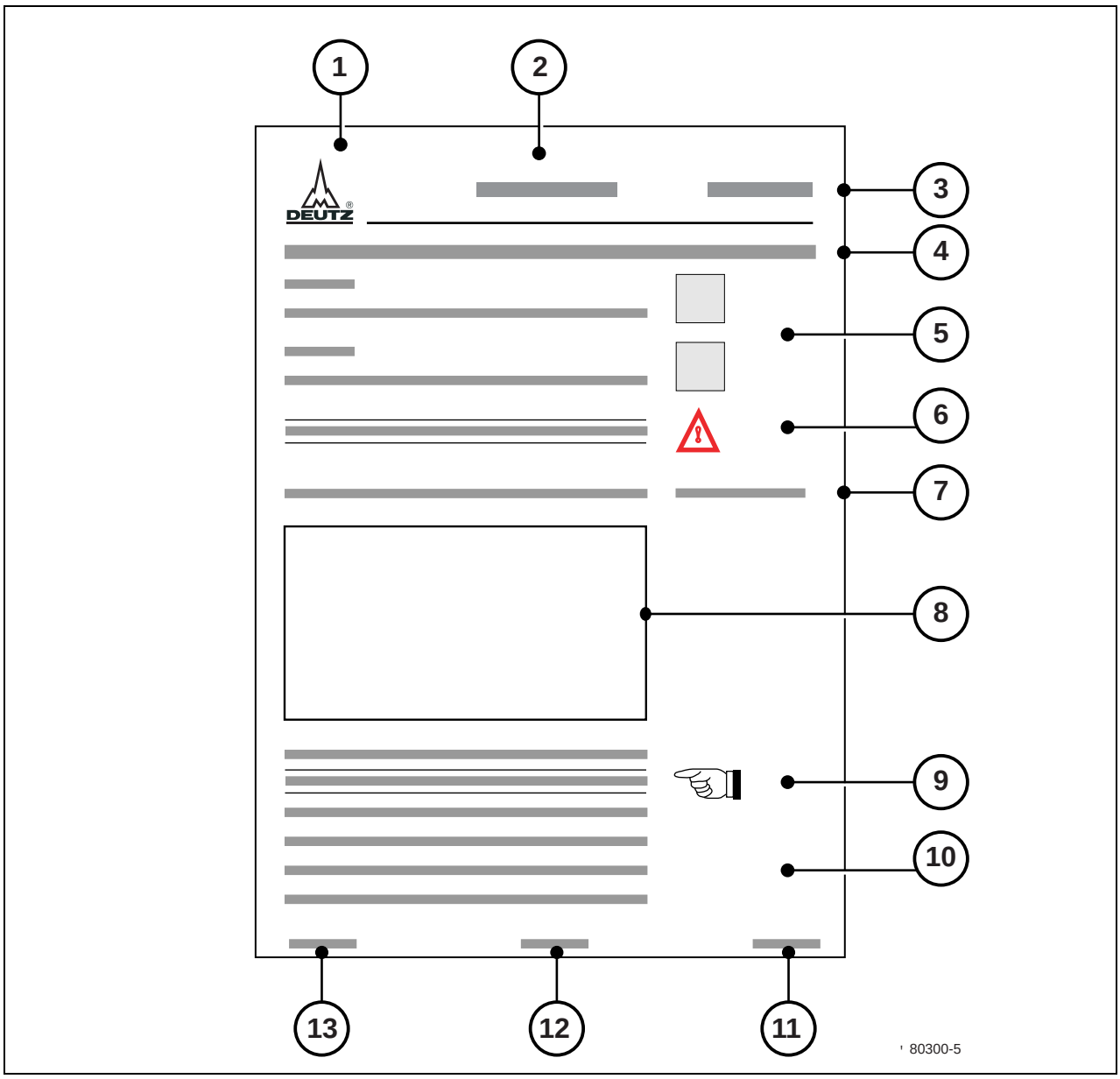


Figure 1-2 Numbering of the job cards

When making inquiries about the job card please always state the engine type or the system 2, the number of the job card 3, the page number 11, the date of issue 13 or alternatively the identification number of the job card.

1	DEUTZ Service, publisher of the service documentation	8	Figures
2	Engine type or system	9	General notes
3	Number of the job card	10	Work sequence
4	Title of the job card	11	Page number
5	Tools, aids, spares and references	12	Identification number of the job card
6	Safety instructions	13	Date of issue of the job card
7	Sub-headings		

Spares

Spares are available from DEUTZ Service. You will find a list of spares in the spare parts list of the engine or the system. You will find further information in Chapter Service, at the end of the operating instructions.

2 Description

The engines in this series are water-cooled four-stroke diesel engines which can be used for various powertrains.

Type and designations

Type designation

See also rating plate (Figure 2-2, item 1)	T	B	D	616	V	_
Turbocharger	**T**					
Charge air cooler		**B**				
Diesel engine			**D**			
Series				**616**		
V-engine					**V**	
No. of cylinders						**8, 12** or **16**

Rating plate
Position on the engine

The rating plate is fixed to the engine. The engine number is punched additionally.

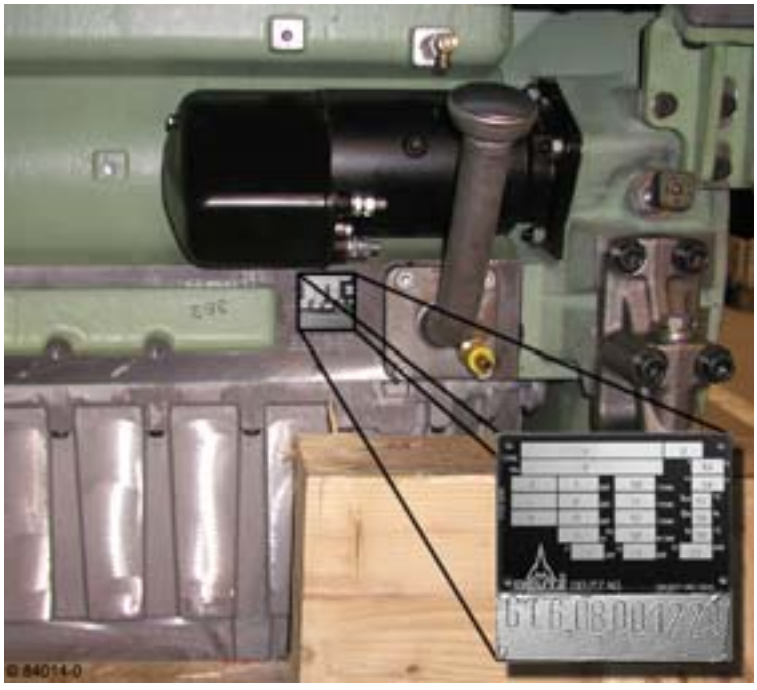


Figure 2-1 Position of the rating plate and the engine number on the engine (example)

Figure rating plate

Figure 2-2 Figure rating plate

1	Engine type designation
2	Year of manufacture
3	Engine number
4, 5, 6	Performance code according to DIN ISO 3046 Part 7 A * or ** is specified after the performance code if the available performance is restricted to a certain time according to special manufacturer specifications, see 13, 14.
7, 8, 9	Numeric value of the performance in kW
10, 11, 12	Engine speed in rpm
13, 14	Time limiting of the available performance in hours (h)
15	Height above sea level (conditions at installation site)
16	Air pressure p_x in mbar (conditions at installation site)
17	Charge air coolant temperature t_{cx} in °C (conditions at installation site)
18	Relative humidity F_x in % (conditions at installation site)
19	Air temperature t_x in °C (conditions at installation site)
20, 21, 22	Numeric value of an auxiliary device in kW (F, G, H)

Designation of the engine sides, cylinder and direction of rotation

The four sides of the engine normally carry the following designations in practice (see Figure 2-3):

The designation used in this operating manual is highlighted respectively in **bold** print and corresponds with DIN ISO 1204.

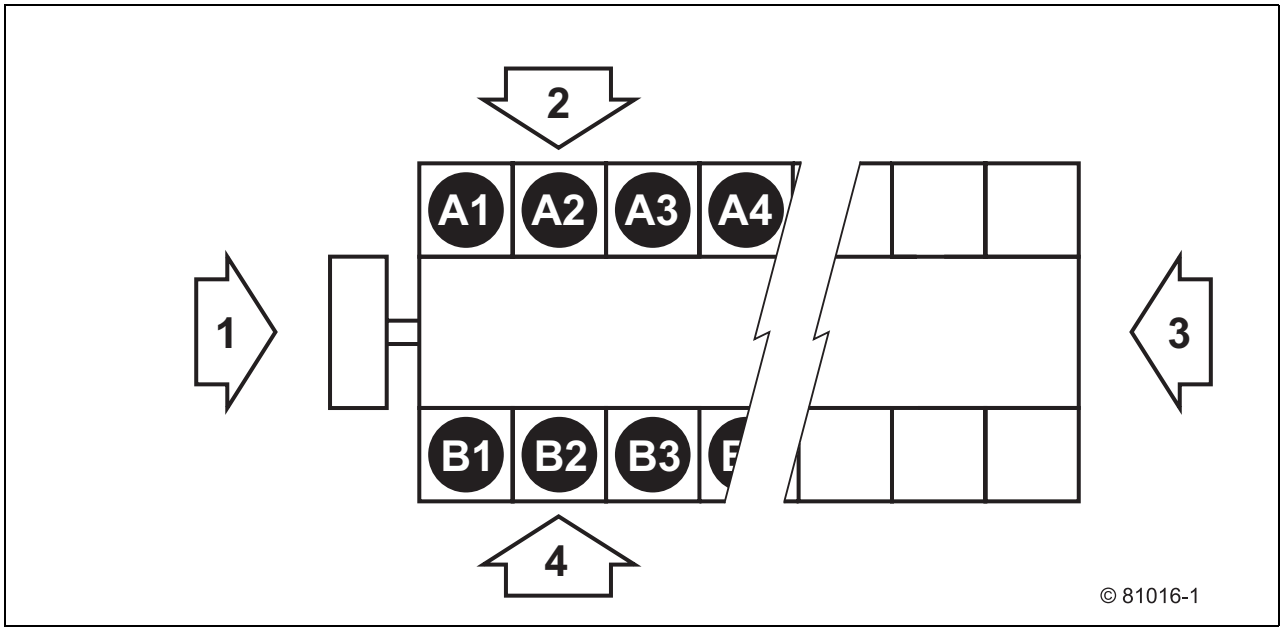


Figure 2-3 Designation of the engine sides and cylinders

Engine sides

1	**Drive side**	Flywheel, clutch side
2	**Left side**	Cylinder side **A**
3	**Free side**	End, damper, fluid pump, clutch opposite side
4	**Right side**	Cylinder side **B**

Cylinder numbering

... counted and labelled from the drive side.

Direction of rotation

Looking towards the drive side in anticlockwise direction ”left-hand rotation”

Engine figures

Left side

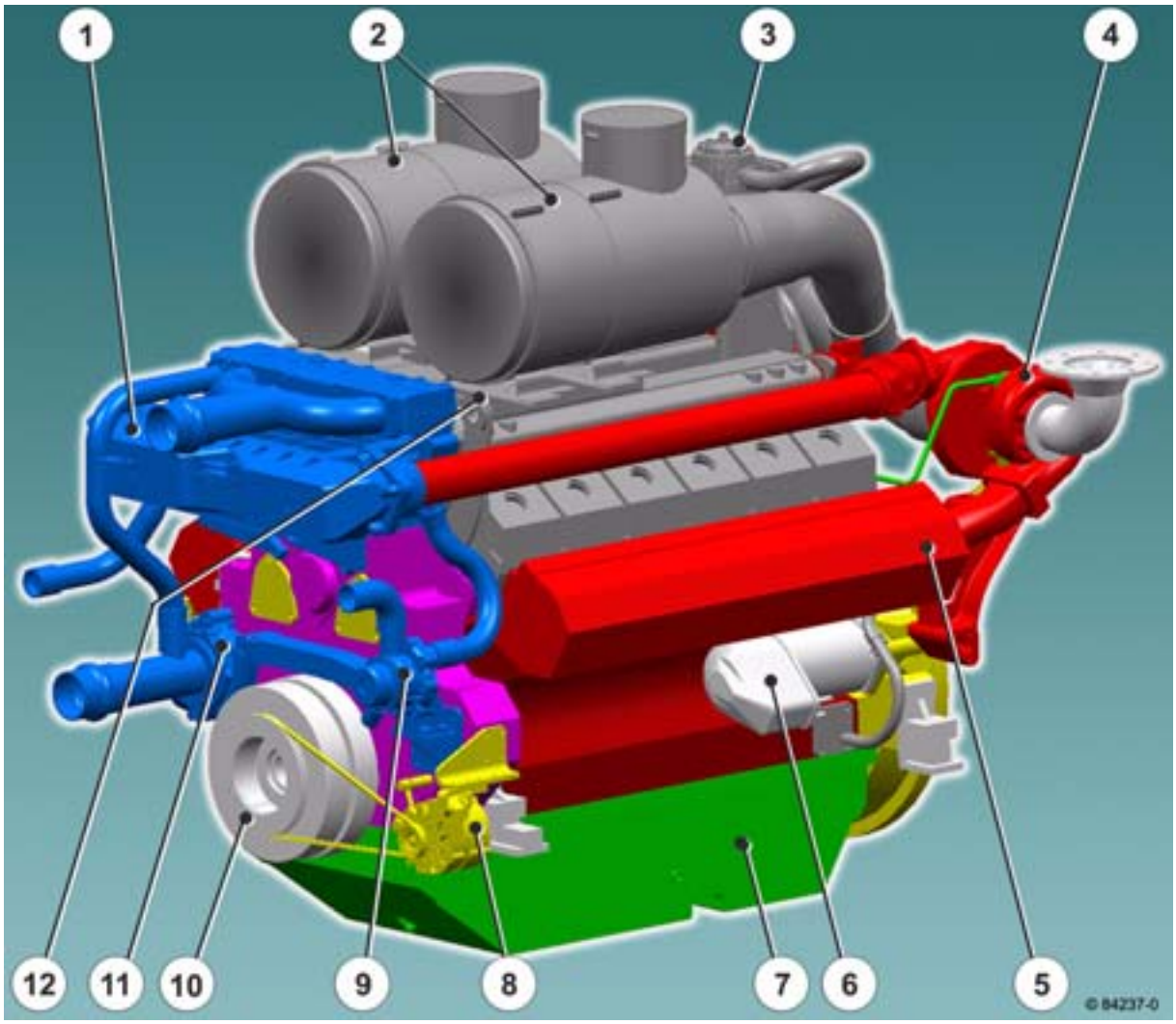


Figure 2-4 Engine, left side

1 Charge air cooler
2 Suction air intake filter
3 Crankcase bleed valve
4 Exhaust gas turbocharger cylinder side A
5 Heat insulation cladding PEARL exhaust pipe
6 Starter
7 Oil pan
8 Rotary current alternator
9 Coolant pump of the charge air cooler
10 Rotary vibration damper
11 Coolant pump engine cooling circuit
12 Holder for attaching the engine (second holder on the diagonally opposite side)

Right side

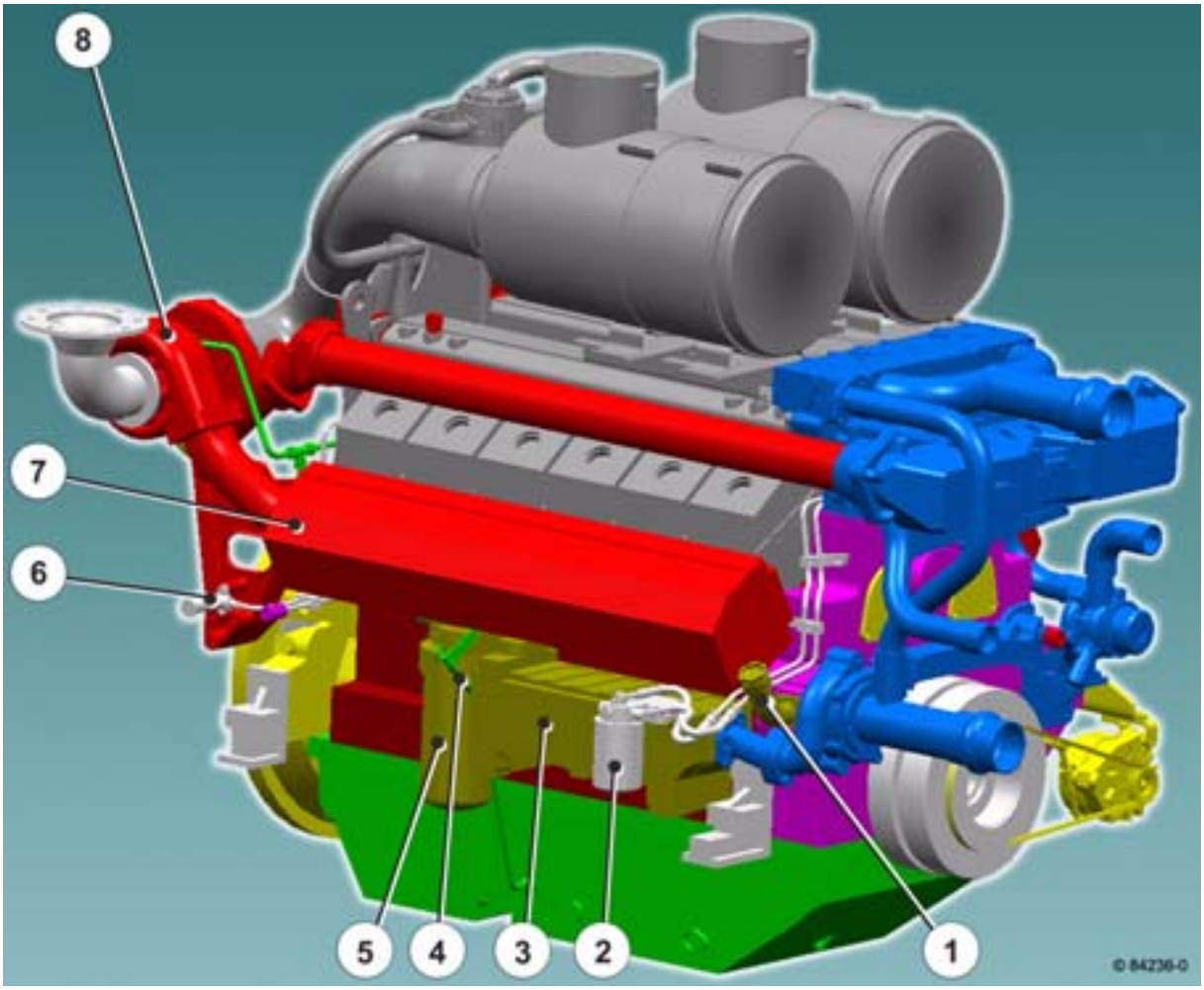


Figure 2-5 Engine, right side

1 Lube oil nozzle
2 Fuel filter
3 Lube oil cooler
4 Oil dipstick
5 Lube oil filter
6 Fuel hand pump
7 Heat insulation cladding PEARL exhaust pipe
8 Exhaust gas turbocharger cylinder side B

Drive side

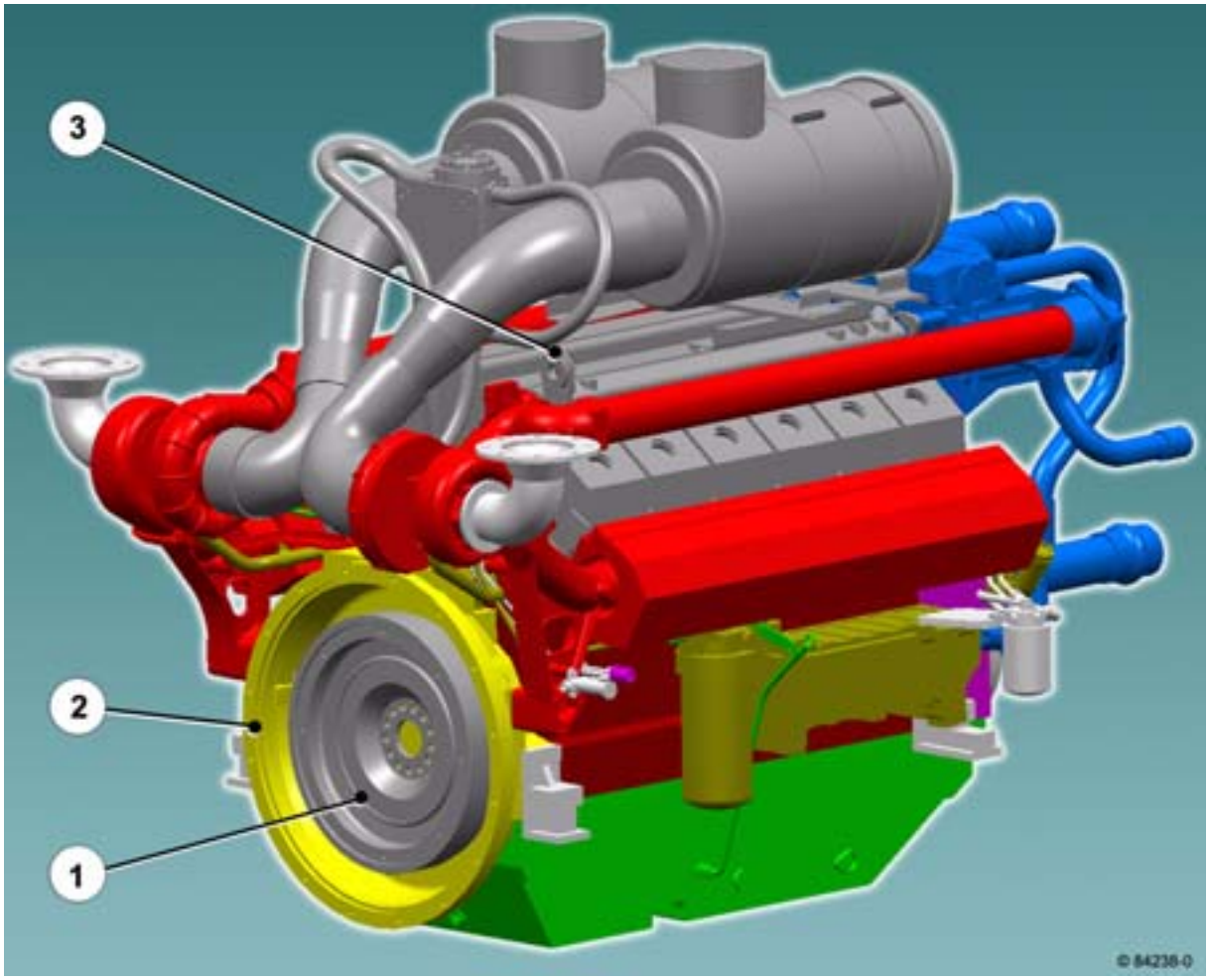


Figure 2-6 Engine, drive side

1 Flywheel
2 Flywheel housing
3 Holder for attaching the engine (second holder on the diagonally opposite side)

Structure and function

Crankcase

The crankcase is made from a special alloyed casting. Torsional strength, breaking strength and casting tightness which enable low weight and compactness distinguish this manufacturing method. The side walls of the crankcase are pulled down below the center of the crankshaft and therefore guarantee additional torsional strength. The cylinder angle of 60° enables a narrow design which is demanded in many applications.

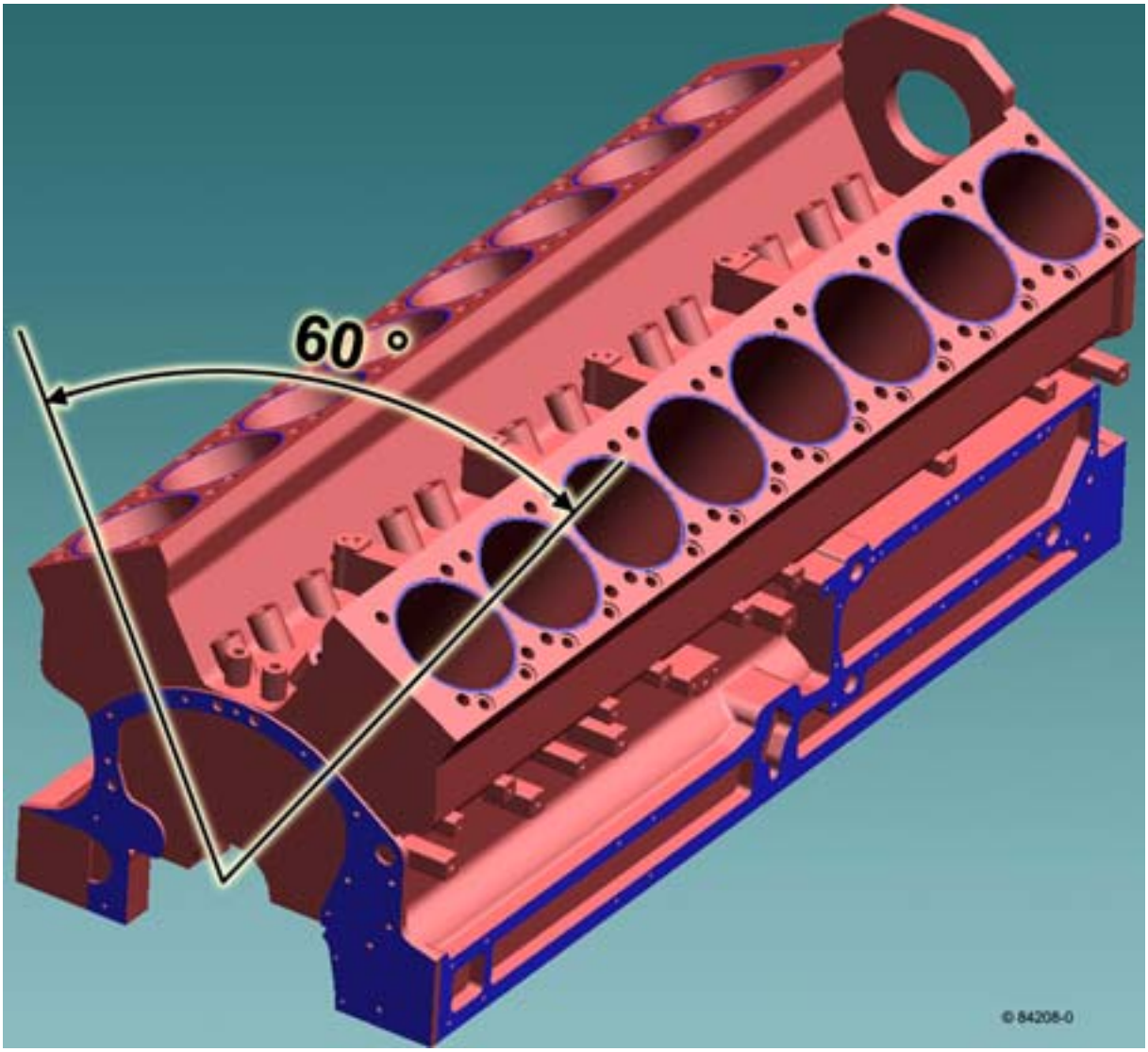


Figure 2-7 Crankcase

Crankcase bleeding (Racor)

Fumes are produced in the crankcase during engine operation. To protect the environment these fumes are not allowed to escape into the atmosphere but are fed into a closed crankcase bleeding system. In this crankcase bleeding system the filter performs important functions.

The fumes flowing into the filter first pass the pressure control valve which is mounted centrally in the top part of the filter system. After passing the filter element the purified residual gases are fed to the suction line between the suction air intake filter and the turbocharger.

The pressure regulator consists of a diaphragm valve loaded both sides. It controls the crankcase pressure while at the same time vacuum pressures from the suction intake system settle at an upper limit. Pulsating pressure peaks are limited as a result.

An optical indicator signals it is time to change the filter element.

The exchangeable and recyclable filter element consists of a micro glass fibre structure with a filter effect up to 0.3 µm. This can be changed without tools due to quick-change catches. The filtered oil particles collect in the sump of the filter casing and are fed back into the oil circuit by a return line.

A floor valve prevents gas getting in through the return line. The oil returns on exceeding the pressure difference between the filter and crankcase or at engine standstill.

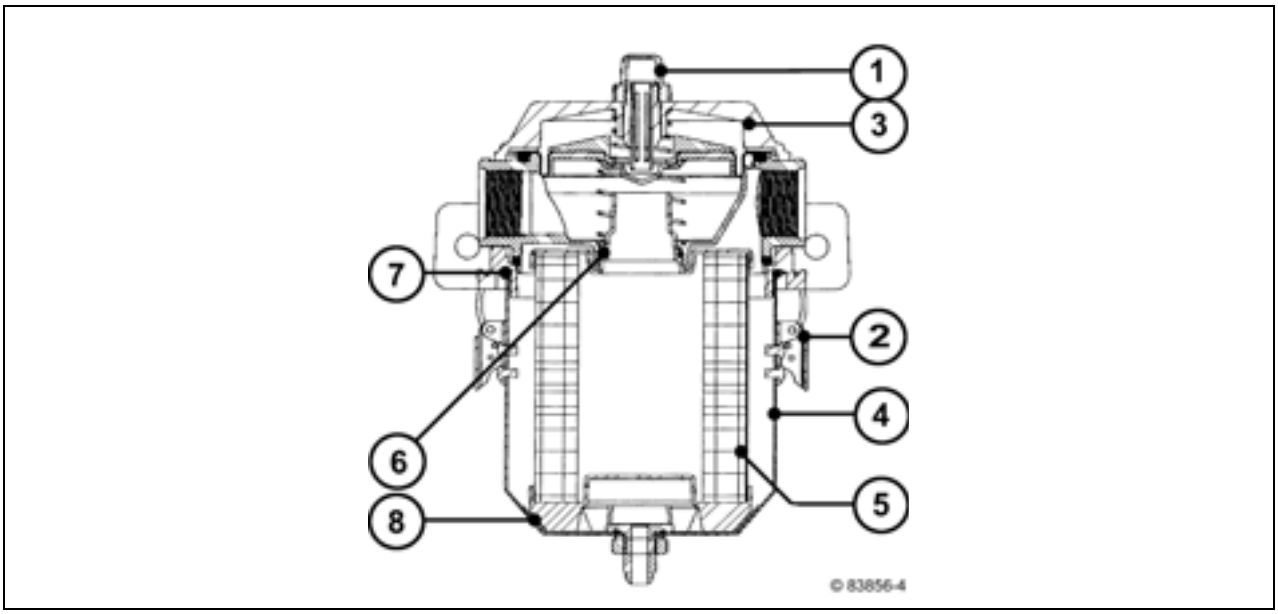


Figure 2-8 Crankcase bleed valve

1 Optical indicator for due change of filter element
2 Quick-release catches
3 Filter top with integrated pressure regulator
4 Powder-coated metal housing
5 Filter element
6 Round sealing ring
7 Round sealing ring
8 Floor insert

This crankcase bleeding system achieves that:

- the engine room and system are not contaminated by oil fumes,
- the smell in the immediate vicinity is reduced,
- environmental pollution is reduced,
- charge air cooler, turbocharger and inlet valves are better protected against soiling.

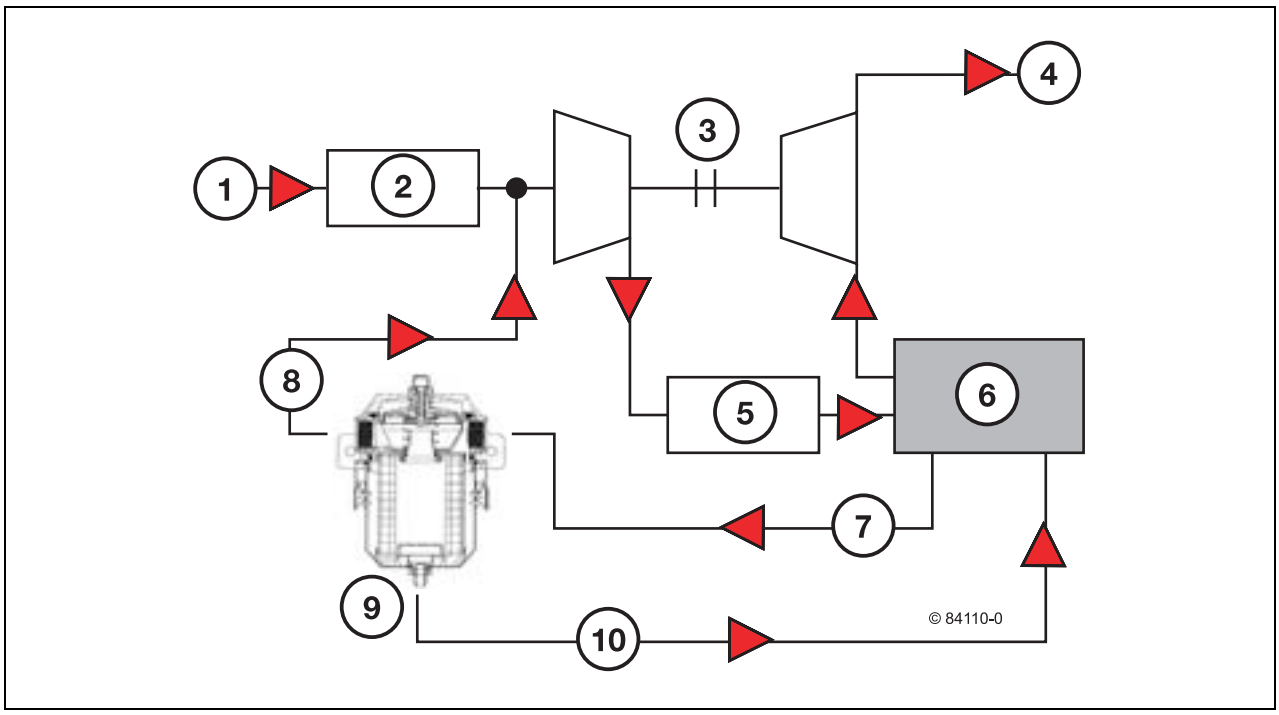


Figure 2-9 Schematic of the crankcase bleeding system

1 Sucked in air
2 Suction air intake filter
3 Turbocharger
4 Exhaust gas
5 Charge air cooler
6 Engine
7 Line for fumes to the filter system
8 Line for filtered fumes into the suction line
9 Filter
10 Return to the oil pan

Crank drive and valve drive

The crank drive comprises crankshaft, con rod, piston, rotary vibration damper and the flywheel.

The drop-forged crankshaft 1 is hung in multilayer bearings in the crankcase 7. Every bearing cover is secured by four studs. Multilayer bearings offer greater lubrication security and emergency running properties. The shaft and crank journals and the contact surfaces of the axial bearings are inductively hardened. The counterweights 9 screwed to the crank webs serve to dissipate the internal mass effect and relieve the crankshaft bearing. The rotary vibration damper and the flywheel ensure smooth running of the engine with their structure calculated exactly for every application.

The double T-shank con rods 2 are divided at an angle. This allows removal of the piston with con rod up through the cylinder liner 3. The con rods run on the crankshaft in sputter bearings. A liner is pressed into the upper con rod eye in which the piston bolt 4 is mounted on a floating bearing.

The pistons 6 are cast from a lightweight metal. The piston rings 5 (trapeze ring, minute ring and a narrow land drain oil control ring) are in cast steel beams. The pistons are supplied with cooling lube oil through a spray nozzle 8. The lube oil flows through the cooling channels of the piston base where it emits heat.

The cylinder liners 3 are made by a spin casting technique. Special emphasis is placed on honing in the further processing. The cross grinding angle created during honing is asymmetrical is response to the demand for low oil consumption and optimum run-in times. The cylinder liners touch the crankcase and are guided in a collar at the top and bottom.

The use of wet cylinder liners enables fast and low cost exchange of a cylinder unit.

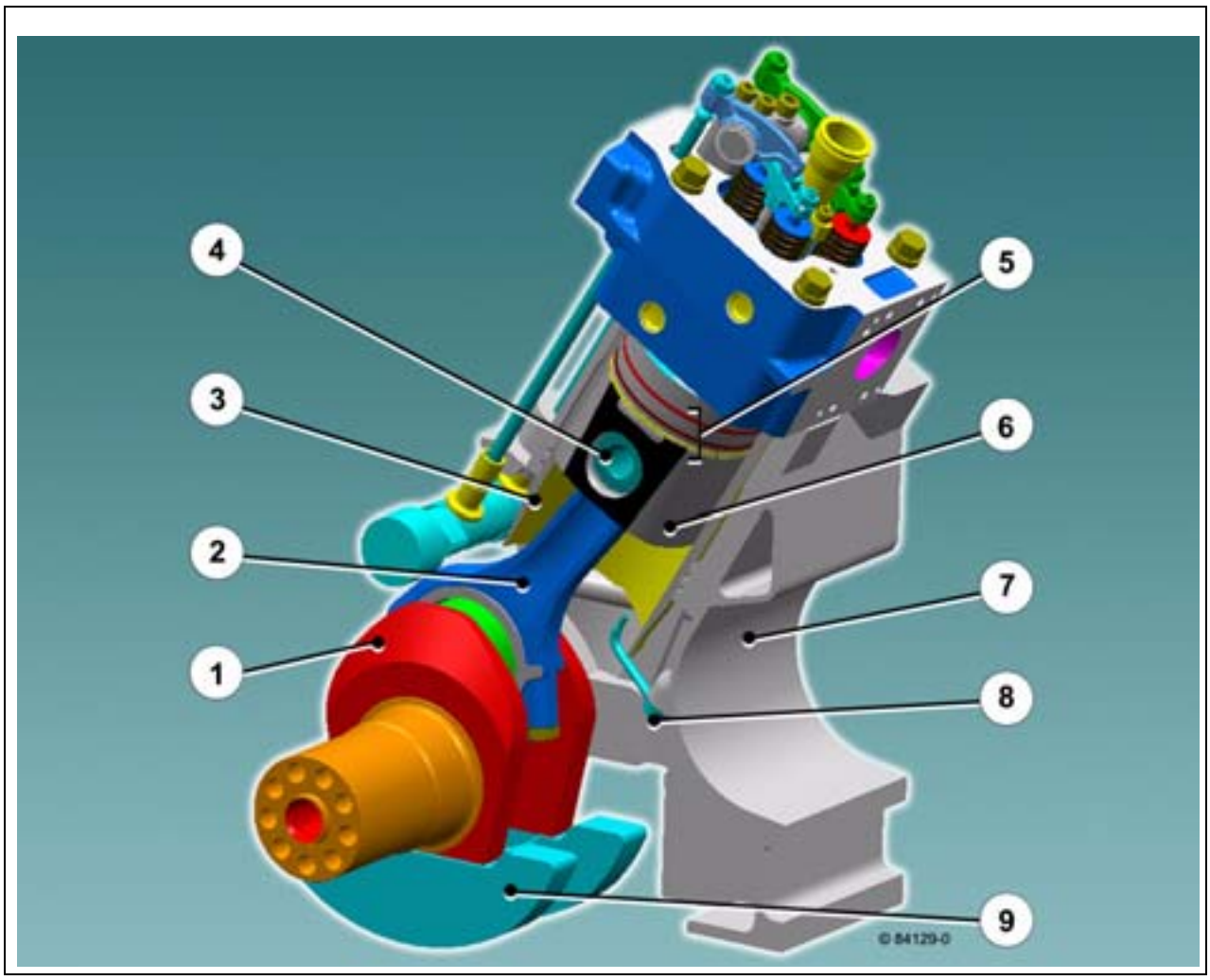


Figure 2-10 Crank and valve drive

1 Crankshaft
2 Con rod
3 Cylinder liner
4 Piston bolt
5 Piston rings
6 Piston
7 Crankcase
8 Oil injection nozzle
9 Counterweights of the crankshaft

Wheel drive

The wheel drive serves for engine control and driving of sub-components.

Engine control unit

The toothed wheel 6 on the crankshaft drives the toothed wheel 3 on the camshaft.

Sub-components

The toothed wheel 3 on the camshaft drives the injection pump via toothed wheel 1. If hydraulic pumps are attached to the engine, toothed wheel 2 or 10, these are driven by toothed wheel 1.

The lube oil pump 7 is driven by toothed wheel 6 on the crankshaft.

If a compressor is installed on the engine, toothed wheel 4, it is driven by the intermediate wheel 5, driven by toothed wheel 6 on the crankshaft.

The coolant pump, toothed wheel 9, is driven by the intermediate wheel 8, driven by toothed wheel 6 on the crankshaft.

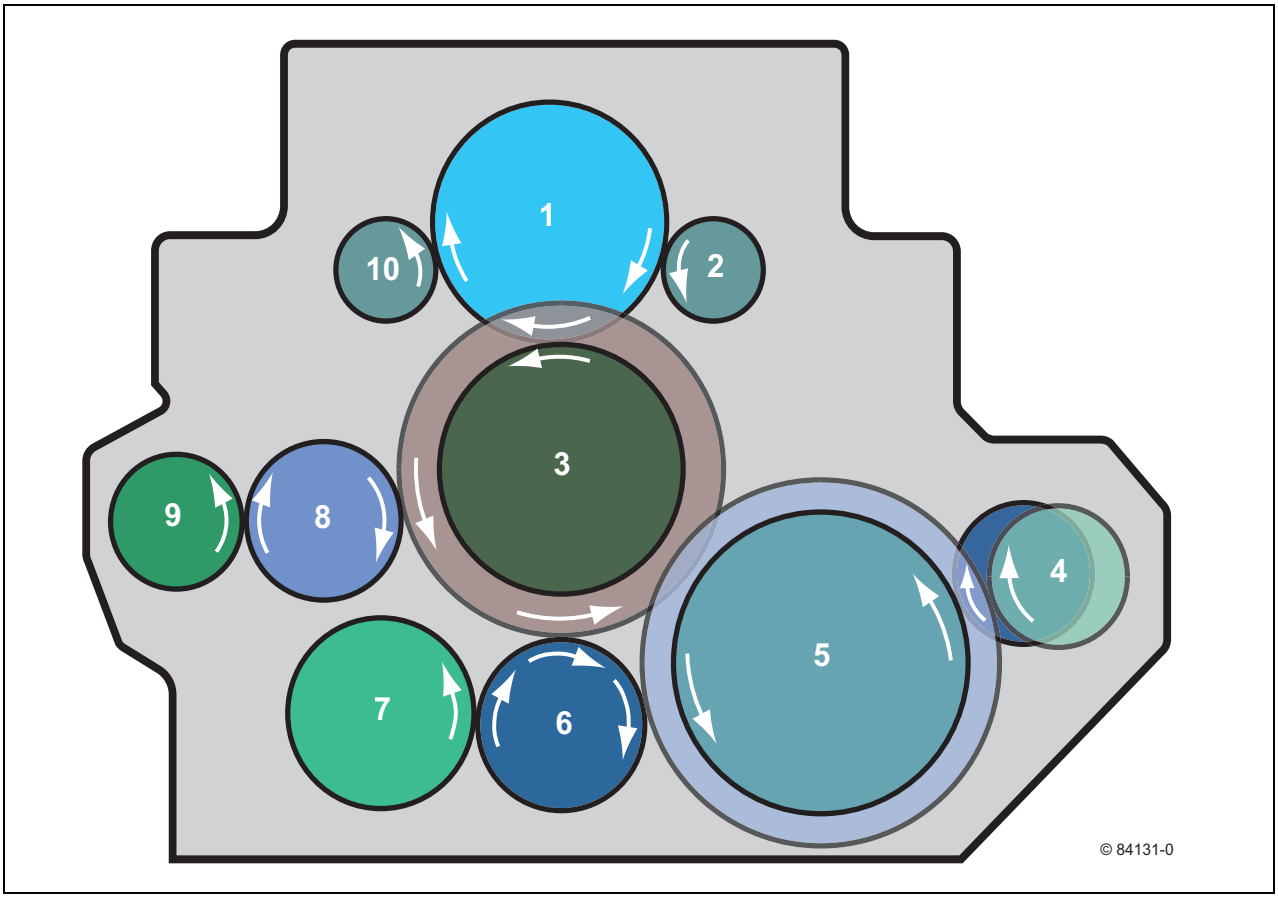


Figure 2-11 Wheel drive on the free side

Gear wheels:

1	Injection pump	6	Crankshaft
2	Hydraulic pump	7	Lube oil pump
3	Camshaft	8	Intermediate wheel
4	Compressor	9	Coolant pump
5	Intermediate wheel	10	Hydraulic pump

Mass compensation shaft (V8 engines only)

Because of the number of cylinders, a mass compensation shaft must run as well in order to be able to achieve low-vibration running of the engine. The mass compensation shaft is driven by a separate wheel drive on the drive side.

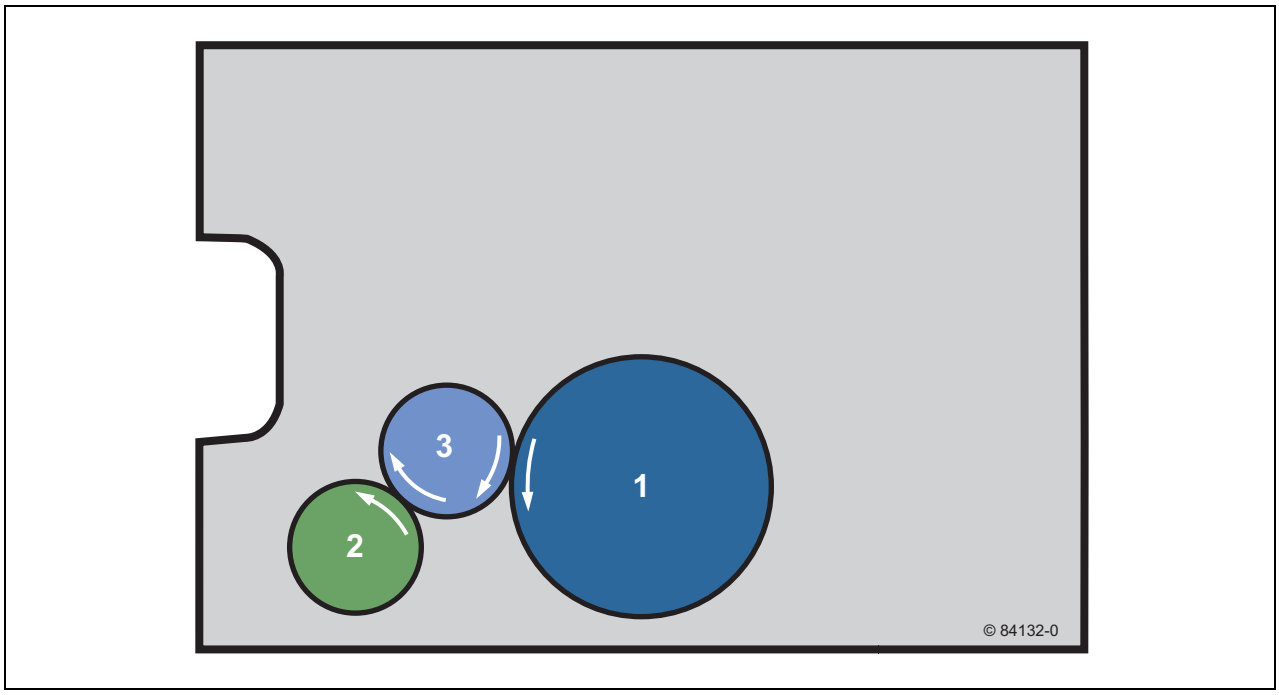


Figure 2-12 Wheel drive of the mass compensation shaft on the drive side

1 Crankshaft
2 Mass compensation shaft
3 Intermediate wheel

Cylinder head

Structure

The cylinder heads are made of a special alloyed casting like the crankcase. One single cylinder head is installed per cylinder. The single cylinder head can be changed very quickly thanks to its excellent accessibility and optimized design.

The channel guide is based on the cross current principle. The cylinder heads are supplied with charge air from the V-chamber via the charge air pipe. The two inlet channels 2 and 3 have different manifolds in the cylinder heads. They are divided into a filling channel 2 and a twist channel 3. The shape of these ensures a change air flow into the combustion chamber which considerably improves the mix formation. The outlet channels 1 end on the respective outside of the engine in the exhaust system in which the exhaust gas energy is not lost but recycled.

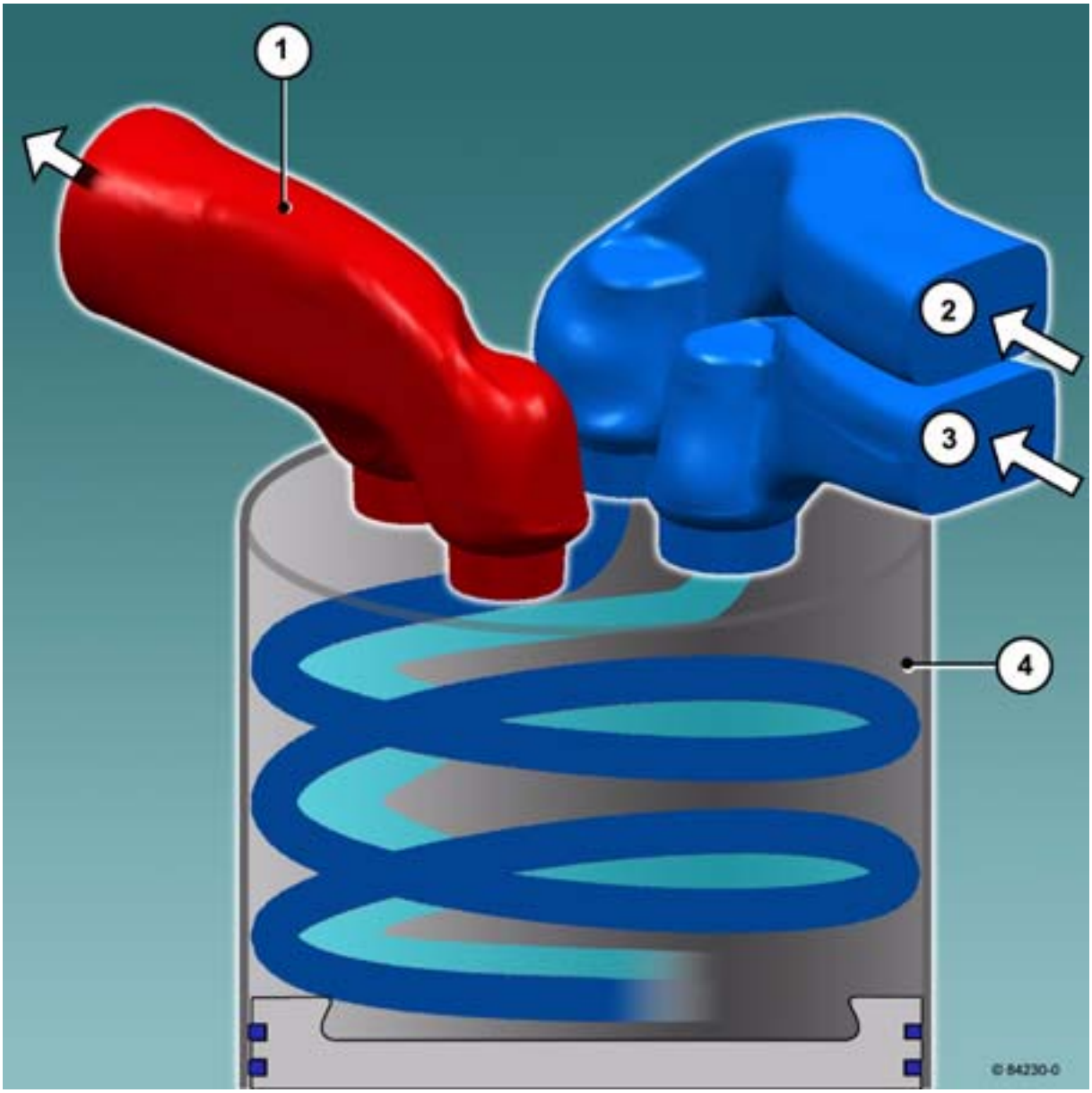


Figure 2-13 Flow through the cylinder head into the combustion chamber

Valve control

The cylinder heads are multi-valve heads, i.e. two inlet valves per cylinder provide for optimum filling and two outlet valves for fast exhaust gas discharge. The high heat-proof valves are fit in the pressed-in and thus easily replaceable valve seat rings. The valves are controlled by a proven valve bridge technique. The valve bridge control operates with very low wear and is extremely maintenance-friendly.

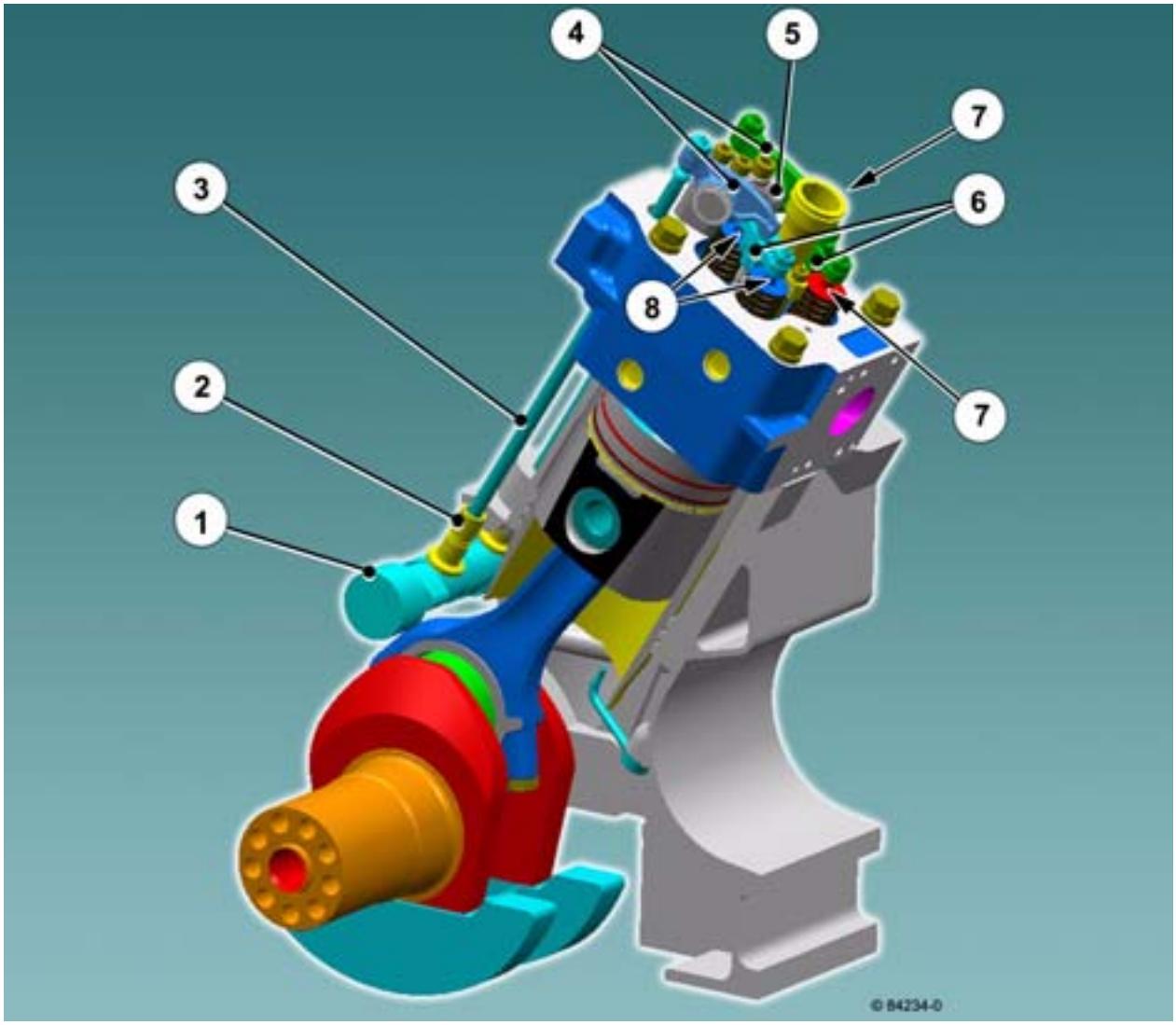


Figure 2-14 Valve control

1	Camshaft	5	Toggle lever block
2	Pilz tappet	6	Valve bridges
3	Tappet rods	7	Outlet valves
4	Rocker arm	8	Inlet valves

Charging

The engine is equipped with a bi-turbocharger and optionally with a liquid-cooled charge air cooler. The bi-turbocharger system shares one row of cylinders each. Therefore one exhaust turbocharger is installed per row of cylinders. The advantage of being equipped with the bi-turbo is in the response behavior for one thing. A small exhaust turbocharger builds up the necessary charge air pressure in a short time. On the one hand the whole engine output is available, on the other hand the typical black smoke is virtually eliminated.

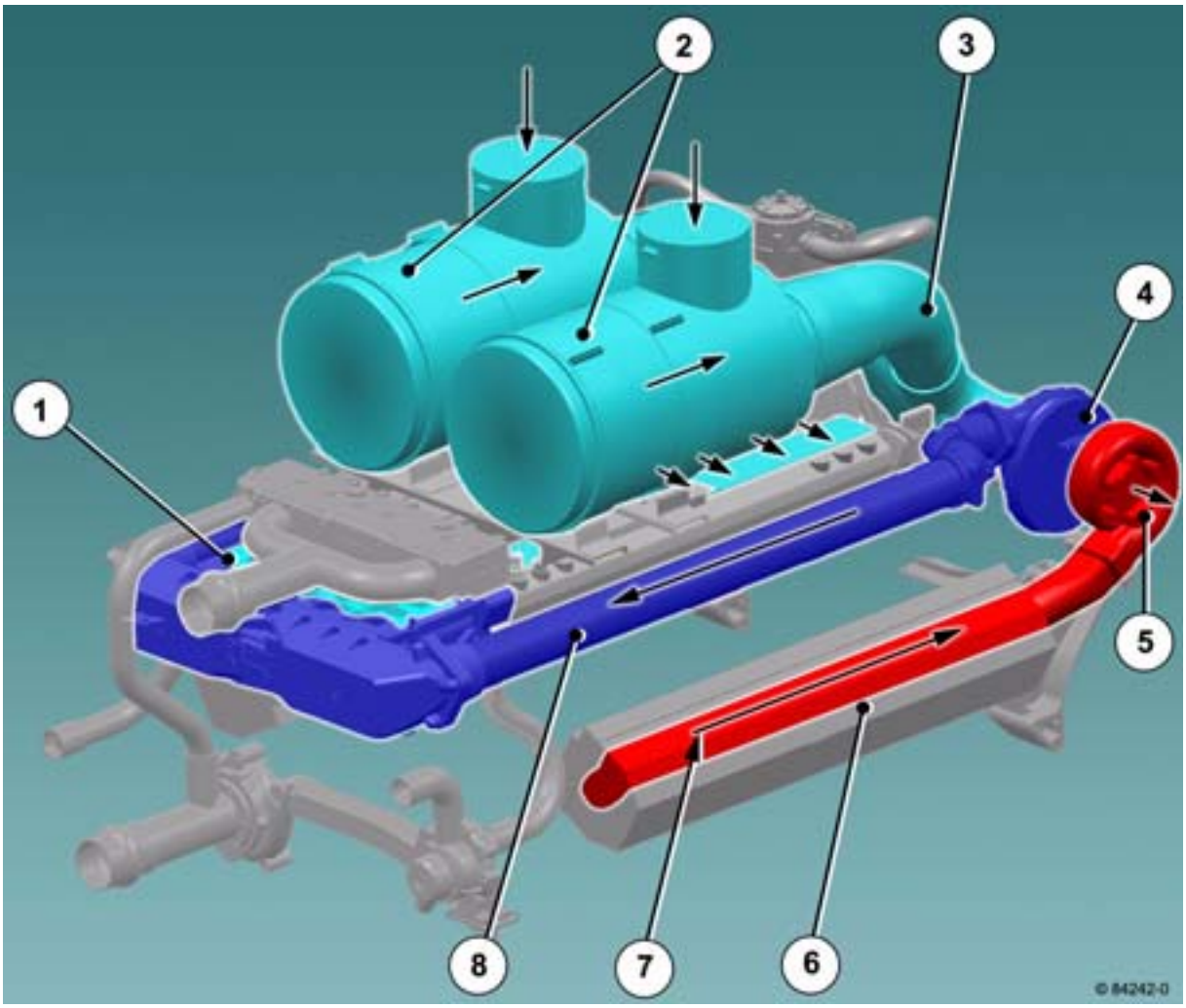


Figure 2-15 Suction intake / charge air path (liquid-cooled charge air cooler)

1 Charge air cooler
2 Air filter
3 Air suction intake pipe
4 Turbocharger compressor
5 Exhaust gas turbine of the turbocharger
6 Heat insulation cladding
7 Exhaust pipe (DEUTZ PEARL® System)
8 Charge air line

Charge air heated by the turbocharger

Cool intake air and charge air cooled by the charge air cooler

Hot exhaust gases

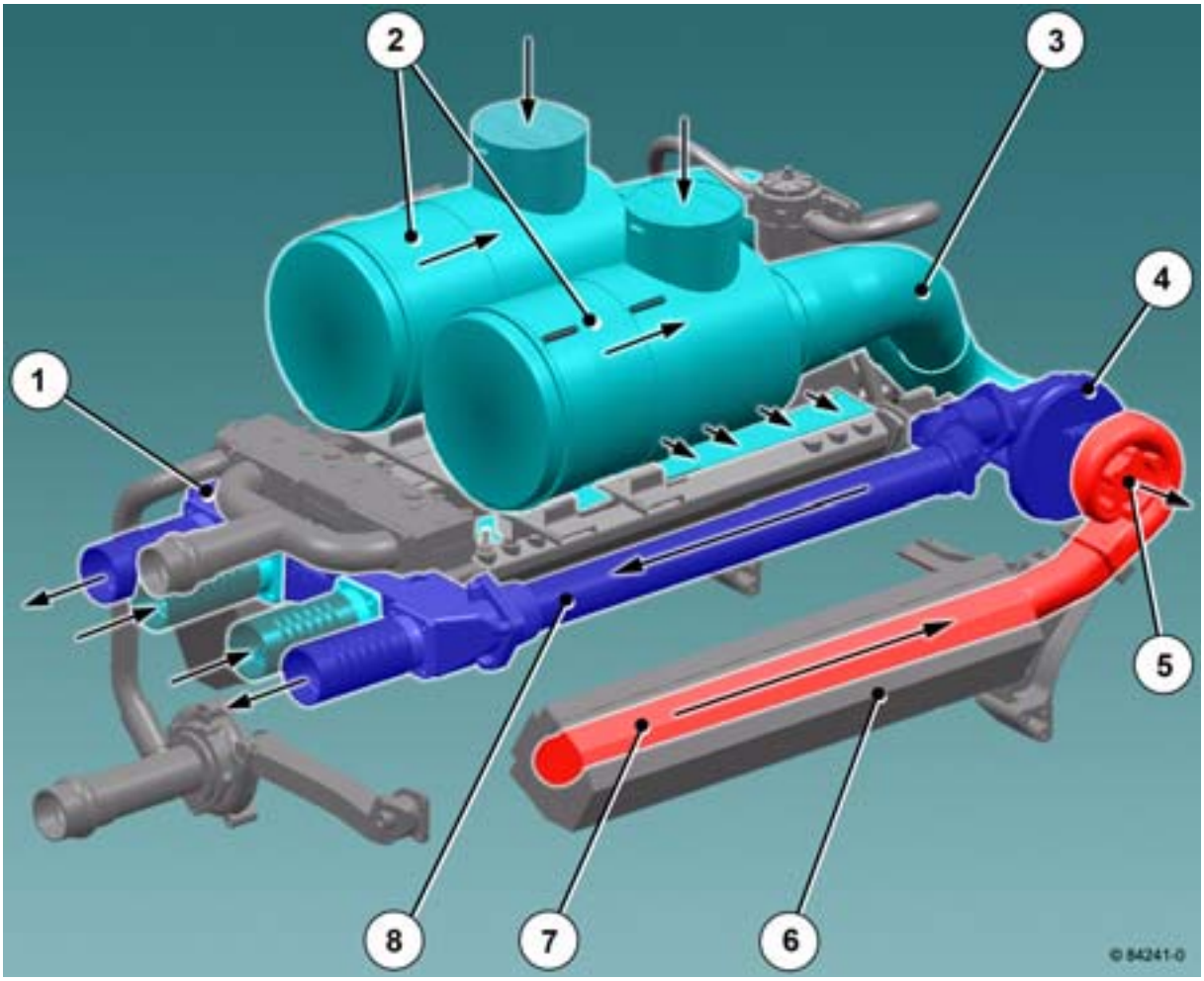


Figure 2-16 Suction intake / charge air path (air / air charge air cooling)

1 Charge air housing
2 Air filter
3 Air suction intake pipe
4 Turbocharger compressor
5 Exhaust gas turbine of the turbocharger
6 Heat insulation cladding
7 Exhaust pipe (DEUTZ PEARL® System)
8 Charge air line

Charge air heated by the turbocharger

Cool intake air and charge air cooled by the charge air cooler

Hot exhaust gases

Schematic diagram of the charge air circuit (with liquid-cooled charge air cooler)

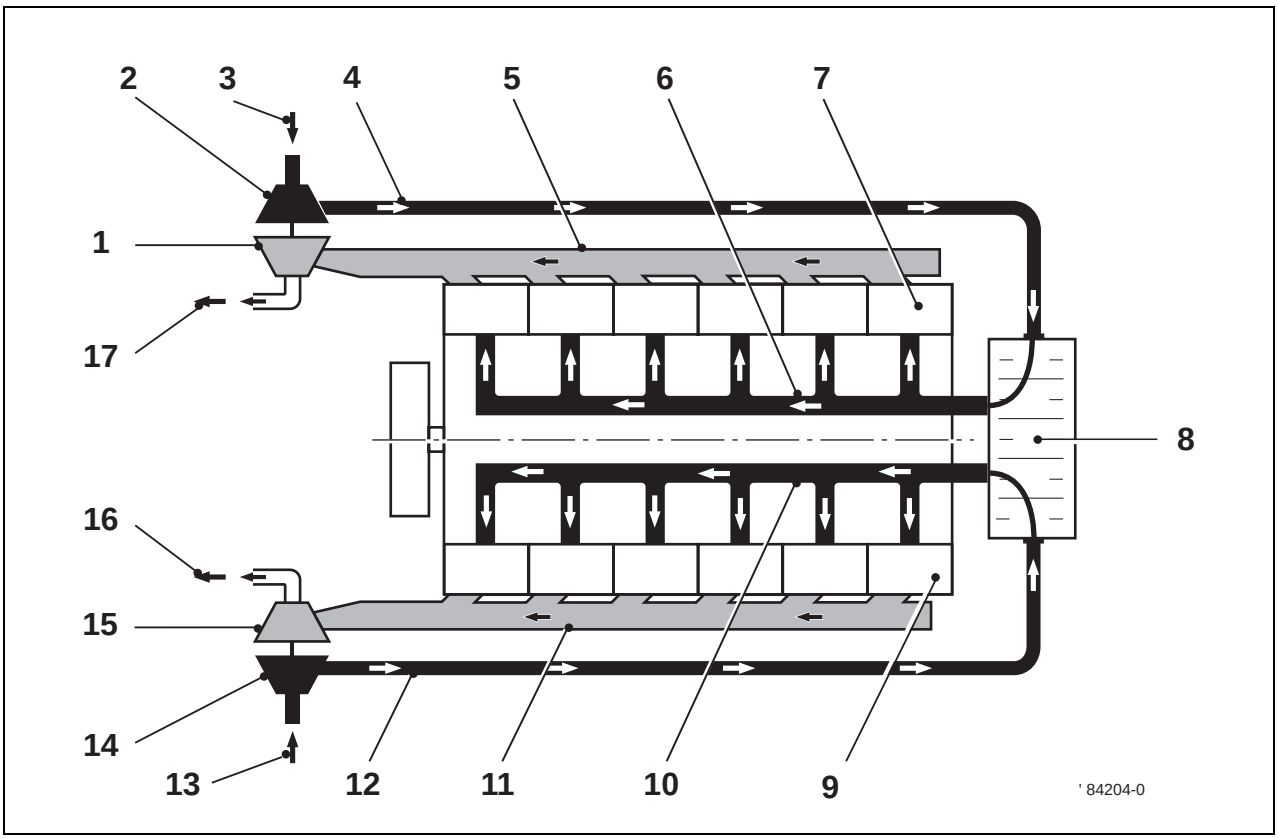


Figure 2-17 Charge air circuit (with liquid-cooled charge air cooler)

1 Exhaust gas turbine of the turbocharger cylinder side A
2 Compressor turbine of the turbocharger cylinder side A
3 Suction intake air cylinder side A
4 Charge air pipe cylinder side A
5 DEUTZ PEARL® exhaust pipe cylinder side A
6 Charge air pipe cylinder side A
7 Cylinder heads cylinder side A
8 Charge air cooler
9 Cylinder heads cylinder side B
10 Charge air pipe cylinder side B
11 DEUTZ PEARL® exhaust pipe cylinder side B
12 Charge air pipe cylinder side B
13 Suction intake air cylinder side B
14 Compressor turbine of the turbocharger cylinder side B
15 Exhaust gas turbine of the turbocharger cylinder side B
16 Exhaust gas discharge cylinder side B
17 Exhaust gas discharge cylinder side A

Schematic diagram of the charge air circuit (air / air charge air cooler)

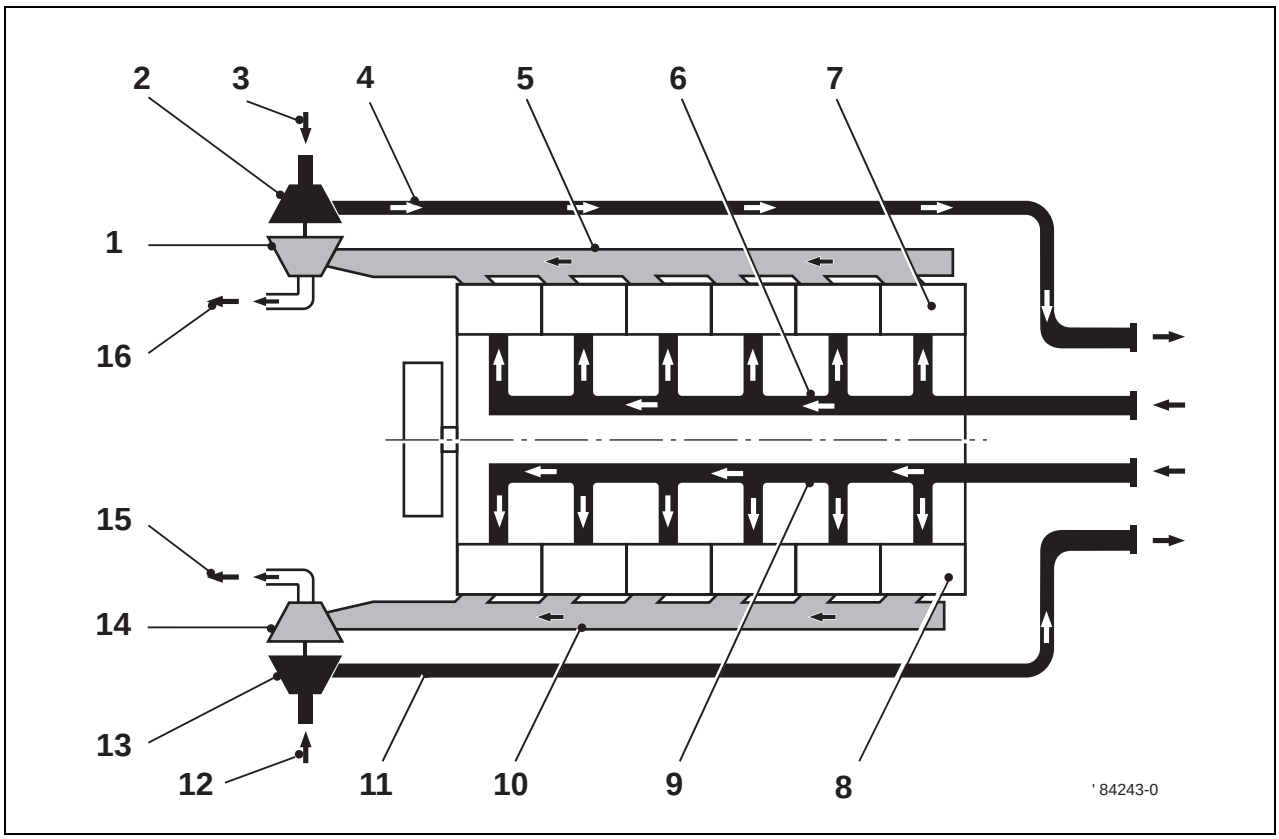


Figure 2-18 Charge air circuit (air / air charge air cooling)

1 Exhaust gas turbine of the turbocharger cylinder side A
2 Compressor turbine of the turbocharger cylinder side A
3 Suction intake air cylinder side A
4 Charge air pipe cylinder side A
5 DEUTZ PEARL® exhaust pipe cylinder side A
6 Charge air pipe cylinder side A
7 Cylinder heads cylinder side A
8 Cylinder heads cylinder side B
9 Charge air pipe cylinder side B
10 DEUTZ PEARL® exhaust pipe cylinder side B
11 Charge air pipe cylinder side B
12 Suction intake air cylinder side B
13 Compressor turbine of the turbocharger cylinder side B
14 Exhaust gas turbine of the turbocharger cylinder side B
15 Exhaust gas discharge cylinder side B
16 Exhaust gas discharge cylinder side A

Exhaust gas system

Exhaust system with the DEUTZ PEARL® System

The 12 and 16-cylinder engines are equipped with the DEUTZ PEARL® system patented by DEUTZ. The DEUTZ PEARL® system allows a more effective utilization of the exhaust gas energy by special shaping and joining of the exhaust pipe elements. This generates a backup in the two turbochargers resulting in a higher turbocharger performance.

The PEARL exhaust pipe elements 1 are connected to compensators 2. They take care of not only the simple connection between the PEARL exhaust pipe elements but also compensate the heat stresses which occur during the warm-up phase, operation and after shutting down the engine.

The PEARL exhaust gas elements are surrounded by a heatproof housing.

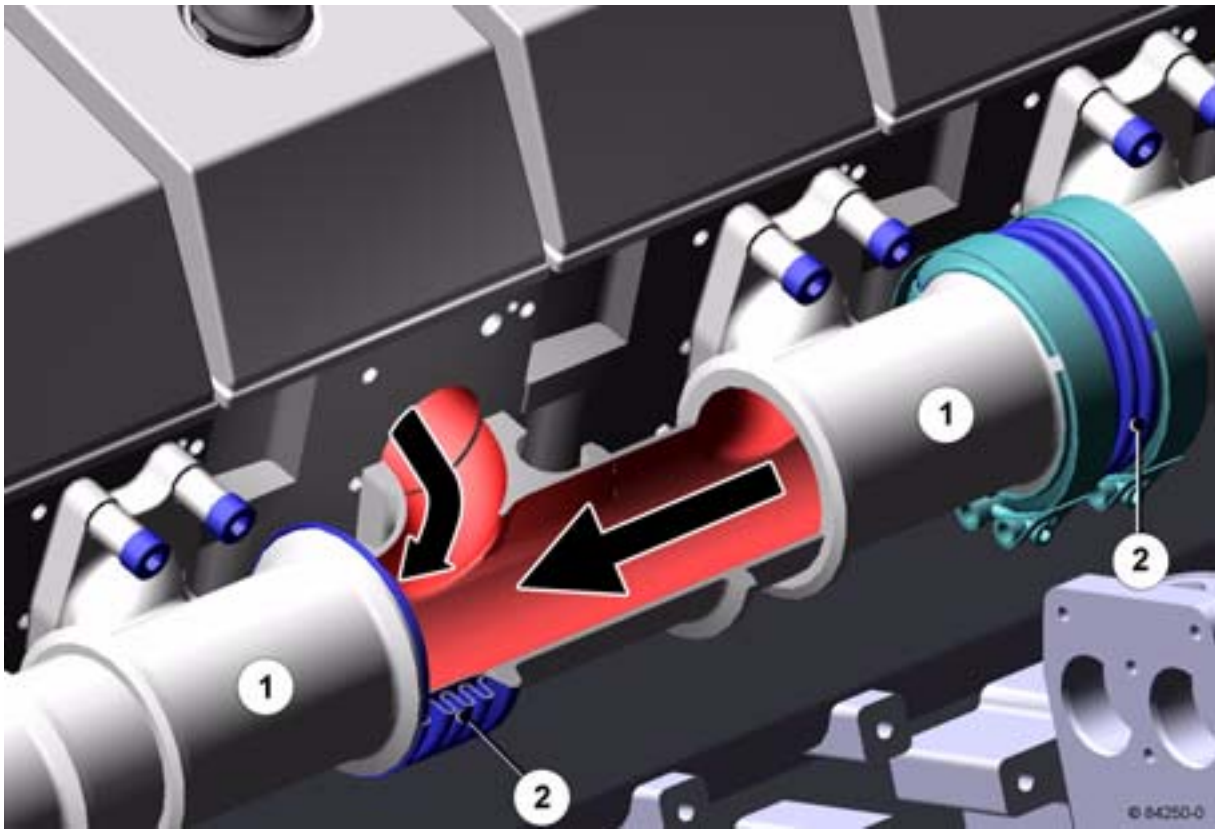


Figure 2-19 **DEUTZ PEARL® System**

Surge charging

The V8 engine is equipped with a surge charging exhaust gas system. The gases enter the exhaust pipe according to the order of ignition. The resulting pressure waves are combined so that a surge charging takes place on the turbocharger.

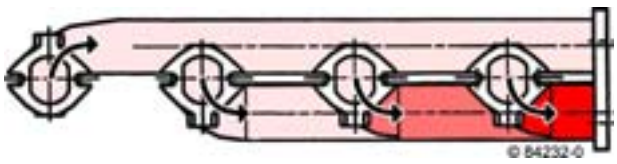


Figure 2-20 Surge charging

Fuel system

Emissions

Bi-Turbo system with charge air cooling, cross current cylinder heads with twist channels, pistons, multi-hole injection nozzles in connection with the high-pressure injection system, DEUTZ PEARL® System, all components which contribute to the progressive emission behavior of the engine are adapted to each other with absolute accuracy. All the limit value specifications are complied with as a result.

Injection

The engines are equipped with a high-pressure injection system. The eight and twelve-cylinder engine operates with one, the sixteen cylinder engine with two high-pressure series injection pumps which are installed in the combustion chamber protected by the cylinder banks. The injection pump drive consists of a maintenance free laminar clutch. The connection between the two series injection pumps of the sixteen cylinder engine is guaranteed by a proven arched denture clutch.

The injection valves operate with multi-hole injection nozzles. Eight injection holes arranged on two levels guarantee optimum fuel distribution and mix formation.

Figure 2-21 Spray behavior of the multi-hole nozzle

Fuel pipe system

Fuelpipe system V8 engine

The layout of the fuel pipes is shown in the following figures.

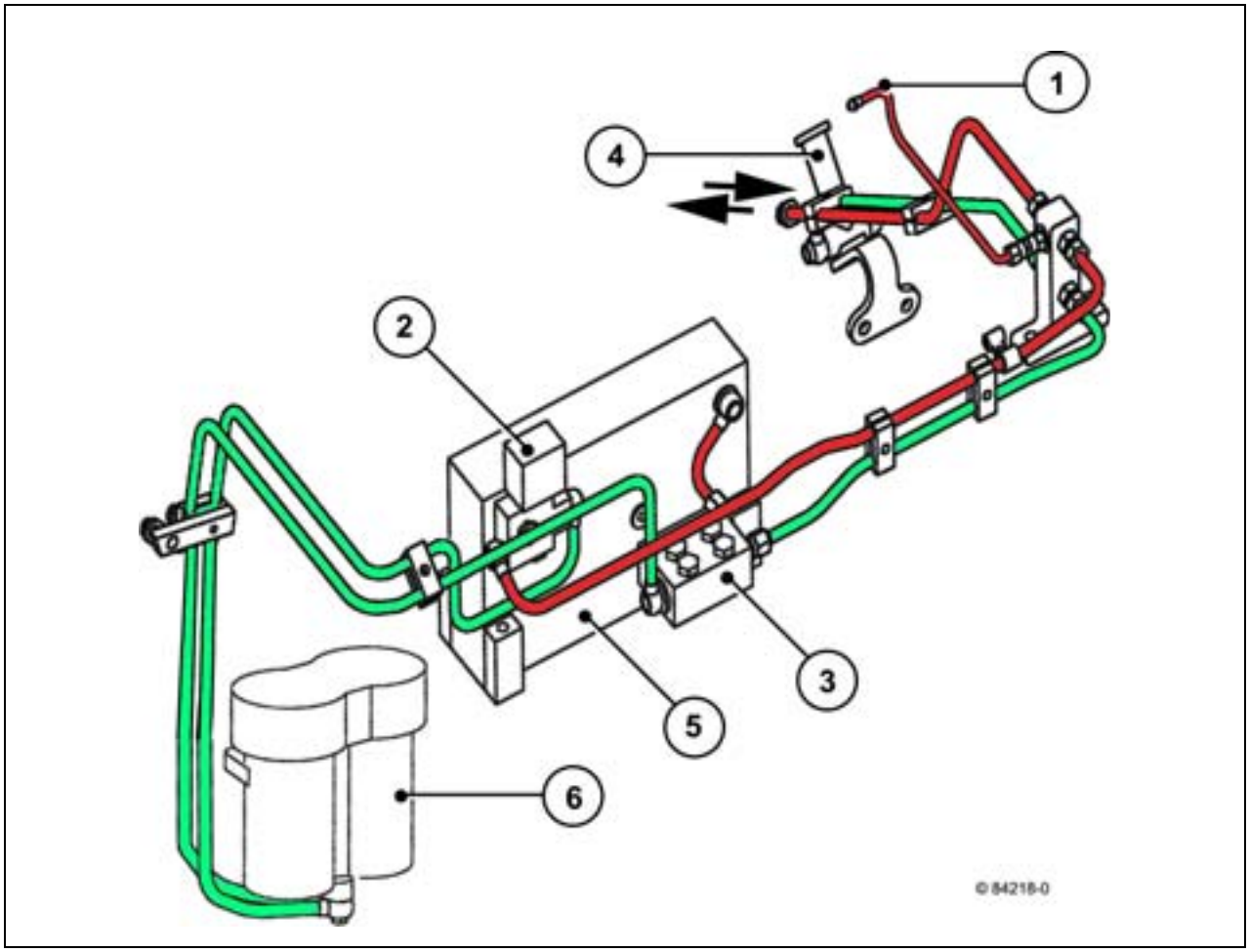


Figure 2-22 Fuel pipes V8 engine

1	Leak fuel pipe	4	Fuel hand pump
2	Solenoid valve engine shutdown	5	Series injection pump
3	Fuel pump	6	Fuel filter

Fuel pipe, supply to series injection pump

Fuel pipe, return from series injection pump

Fuel pipe system V12 engine

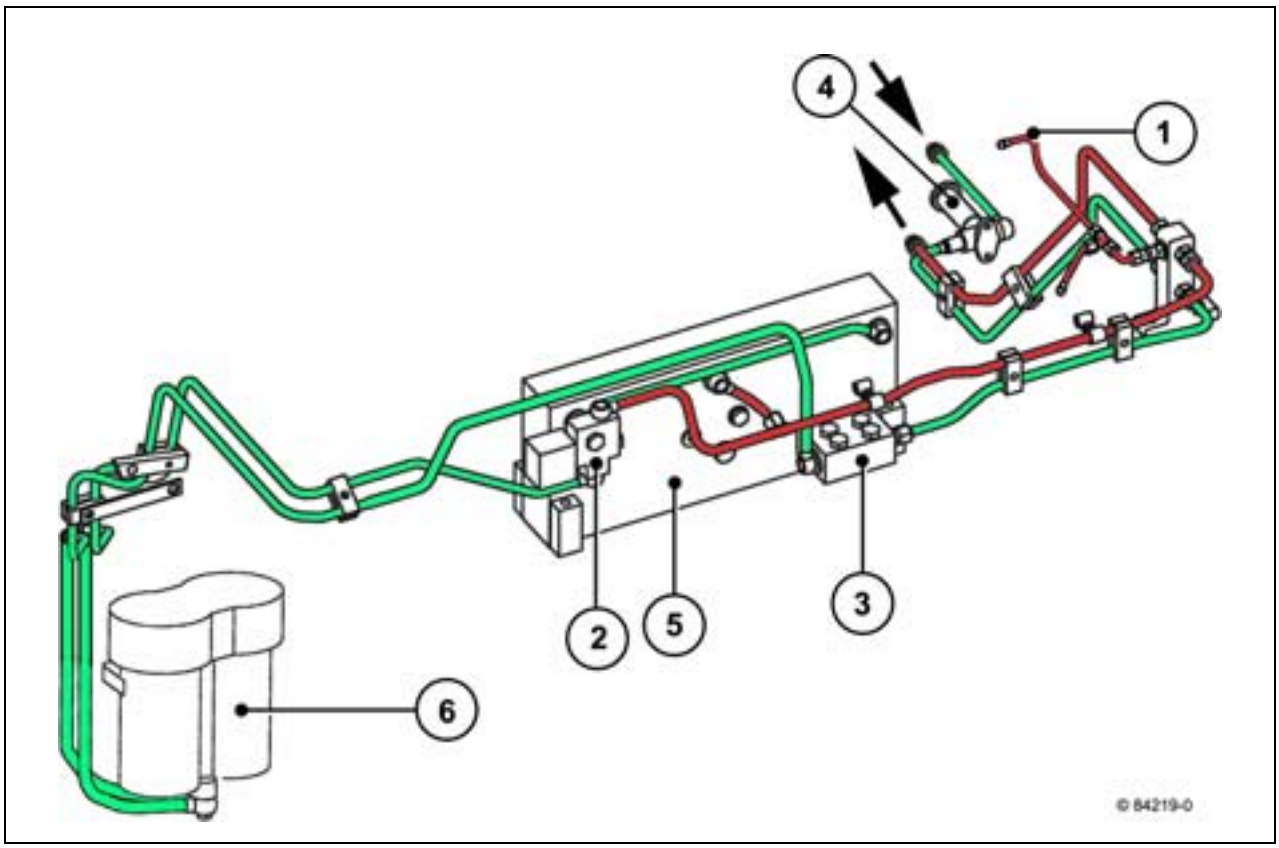


Figure 2-23 Fuel pipes V12 engine

1	Leak fuel pipe	4	Fuel hand pump
2	Solenoid valve engine shutdown	5	Series injection pump
3	Fuel pump	6	Fuel filter

Fuel pipe, supply to series injection pump

Fuel pipe, return from series injection pump

Fuel pipe system V 16 engine

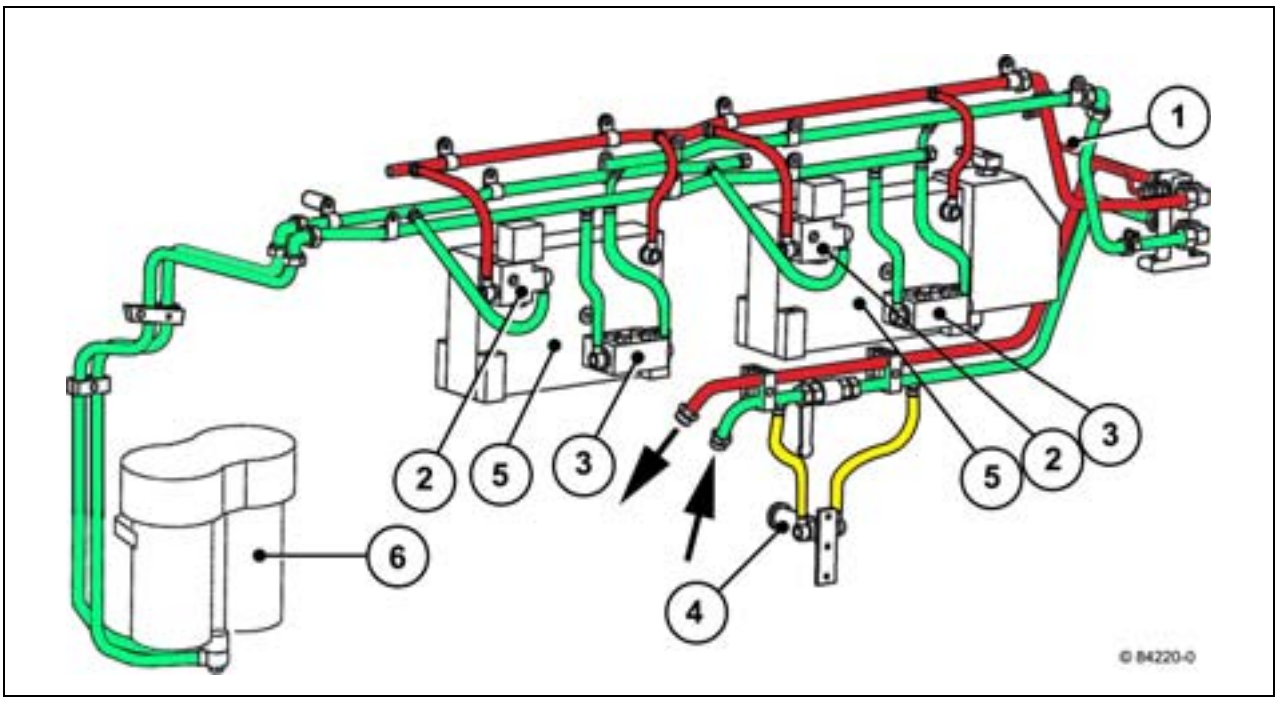


Figure 2-24 Fuel pipes V16 engine

1	Leak fuel pipe	4	Fuel hand pump
2	Solenoid valve engine shutdown	5	Series injection pump
3	Fuel pump	6	Fuel filter

	Fuel pipe of fuel hand pump
	Fuel pipe, supply to series injection pump
	Fuel pipe, return from series injection pump

Speed regulation

The task of speed governing systems is to influence the fuel supply to the engine by adjusting the injection pump control rod, in such a way that the performance required from the engine is obtained whilst maintaining a pre-set constant or variable speed.

Two electronic governing systems are available for the engines of the TBD 616 OEM series:

- Heinzmann actuator StG 2040-DP with EMR2 (digital)
- GAC (analog)

The following applies for speed governing systems:

- The speed governing systems are set according to the requirements and application of the engine.
- Settings, blockings and seals of the speed govering systems may not be changed or removed. In the event of manipulations to the governing systems, the warranty and guarantee are voided.
- If new settings become necessary due to repairs or changes in the application conditions, these may only be done by authorized personnel.

Electronic speed governing systems

In their basic design the electronic speed governing systems consist of the following components:

- Magnetic frequency pick-up
- Control device, analog or digital
- Actuator
- Set-point transmitter

The magnetic frequency pick-up records the actual value of the speed on the ring gear of the flywheel and passes it on to the control device. In the control device, which can be an analog or digital design, the actual value is compared to the setpoint. In the case of deviations the control device sends the command to the actuator to adjust the injection pump control bar. The actuator sends a return signal of the control bar position to the control device.

Actuators

Heinzmann actuator

On the internal shaft of the actuator is a multi-pole permanent magnet. Opposite the permanent magnet is a coil body on which is mounted a working coil. If the working coil conducts, torque occurs in one direction, the reversal of the current provides torque in the opposite direction.

The lever attached to the internal shaft is connected to the injection pump control rod with the help of a special connection system. By this means the rotary motion of the internal shaft is transferred directly as a linear movement to the control rod.

The setting of the control output shaft is detected using a non-contact method by a return system mounted firmly on the shaft and then passed to the control device.

On reaching the stop, current limitation is implemented after approx. 20 seconds, which reduces the actuator current to such an extent that no damage is suffered by the actuator.

Emergency stop is possible with an additional stop lever.

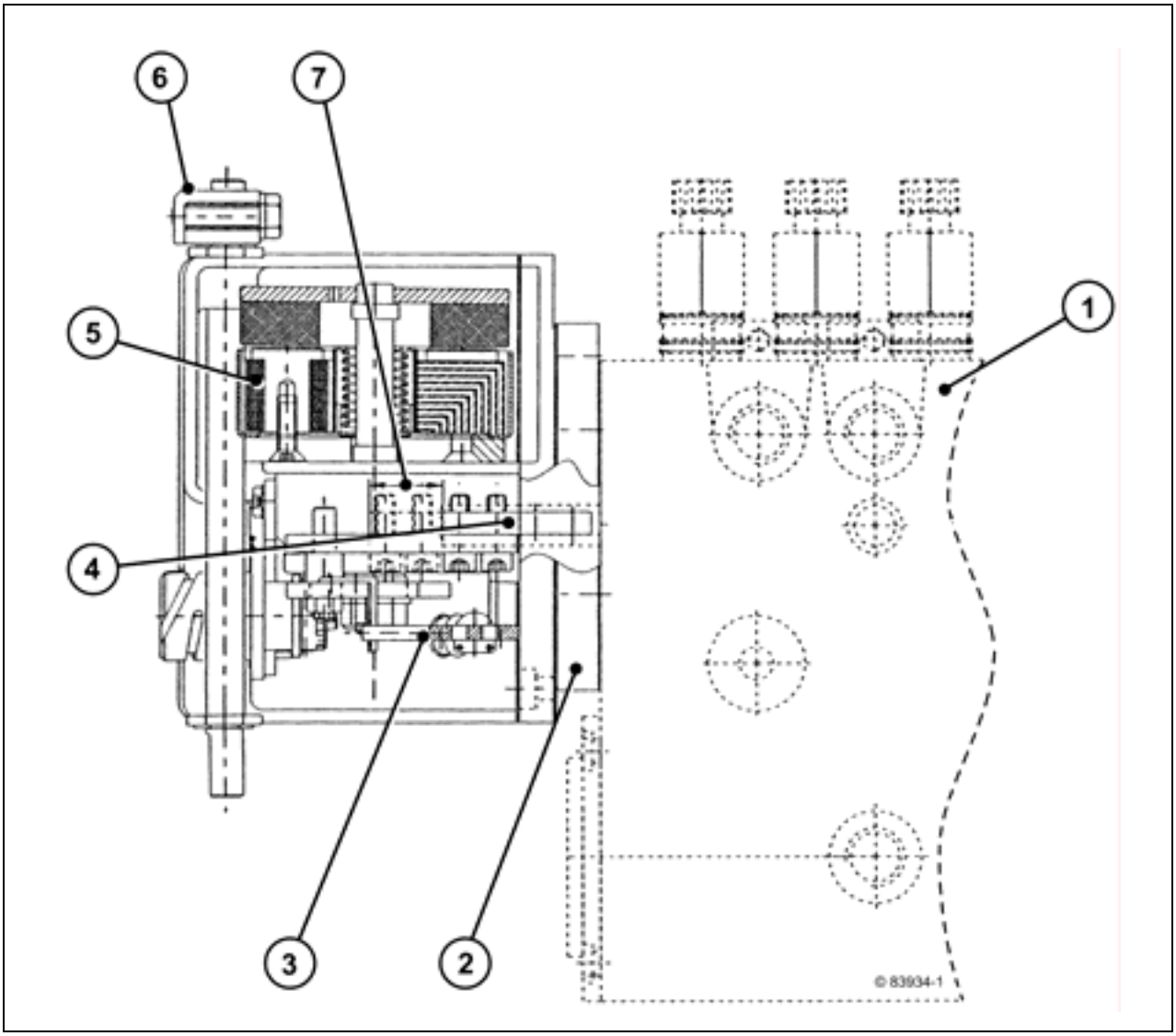


Figure 2-25 Actuator, Heinzmann StG 2040-DP

1 Injection pump
2 Adapter plate
3 Return system
4 Connection to injection pump control rod
5 Working coil
6 Stop lever
7 Control rod motion (adjustable)

GAC actuator

The GAC actuator is used to measure the fuel injection volume The difference between the nominal and actual speed is converted into a voltage signal for the electric positioning magnets in the actuator which sets the control bar of the injection pump by the control device. In this way the fuel volume is constantly increased or reduced depending on the load requirement at constant speed. The actuator is mounted directly on the injection pump.

The actuator operates linearly, the feedback of the control bar position takes place without contact.

Emergency stop is possible with an additional stop lever.

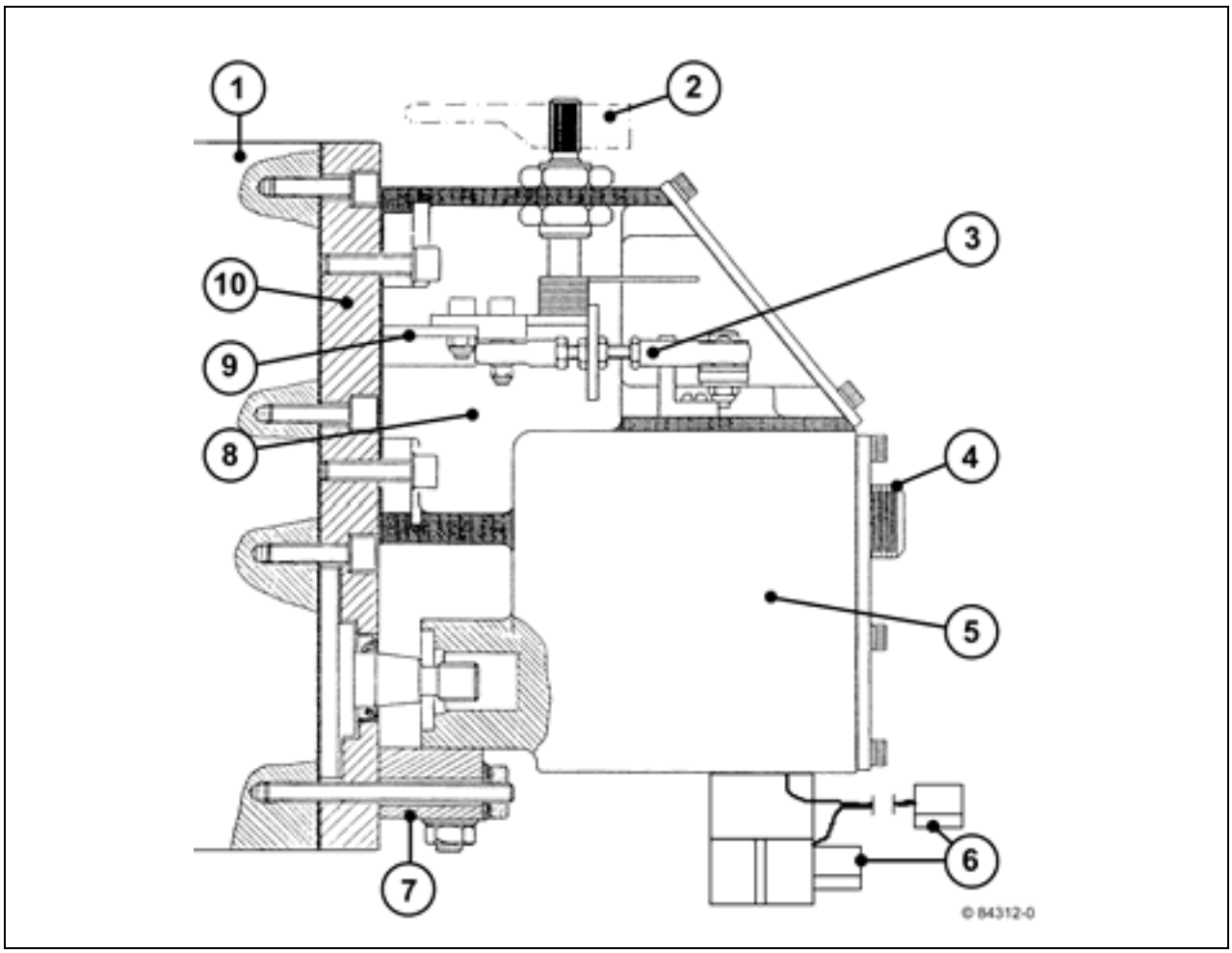


Figure 2-26 GAC actuator

1	Injection pump	6	Connector plug, in GAC (digital)
2	Stop lever	7	Fastening strip
3	Connecting linkage	8	Upper chamber, in lube oil circuit
4	Connector plug, in GAC (digital)	9	Injection pump control rod
5	Electromagnetic chamber (encapsulated)	10	Connecting plate

Frequency pick-up

The magnetic frequency pick-up is installed on the drive side. It produces electrical pulses proportional to the speed of the ring gear on the flywheel, by sampling the teeth of the ring gear, which move past the frequency pick-up, and transmits these pulses to the control device.

The number of installed frequency pick-ups depends on the speed governing system used.

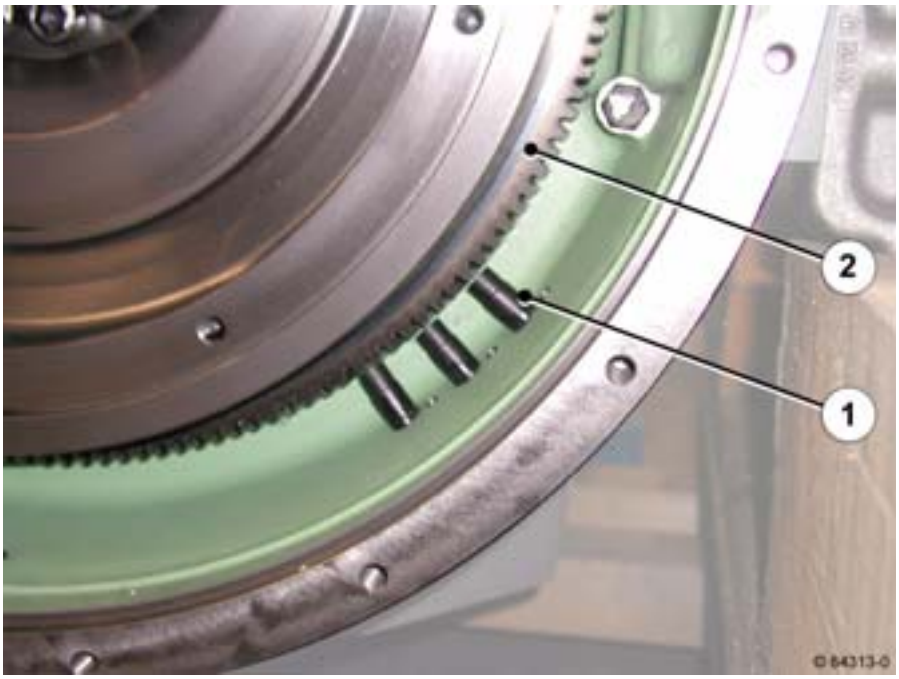


Figure 2-27 Frequency pick-up (installation example for EMR2)

1 Frequency pick-up
2 Starter ring gear on flywheel

Setpoint potentiometer

The setting of the setpoint speed can be implemented by a setpoint potentiometer, current or voltage signals or adjusted fixed values.

Control devices

The control device monitors the various input signals, e.g. the actual value of the speed, the current setting of the set-point transmitter and the setting of the actuator. In the case of deviations from the setpoint, the control device sends the command to the actuator to adjust the injection pump control bar and thus adapt the available fuel volume.

According to the control system used, various control devices are available:

- Electronic engine controller DEUTZ EMR2
- Control device for GAC speed governing system (analog)

Electronic engine controller EMR2

The electronic engine controller EMR2 is equipped with an efficient microprocessor and an internal controller program. Changes to the settings are made by a PC/laptop with a special connecting cable and the appropriate software and may only be performed by authorized personnel.

Further information about the electronic engine controller EMR2 can be found in the section ”Electronic engine controller EMR2”.

Control device for GAC speed governing system (analog)

This speed governing system is an electronic analog governor, it is set with the potentiometers and switches on the control device.

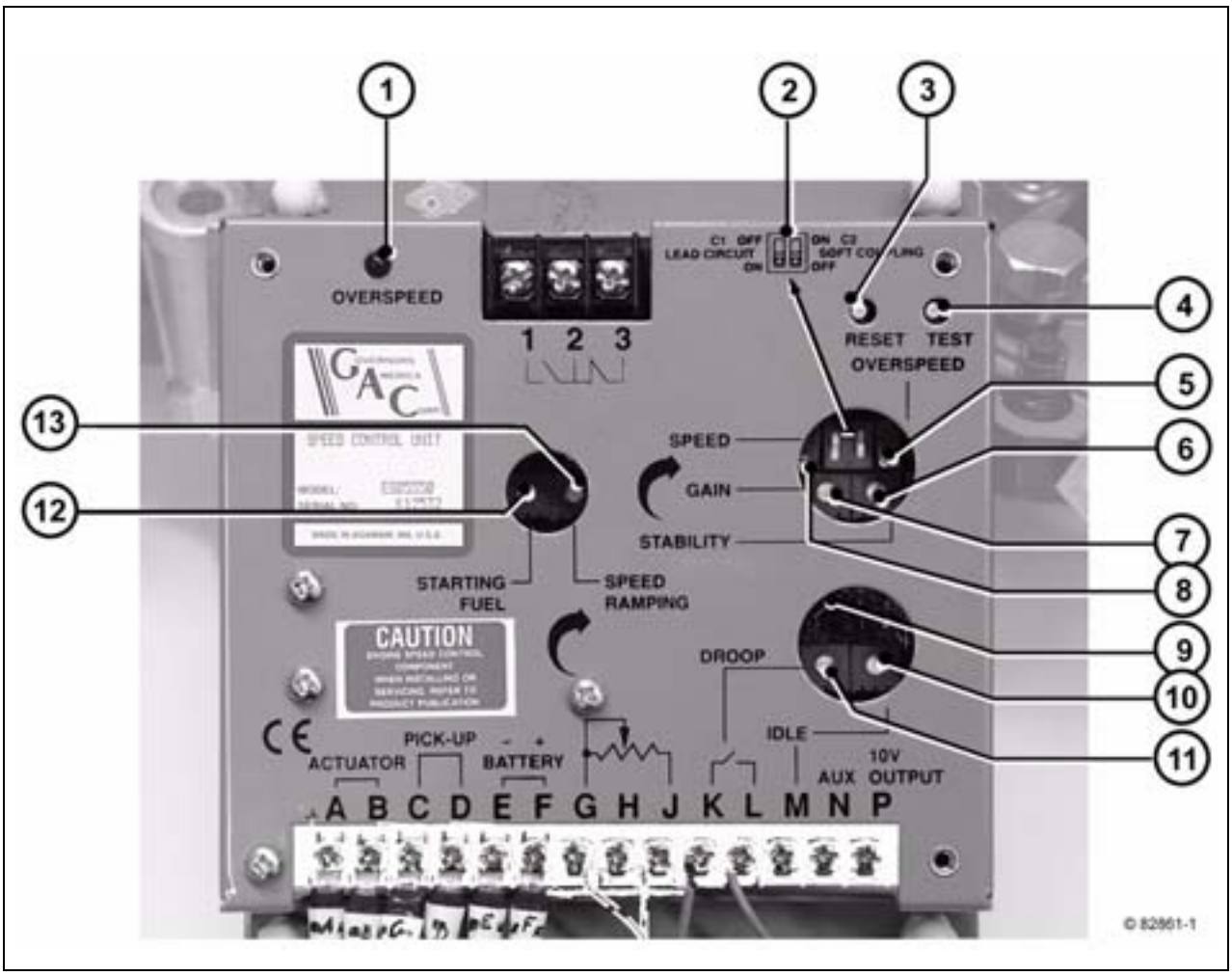


Figure 2-28 Control device GAC (analog)

Item:	Name:	Function:
1	OVERSPEED	Indicator LED for overspeed
2	C1 LEAD CIRCUIT	Switch for additional damping
	C2 SOFTCOUPLING	Switch for resonance vibration suppression
3	RESET	Overspeed reset button
4	TEST	Overspeed test button, reduces the switching point by 10 %
5	OVERSPEED	Setting of overspeed
6	STABILITY	Setting the strength
7	GAIN	Setting the sensitivity
8	SPEED	Setting the rated speed
9	-	Bridge or capacitor for improving stability
10	IDLE	Setting the low idling speed
11	DROOP	Setting the P factor
12	STARTING FUEL	Setting the fuel starting volume
13	SPEED RAMPING	Setting the start ramp to minimize the smoke development

Settings on the control unit may only be made by authorized personnel.

Lube oil system

The lube oil reduces friction of the components which rub against each other and dissipates heat from the rubbing positions and the piston. A film of lube oil on the cylinder surfaces supports the sealing effect of the piston rings. The lube oil also suspends contamination and transports it to the the lube oil filter.

The lube oil pump sucks the lube oil from the oil panand feeds it through the lube oil cooler and the lube oil filter into the lubrication circuit of the engine.

The lube oil pressure in the engine circuit is set by a lube oil pressure regulating valve. The bypass valve is installed in the lube oil cooler to avoid the flow of lube oil being interrupted in a cold start. The overpressure valve opens when the lube oil pressure is sufficiently high and allows the surplus lube oil to flow back into the oil pan.

Cooling system

The chemical energy in the fuel is converted into heat energy during combustion. The engine can only partly convert this into mechanical energy. The remaining heat is dissipated mainly with the exhaust gas and the coolant.

The engine operates with a dual-circuit cooling, i.e. a high temperature circuit and a low temperature circuit.

The combustion chamber walls are cooled by the high temperature circuit. The coolant is fed through the coolant chambers between the crankcase and the cylinder liners. From there the coolant is fed through bores in the crankcase to the cylinder heads. Channels in the cylinder heads feed the coolant to the floor of the cylinder head and the valve seats. The coolant emerges from the cylinder heads and is fed into the coolant manifold to the thermostats integrated in the charge air line.

The charge air cooler is cooled by the low temperature circuit. Depending on the version as air/water or air/air cooling. In the air/water version a second coolant pump drives another cooling circuit which cools the charge air in the charge air cooler. In the air/air charge air cooling, the charge air cooling system precedes.

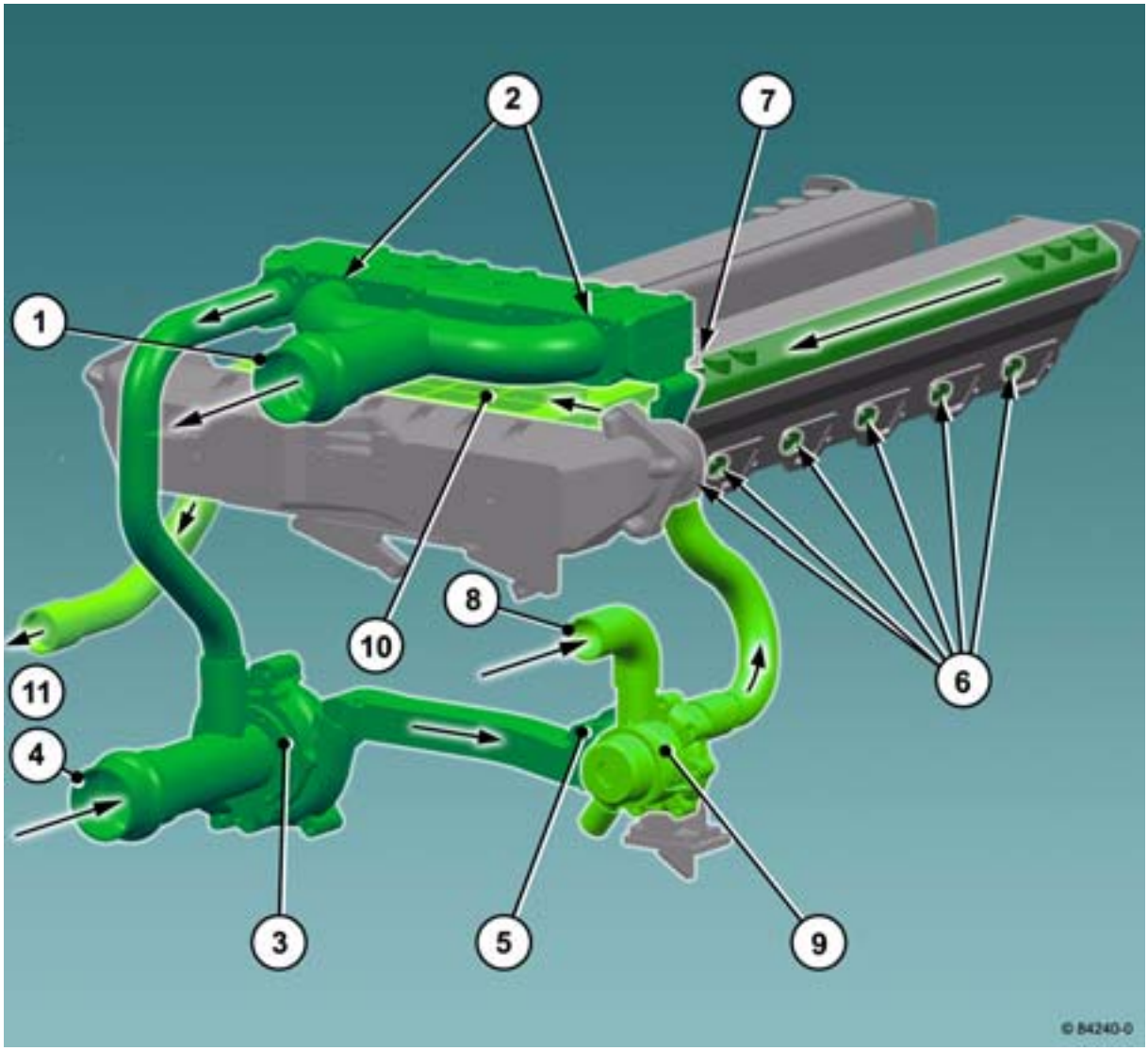


Figure 2-29 Cooling system (air / water charge air cooling)

1	Discharge of hot coolant to the cooler	7	Temperature sensor
2	Thermostat housing	8	Suction intake of cooled coolant to the charge air cooler
3	Coolant pump and inlet of the coolant in cylinder side ”B”	9	Coolant pump (cooling circuit charge air cooler)
4	Suction intake of cooled coolant to the engine	10	Charge air cooler
5	Inlet of coolant to cylinder side ”A”	11	Discharge of hot coolant after charge air cooler
6	Coolant overflow of cylinder heads		

Coolant circuit for cooling the cylinders and cylinder heads

Coolant circuit of the air/water charge air cooler

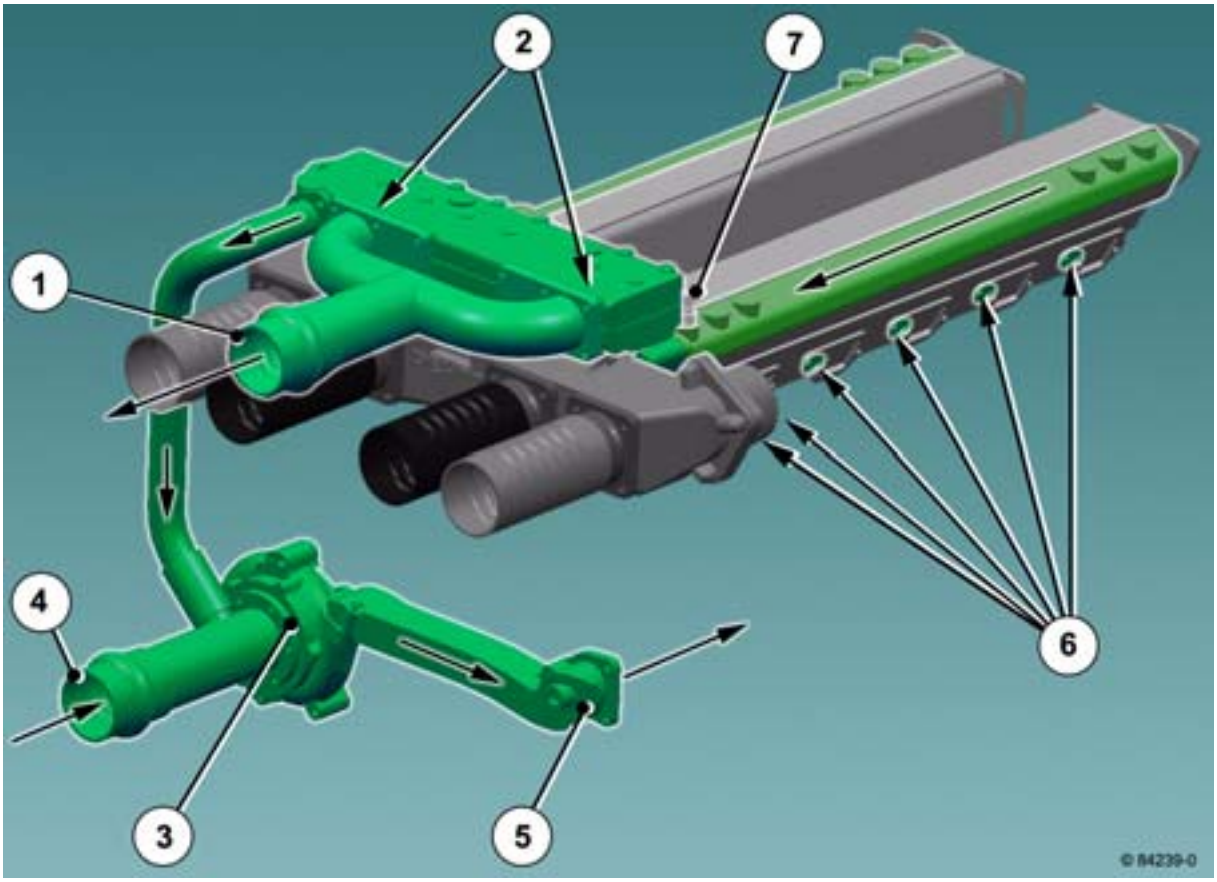


Figure 2-30 Cooling system (air/air)

1 Discharge of hot coolant to the cooler
2 Thermostat housing
3 Coolant pump and inlet of the coolant in cylinder side ”B”
4 Suction intake of cooled coolant to the engine
5 Inlet of coolant to cylinder side ”A”
6 Coolant overflow of cylinder heads
7 Temperature sensor

Coolant circuit for cooling the cylinders and cylinder heads

Schematic representation of the dual-circuit cooling

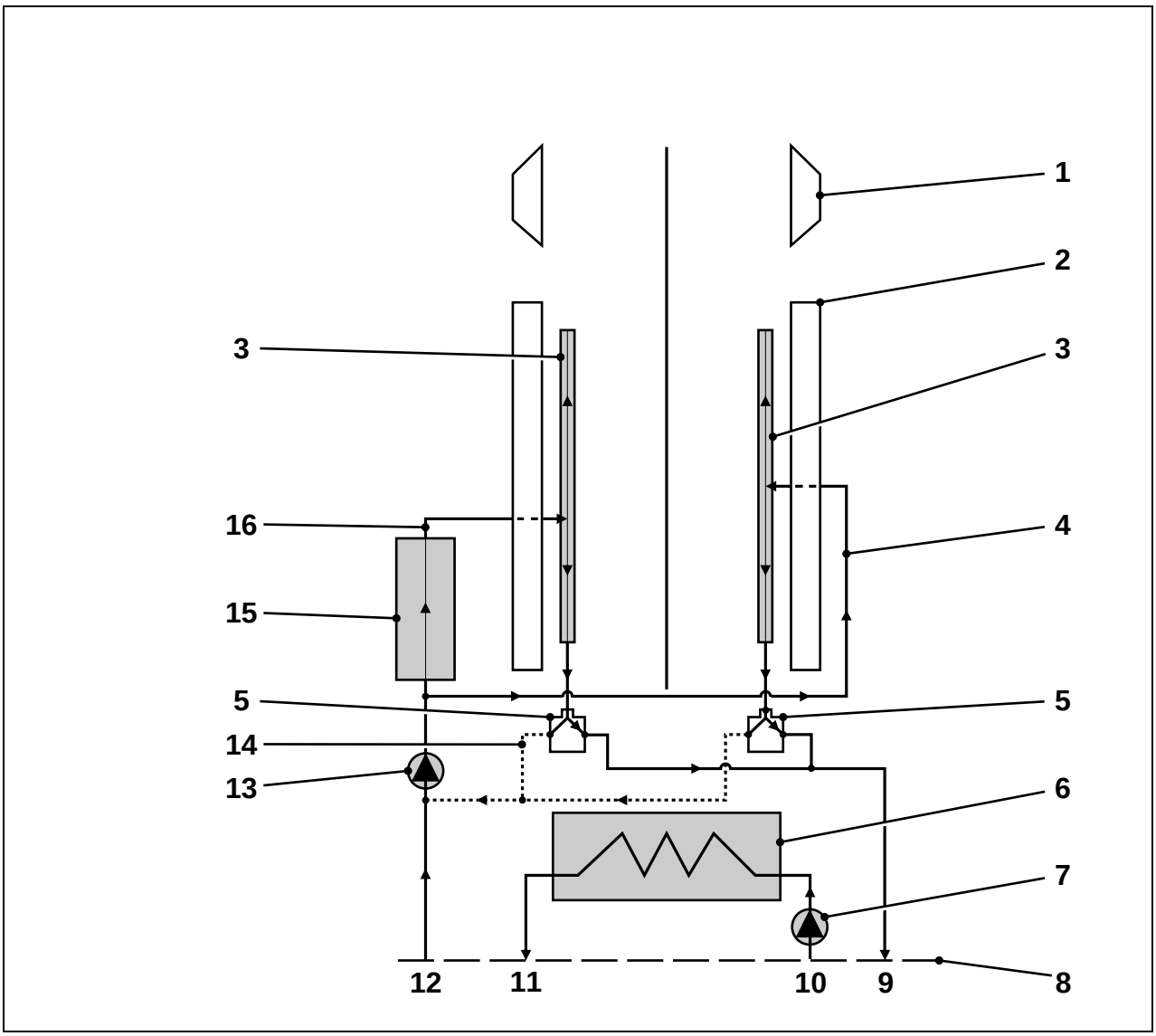
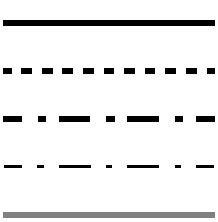


Figure 2-31 Cooling system schematic (air / water)

The dual-circuit cooling system is shown in the air/water version in the figure. In the air/air version the items 6, 10 and 11 are omitted. The charge air cooler then precedes in the air/air version.

1 Turbocharger
2 Exhaust pipe
3 Charge air line
4 Pipe from the coolant pump to the engine
5 Thermostat
6 Charge air cooler (air/water)
7 Coolant pump (low temperature circuit)
8 Engine interface
9 Pipes to the cooler (engine cooling)
10 Pipes from the cooler (charge air cooling)
11 Pipes to the cooler (charge air cooling)
12 Pipes from the cooler (engine cooling)
13 Coolant pump (high temperature circuit)
14 Short-circuit line
15 Lube oil cooler
16 Pipe from lube oil cooler to the engine

Labeling of coolant:



Starter

The engine is started by an electric or pneumatic starter depending on the version.

The starter 1 has the job of accelerating the engine crankshaft to ignition speed. On reaching this speed the compression temperature in the cylinders has heated up to ignition temperature of the injected fuel.

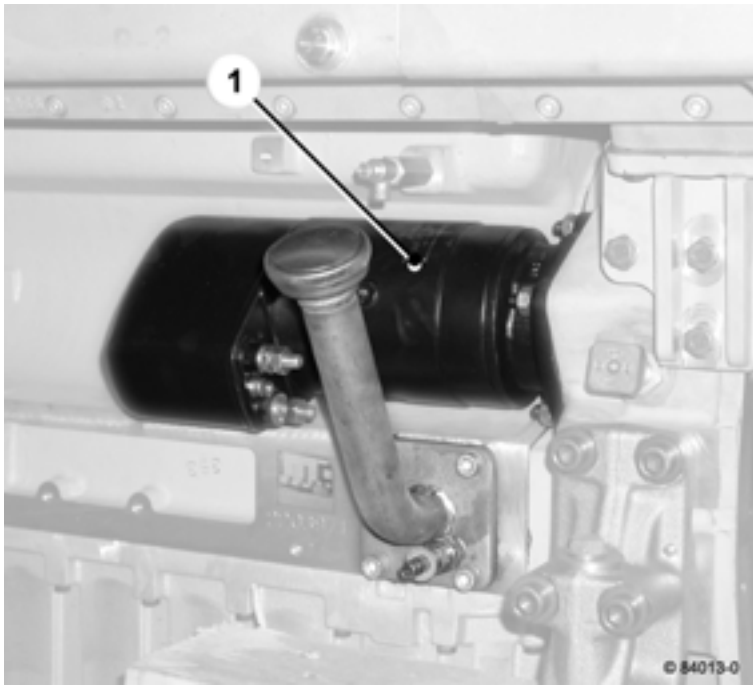


Figure 2-32 Electrical starter

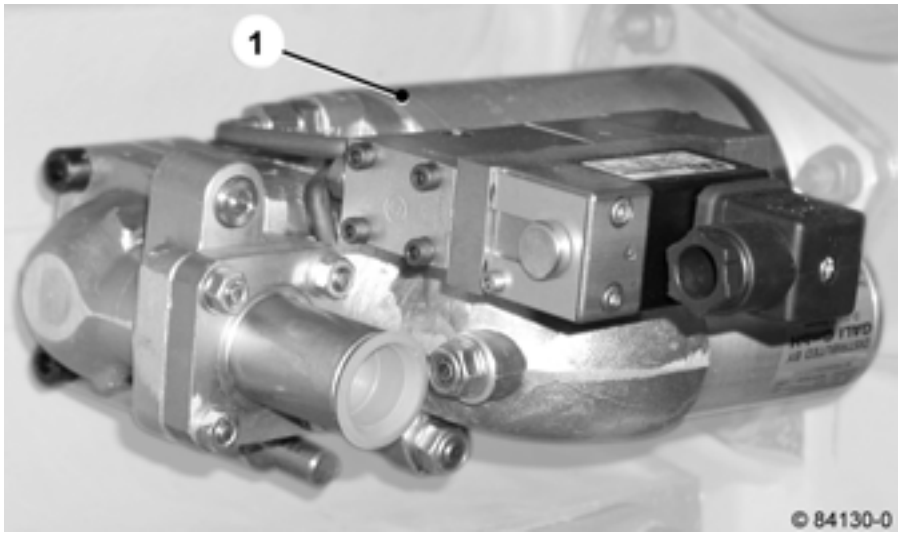


Figure 2-33 Pneumatic starter

Electronic engine controller EMR2

Use and structure

The electronic engine controller EMR2 serves for speed governing of DEUTZ diesel engines.

The EMR2 basically consists of sensors, the control device and the actuator. The installation on the engine side and the system side are connected to the EMR2 control device by separate cable harnesses.

Engine side installations

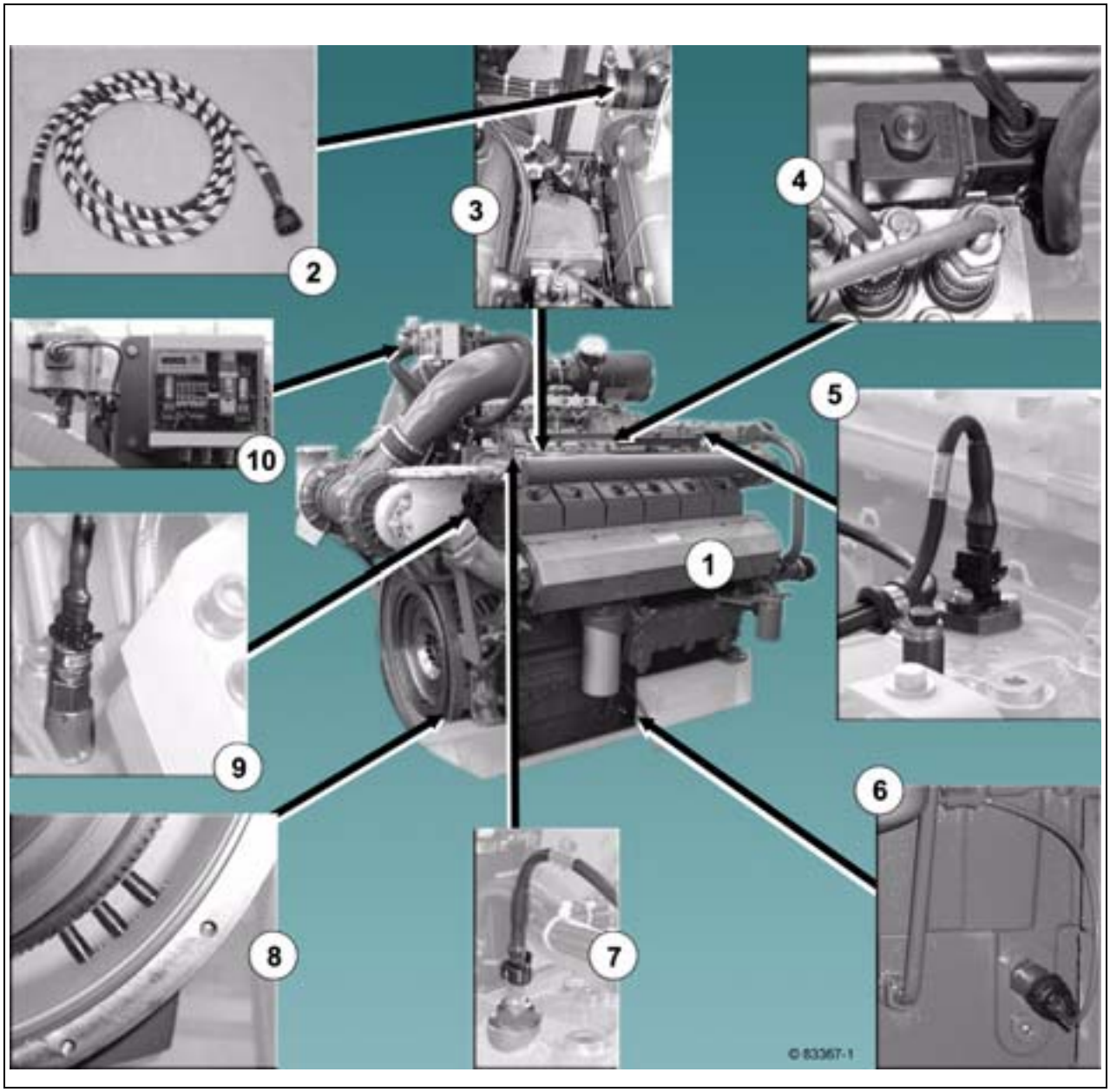


Figure 2-34 EMR2, engine side installations (example: TBD 616 V12)

1	Engine	6	Sensor lube oil level
2	Cable harness engine – EMR2 control device	7	Sensor coolant temperature
3	Actuator and connection for cable harness	8	Frequency pick-up
4	Stop magnet	9	Sensor lube oil pressure
5	Sensor charge air temperature	10	Sensor crankcase pressure and safety cut-out (Noris)

System side installations

- EMR2 control device
- Power supply
- Speed potentiometer (setpoint generator)
- Diagnostic interface / CAN bus
- Fault lamp
- Diagnostic button
- Warning lamps for overspeed, lube oil pressure, lube oil level, coolant temperature
- Switch for P factor, speed
- Engine stop

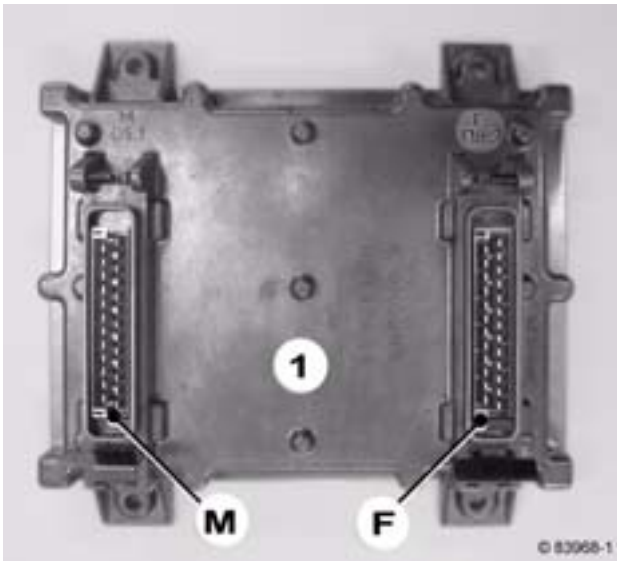


Figure 2-35 EMR2 control device

1EMR2 control device

Mconnection for engine side cable harness

Fconnection for system side cable harness

Function

The sensors mounted on the engine supply the control device electronics with all the relevant data.

According to the information about the momentary condition of the engine and the presets (setpoint generator for speed, etc.) the EMR2 drives the actuator which adjusts the injection pump control rod and thus adapts the fuel volume according to the power requirement. The actuator sends a return signal of the injection pump control rod position to the control device.

The EMR2 is equipped with safety devices and measures in hardware and software to ensure emergency operation functions.

The ignition switch cuts off the power to the EMR2 to shut down the engine. A sufficiently strong spring in the actuator pulls the injection pump control bar to the zero position in the powerless state. Additionally and independently of this the fuel supply is interrupted by shutoff magnets.

System functions

The EMR2 offers a wide range of functions which can be activated by an application-related configuration and allocation of the inputs and outputs. It enables a signal exchange both between the engine and EMR2 (via the engine side plug) and between the system and EMR2 (via the system side plug).

The functions of the EMR2 refer to the speed governor, volume restriction (fuel injection), monitoring, system and device functions and communication and diagnostic interfaces.

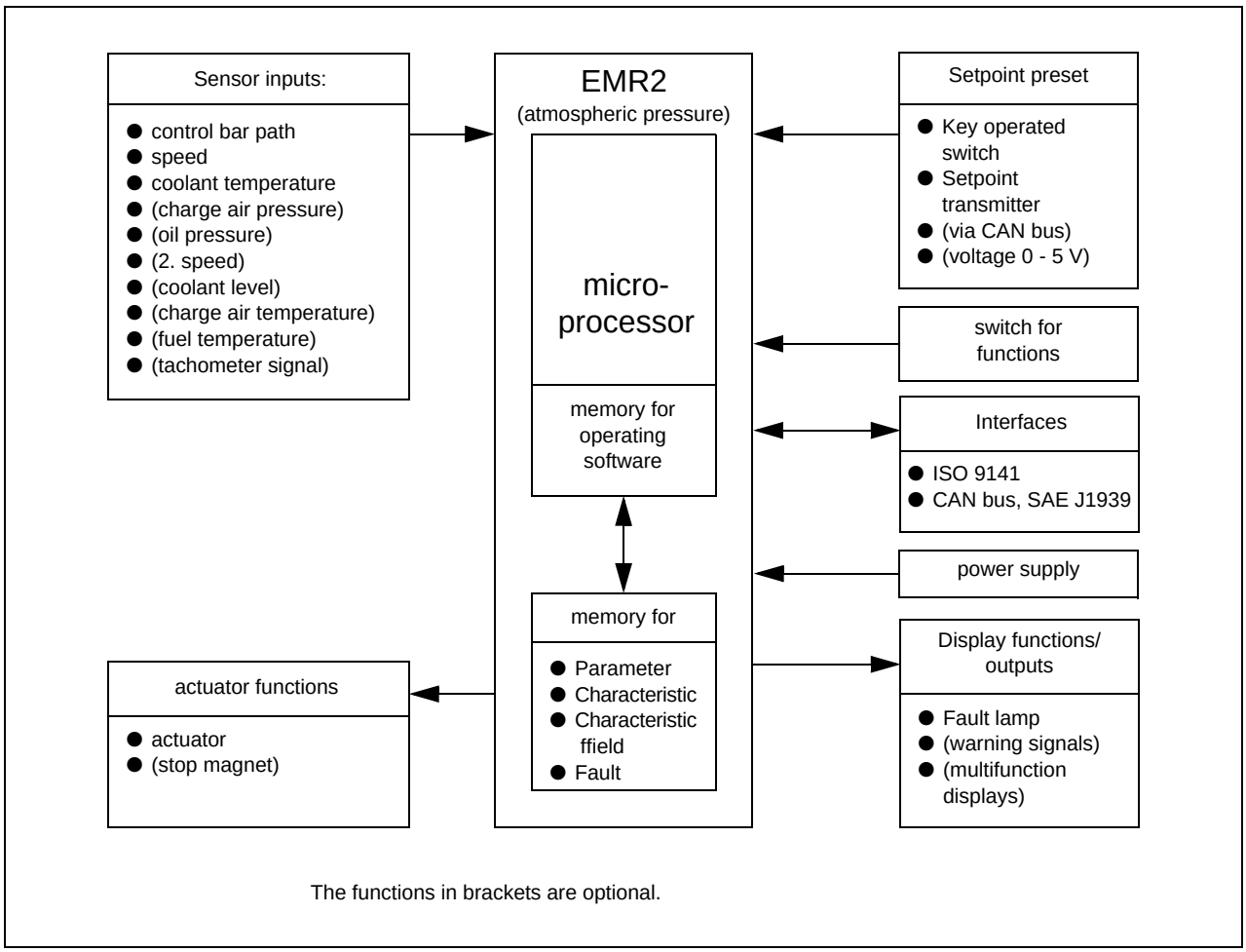


Figure 2-36 System functions, overview

Selected system functions are described briefly below.

Speed governing system

Different versions of the speed governor are possible depending on the application, e.g. all speed governor, fixed speed governor.

It is possible to protect the engine against overspeed with the EMR2.

Setpoint preset

The setpoint preset can be made for example by a setpoint potentiometer, a voltage signal or via an interface.

P-factor

A constant or speed-dependent P factor can be set depending on the application. In addition, switching between two P factors or between constant and speed-dependent P factor can be provided for.

Engine start/stop

As soon as the control device detects the start speed, the injection pump control bar is released for starting. The power to the EMR2 must be cut off with the key operated switch to shut down the engine. The actuator then pulls the injection pump control bar to the stop position. Additionally and independently of this, the fuel supply is interrupted by shutoff magnets.

The engine may also be shut down by an error in the EMR2, e.g. exceeding or dropping below fixed measured value limits.

Displays/outputs (monitoring function)

Different signals can be displayed and output through the control device outputs, e.g. fault lamp, speed, warning signals for coolant temperature, lube oil pressure, lube oil level.

The fault lamp must be mounted by the customer in a well visible place on the system. It serves for a rough estimation of an error that has occurred, see also section ”Diagnostic possibilities”.

Interfaces

The EMR2 is equipped with different interfaces for diagnostics, programming and configuration as well as the measured value and data exchange.

Error messages, measured values and other parameters can be displayed via the diagnostic interface with a PC connected via an interface and the diagnostic software SERDIA, see also section ”Diagnostic possibilities”.

Configuration and parameterization

The EMR2 is programmed and configured for every engine, i.e. the EMR2 gets an engine-specific data record.

A PC with the SERDIA diagnostic software is connected to the diagnostic interface via an interface for programming. Access to the various parameters is protected by access rights divided into four levels and can only be gained by authorized personnel with the relevant authorization level.

Diagnostic possibilities

Self-diagnosis

The EMR2 has numerous protection functions for the engine. The scope depends on the available measuring points and sensors. Depending on the severity of the detected fault the engine may be able to continue running with restrictions whereby the fault lamp lights steadily or the engine is shut down whereupon the lamp starts flashing.

Self-diagnosis is started by switching on the key operated switch. There is no active fault if the fault lamp goes out after 2 s. When the fault lamp flashes after 2 s, there is at least one serious fault, the engine cannot be started. If the fault lamp lights steadily, there is at least one fault, the engine may possibly be operable with restrictions in emergency mode.

If other warning lamps are configured, e.g. oil pressure, coolant temperature, these are switched on with the key operated switch as well for the duration of the self-diagnosis (2 s).

Fault messages are recorded and saved in the EMR2 control device and displayed by the fault lamp. The fault lamp goes out as soon as the fault is eliminated. If the EMR2 has switched over to emergency operation, the engine has to be shut down briefly with the key operated switch to switch off the fault lamp.

Eliminated or no longer current faults remain stored in the control device and can be read out or deleted with the SERDIA diagnostic software.

Diagnosis with key and fault code

With a diagnosis key and the fault lamp, faults can be read out as flashing codes, it is also possible to clear the fault memory 1, see also work card B 11-6-1, Reading out the fault memory 1 of the EMR2.

Diagnosis with SERDIA

The SERDIA software program offers the following options:

- Monitoring measured values with the engine running
- Changing parameters with the engine at a standstill
- Read out and evaluate all the fault messages stored in the control device (fault memory 2) and delete fault message of eliminated or non-current faults
- Activate function test, outputs and actuator with engine at a standstill
- Show assignment of inputs and outputs
- Show measured values graphically

Handling SERDIA is described in a separate operating manual.

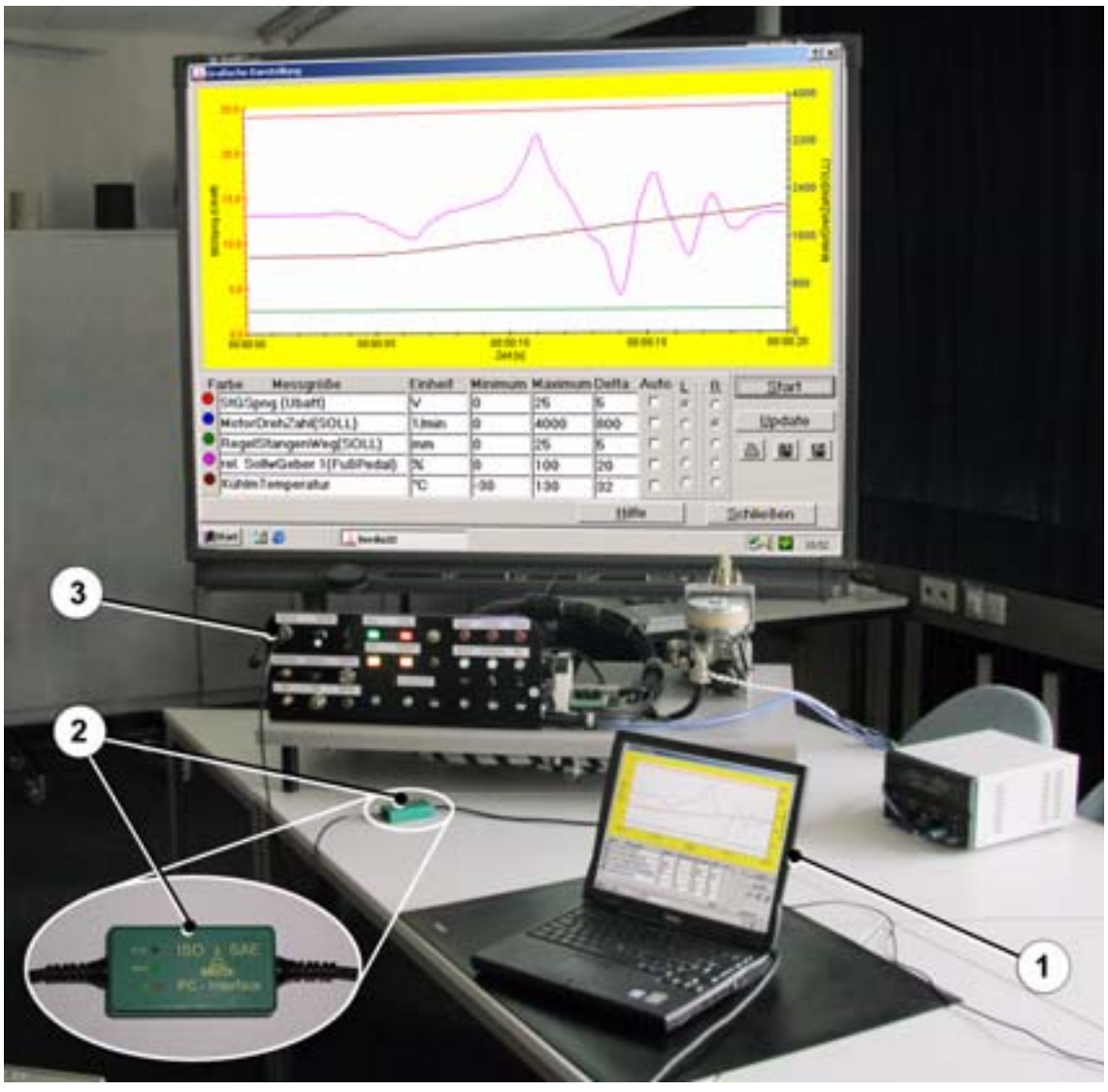


Figure 2-37 Diagnosis with SERDIA (illustrated Installation in the DEUTZ Training Center in Mannheim)

1 PC / Notebook with SERDIA diagnostic software
2 Interface
3 Diagnostic interface

3 Operation

Work prior to commissioning

General

Work prior to commissioning applies both for commissioning new engines and for overhauled, serviced and maintained engines. Furthermore, the commissioning report must be observed.

The work and inspections described below are necessary for trouble-free operation and prevention of accidents. The perfect functioning of the drive mechanism and speed control is necessary above all for trouble-free operation.

- Clean the lines and tanks for fuel, coolant and lube oil before filling. All lines, screw fittings and connecting elements must be checked for a tight fit, perfect condition and leaks and repaired if necessary.
- Check the alignment of the engine and proper anchoring to the foundation.
- Clean the engine and remove objects which have been placed on the engine. Fit all protective coverings to the engine.

Loose objects (especially on moving parts such as flywheels) can lead to serious damage or accidents.

- Check the electrical wiring for perfect condition and laying, correct if necessary.
- Check the easy action of the control and shut-down mechanism as well as the function of monitoring, shut-down and remote control devices and repair if necessary.

Operating media

Observe the necessary quality of the operating media mentioned below according to operating media specifications Chapter 4, Expendables.

Coolant

New engines and engines overhauled at DEUTZ are run with a special coolant on the test stand. This is drained off afterwards which means that the engines are delivered dry.

- The operator must clean the coolant lines before commissioning for the first time.
- Open engine bleeding screw (arrow)
- Open the valves in the coolant lines if available

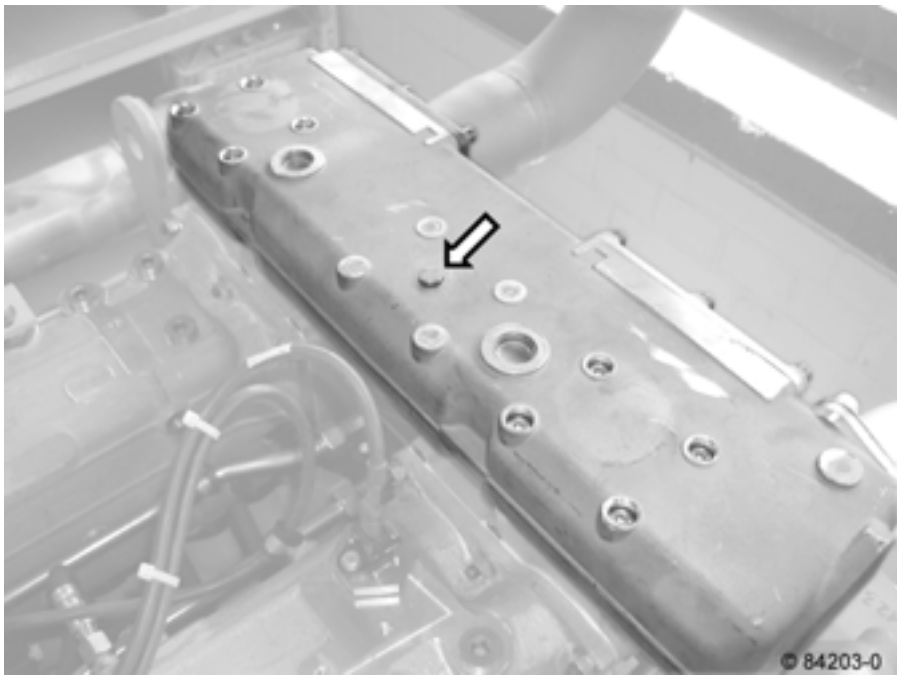


Fig. 1 Engine bleeding screw thermostat housing

- Fill up the engine's cooling system with prepared coolant through the filling nozzle on the cooler until the coolant emerges from the engine bleed valve without bubbles. Seal the engine bleed screw (arrow) with a new sealing ring.
- The filled cooling system does not bleed automatically depending on the structure of the external cooling system. It may be necessary to remove the highest coolant hose until the coolant emerges without bubbles. Collect the emerging coolant.

Coolant level

- Check the coolant level in the cooler. The test marks may vary depending on the system structrue.
- Lines, connecting elements and engine must be checked for leaks after filling and repaired if necessary.
- Make a test run, see job card B 0-1-4, Test run.
- Check the coolant after shutting off the engine and refill if necessary.

The cooling system is under pressure, danger of scalding!

Fuel

Ensure cleanliness!

Do not spill fuel!

Only fill up with fuel with an approved filling device with the engine switched off!

- Fill the supply tank and daily supply tank with fuel.

Bleed the fuel system and check for leaks:

- Loosen the bleeding screw 4.

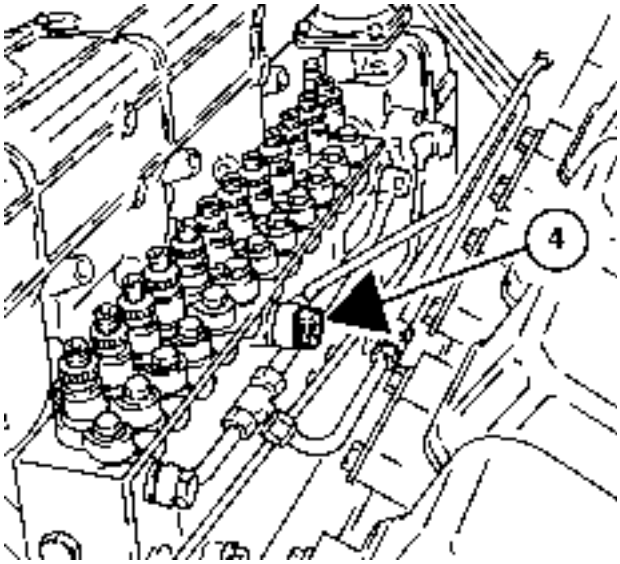


Figure 3-1 Bleeding screw of the injection pump

- Operate the hand pump 1 until fuel emerges free of air bubbles.

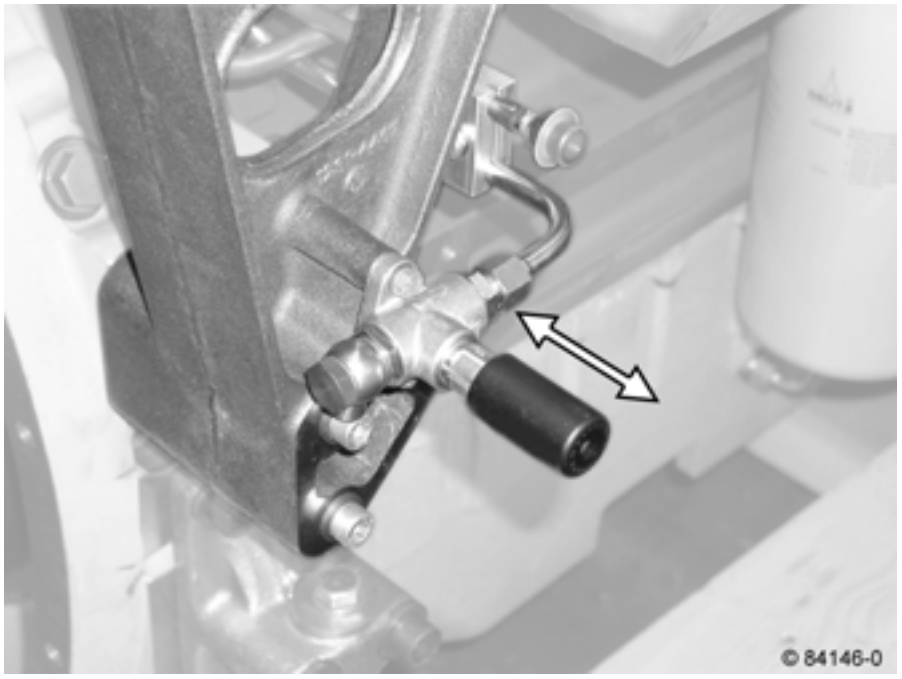


Figure 3-2 Hand pump fuel system (installation site is access-dependent)

- Tighten the bleeding screw whilst continuing pumping.

The engines are delivered without lube oil filling.

Lubricant

- Fill the engine with lube oil up to the top dipstick mark through the lube oil nozzle (arrow).

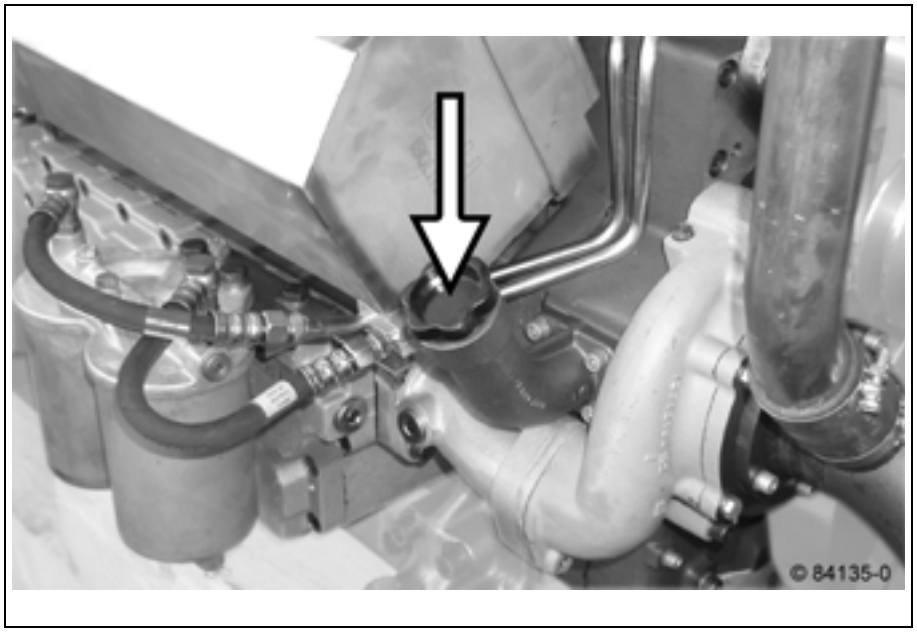


Figure 3-3 Lube oil nozzle (depending on the installation position of the engine, the lube oil nozzle is on the side with the better access)

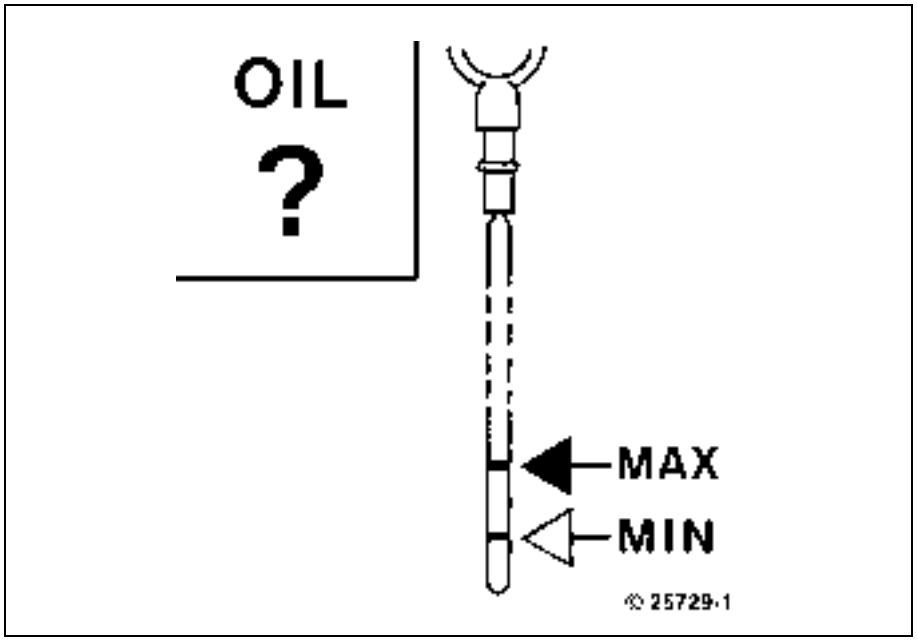


Figure 3-4 Oil level dipstick

- Switch on pre-lubrication (if installed).
  - Pre-lubricate for at least 10 minutes after changing the lube oil.
  - Pre-lubricate for at least 10 minutes after an engine standstill of > 3 hours.
  - Pre-lubricate for at least 2 minutes after an engine standstill of < 3 hours.
- Check the lube oil level again, fill up to the top mark if necessary.

Monitoring

- Check the power supply to the engine monitoring system (battery).
- Switch on engine monitoring system

Starter system

Compressed air starter system

- Fill starter air tank with starter air compressor or carbon dioxide (CO_2) from pressurised vessel to 30 bar and drain water.

Filling the starter air tank with oxygen or combustible gases such as hydrogen is mortally dangerous due to the risk of explosion.

Electric starter system

- Check the power supply to the monitor (battery).
- Check the connecting cable for correct polarity, tight fit and good contact.

Room ventilation

- Switch on the room ventilation to evacuate radiation heat and oil vapour. The room ventilation also has the job of supplying the engine with combustion air if this sucks in from the system room.

Commissioning

There is a danger of fire, backfiring or explosion due to igniting of unburned fuel in the exhaust system which could cause damage.

Therefore the following notes must be observed.

There may be a danger of backfiring, fire or explosion:

- in the case of voluminous and long, horizontally laid exhaust systems;
- after setting and adjustment work on the fuel system with idling periods in rapid succession and cold exhaust pipes;
- after three mis-fires;
- in the case of insufficiently bled fuel lines.

Starting the engine

- After longer pauses in operation (cold engine) perform work according to chapter 3 Commissioning.
- Open the coolant and fuel taps. Switch on the pump if available.
- Remove the turning gear (if attached).
- Switch on engine monitoring system
- Set low engine speed.
- Start engine on the engine monitoring system.
- Slowly increase the speed and load after building up the lube oil pressure.

Do not warm up engines in idling speed without load.

Monitoring operation

During engine operation, check whether the data displayed by the engine monitoring system are within the specified parameters.

Shutting down

- Avoid shutting down from full load.
  Let the engine run for about another 5 minutes at increased idle speed without gears before shutting down to avoid heat building up at cylinder liners and cylinder heads as well as coking on the exhaust turbocharger.
- Shut down engine on the engine monitoring system.
- Let the coolant pump assembly run for a few minutes more after shutting down.
- If the engine is shut down for longer, close the coolant and fuel taps and the starter air tap if available.

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4 Expendables

General remarks

Warranty

If unsuitable expendables are used, or if it cannot be documented that the expendables used conform to requirements, no warranty will be accepted by the engine's manufacturer for trouble-free operation. This also applies for inadequate care and maintenance of the engines and the expendables.

Product selection

Due to the large number of products available nationally and internationally and the wide variety of qualities involved, plus continual improvements as well, it is impossible for us to check all suitable products and name them, and accordingly we cannot accept any responsibility for these products.

The supply of the expendables concerned bears sole responsibility for globally consistent quality of the products named here, and in the case of products not named additionally for compliance with the specified requirements for the expendables and their operational reliability. This shall also apply in the event that the producer concerned improves the products named here.

The expendables named here (reference products) are only a selection from certain producers and their products. Other expendables not listed here may also be used, provided they conform to the requirements involved, i.e. are at least equivalent in terms of all criteria. The expendables named in this specification shall be used as reference products for purposes of comparison. The expendables suppliers involved can supply the requisite information, and should also confirm the suitability of their products correspondingly.

Mixability

Mixing different expendable types together, .e.g. different lube oils with each other, different coolant additives with each other, may lead to malfunctions.

In every such case, before any mixing is performed, permission must be obtained from the suppliers of the products involved, who shall then bear the responsibility for any such mixing. This shall also apply to putting any further additives in the expendables.

Fuel

see Technical Circular TR 0199-99-2089.

Engine lube oil

see Technical Circular TR 0199-99-2090.

Engine coolant

see Technical Circular TR 0199-99-2091.

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Auxiliary materials

Sealants and securing agents

- Observe storage stability, if any, given on the package!
- Upon transport, storage and disposing of the above-mentioned items, observe Chapter 1, Regulations, of the operating manual, if no according information is given on the package.

Material designation	Type	Standards and specifications	Characteristics	Application examples
DEUTZ DW 43	Sealant		Solvent-free, caoutchouc-based flexibly hardening, rapid skin formation, temperature range 30°C to 100°C	Sealing of small joints
DEUTZ DW 47	Sealant	LV 0161 9672 FV 0160 9610	Silicon caoutchouc, viscously flexible, easily detachable, temperature range max. 180°C, oil max. 150°C	Sealing of rough and uneven surfaces
DEUTZ DW 48	Sealant	LV 0161 9572 FV 0160 9610	Silicon caoutchouc, viscously flexible, strong adhesion, temperature range –65°C to 265°C	Sealing of rough and uneven surfaces
DEUTZ DW 49	Sealant	LV 0161 9571 FV 0160 9607	Mixed polymeride of vinyl- and acryl compositions, strong adhesion permanently elastic, temperature range –40°C to 130°C	Sealing of core hole plugs
DEUTZ DW 50	Sealant		Liquid, hardening artificial resin, compatible with gaskets, temperature range –40°C to 180°C	Sealing of housings
DEUTZ DW 51	Sealant	LV 0161 9573	Physically dry artificial resin, permanently elastic and vibration-free, temperature range –30°C to 150°C	Sealing of surfaces
DEUTZ DW 55	Securing agent	FV 0160 9605	Anaerobic solvent-free single-component substance hardening upon metal contact when excluding oxygen, high strength, fluid, temperature range –55°C to 150°C	Securing and sealing of threads up to M12; joints up to max. gap width of 0.15 mm
DEUTZ DW 56	Securing agent	FV 0160 9605	Anaerobic solvent-free single-component substance hardening upon metal contact when excluding oxygen, high strength, thick-flowing, temperature range –55°C to 150°C	Securing and sealing of threads up to R2"
DEUTZ DW 57	Securing agent	FV 0160 9605	Anaerobic solvent-free single-component substance hardening upon metal contact when excluding oxygen, low strength, liquid, temperature range –55°C to 150°C	Securing and sealing of threads up to M12;
DEUTZ DW 59	Securing agent	FV 0160 9605	Anaerobic solvent-free single-component substance hardening upon metal contact when excluding oxygen, high strength, medium viscous, temperature range –55°C to 150°C	Securing and sealing of threads up to M20; joints up to max. gap width of max. 0.15 mm
DEUTZ DW 60	Securing agent	FV 0160 9605	Anaerobic solvent-free single-component substance hardening upon metal contact when excluding oxygen, medium strength, liquid, temperature range –55°C to 150°C	Securing and sealing of threads up to M56 or R2"
DEUTZ DW 61	Activator	FV 0160 9605	Accelerates and permits the complete hardening of anaerobic substances with passive materials	Only for passive materials

Material designation	Type	Standards and specifications	Characteristics	Application examples
DEUTZ DW 62	Securing agent	FV 0160 9605	Anaerobic solvent-free single-component upon metal contact when excluding oxygen, high strength, medium-viscous, thixotrope, temperature range –55°C to 175°C	Joints up to a gap width of max. 0.12 mm
DEUTZ DW 63	Sealant	FV 0160 9605	Anaerobic solvent-free single-component upon metal contact when excluding oxygen, low strength thick-flowing, thixotrope, temperature range –55°C to 150°C	Sealing of surfaces up to a gap with of max. 0.10 mm
DEUTZ DW 64	Securing agent	FV 0160 9605	Anaerobic solvent-free single-component upon metal contact when excluding oxygen, high strength, medium-viscous, temperature range –55°C to 150°C	Securing and sealing of threads up to M80 or R3"
DEUTZ DW 65	Securing agent	FV 0160 9605	Anaerobic solvent-free single-component upon metal contact when excluding oxygen, high strength, thick-flowing, temperature range –55°C to 150°C	Joints up to a gap width of max. 0.25 mm
DEUTZ DW 66	Securing agent	FV 0160 9605	Anaerobic solvent-free single-component upon metal contact when excluding oxygen, low strength thick-flowing, temperature range –55°C to 150°C	Securing and sealing of threads up to R3"
DEUTZ DW 67	Sealant	FV 0160 0040	Anaerobic solvent-free single-component upon metal contact when excluding oxygen, high strength, thick-flowing, thixotrope, temperature range –55°C to 150°C	Sealing of surfaces up to a gap width of max. 0.50 mm
DEUTZ DW 68	Sealant	FV 0160 0039	Anaerobic solvent-free single-component upon metal contact when excluding oxygen, low strength thick-flowing, thixotrope, temperature range –55°C to 150°C	Sealing of surfaces up to a gap width of max. 0.50 mm, securing and sealing of threads R2"
DEUTZ DW 69	Securing agent	FV 0160 9605	Anaerobic solvent-free single-component upon metal contact when excluding oxygen, low strength liquid temperature range –55°C to 150°C	Securing and sealing of threads up to M36
DEUTZ DW 70	Securing agent	FV 0160 9605	Anaerobic solvent-free single-component upon metal contact when excluding oxygen, medium strength liquid temperature range –55°C to 150°C	Securing and sealing of threads up to M12
DEUTZ DW 71	Securing agent	FV 0160 9605	Anaerobic solvent-free single-component upon metal contact when excluding oxygen, high strength, medium viscous, temperature range –55°C to 175°C	Securing and sealing of threads up to M20; joints up to a gap width of max. 0.15 mm
DEUTZ DW 72	Securing agent	FV 0160 9605	Anaerobic solvent-free single-component substance hardening upon metal contact when excluding oxygen, medium strength, medium viscous, temperature range –55°C to 150°C	Securing and sealing of threads up to M36

Tab. 1 Sealants and securing agents

Gluing agents

Material designation	Type	Standards and specifications	Characteristics	Application examples
DEUTZ KL 1	Gluing agent	LV 0161 9633 FV 0160 9608	Two-component, epoxy-resin based, water-, oil- and diesel fuel resistant, admiss. application temperature max. 150°C Mixing ratio 1:1, gluing agent DEUTZ KL 1 and hardener DEUTZ KL 2	Combines steel, aluminium, brass and plastic materials such as plexiglass, polyethylene and similar, gluing them together or among them
DEUTZ KL 2	Hardening agent	LV 0161 9633 FV 0160 9608		

Tab. 2 Gluing agents

Lubricants

Material designation	Standards and specifications	Temperatur-range	Application examples
DEUTZ S1	FV 0160 9537	-180°C to 1400°C	Avoids burning in of screw connections in exhaust gas pipes
DEUTZ S2	LV 0161 9734 FV 0160 9506	-25°C to 450°C	Spray for reducing friction and wear for surfaces difficult to access Generates an emergency lubrication and avoids sliding back.
DEUTZ S3	LV 0161 9733 FV 0160 9505	-35°C to 450°C	Spray for reducing friction and wear. Generates an emergency lubrication and avoids sliding back.
DEUTZ S4	LV 0161 9735	-40°C to 450°C	Preferably used for pre-treating components with a high application temperature. After the evaporation of the carrier oil (at 200°C), an effectively lubricating solid film remains. Compatible with natural rubber and plastic materials.
DEUTZ S5	LV 0161 9738	-30°C to 130°C	For the long-term lubrication of antifriction- and slide bearings with medium bearing pressures and higher temperatures. Water-resistant, good emergency lubrication.
DEUTZ S6	LV 0161 9741	-20°C to 180°C	For the long-term lubrication of antifriction- and slide bearings with medium bearing pressures and higher temperatures. Water-resistant, good emergency lubrication
Grease	DIN 51825- KP 2 N-30	-30°C to 140°C	Consistent grease for lubricating antifriction bearings, slide bearings and sliding surfaces. For example, for filling the spiral-toothed coupling TBD 234/616.

Tab. 3 Lubricants

Other auxiliary materials

Below you will find a reference list for the used auxiliary materials with which the best results have been achieved. Equivalent products can also be used; in this case, the supplier must assure the suitability of the product for the application.

- When using the products indicated below, the following references of the manufacturer must absolutely be observed:
  - Safety references
  - Personal protection equipment
  - Use as directed
  - Disposal as directed

Product group	Application	Product name	Supplier
Detergent	for engine components	P3 cold cleaner (liquid)	Messrs. Henkel KGAA 40191 Düsseldorf
		Vecom B 24 B (liquid)	Messrs. Vecom GmbH 21107 Hamburg
		Carbon remover or Ameroid ACC-9 (liquid)	Messrs. Drew Ameroid Deutschland GmbH 21107 Hamburg
	for engine cooling system	P3 T 288 (powder) P3 Standard (powder)	Messrs. KGAA 40191 Düsseldorf
		Vecom BA-S (powder) Vecom BA-30 (liquid)	Messrs. Vecom GmbH 21107 Hamburg
		SAF-Acid (powder) HDE-777 (liquid)	Messrs. Drew Ameroid Deutschland GmbH 21107 Hamburg
	for intercooler (water side) and raw water circuit	P3 - T1166 P3 - croni (neutraliser)	Messrs. Henkel KGAA 40191 Düsseldorf
		SAF-Acidonly calcium solutizer) Concentration: 5 % Temperature: 55 °C - 75 °C	Messrs. Drew Ameroid Deutschland GmbH 21107 Hamburg
		Porodox Concentration: 2 % - 10 % Temperatuer: 20 °C - 60 °C Treatment time: max. 16 hours	Messrs. Collardi GmbH 50825 Köln
	for intercooler (air side)	ACC 9	Messrs. Drew Ameroid Deutschland GmbH 21107 Hamburg
		Vecom B 85	Messrs. Vecom GmbH 21107 Hamburg
		P3T-5308	Messrs. Henkel KGAA 40191 Düsseldorf
	for tank plants	Vecom B 24 B (liquid) Vecom B 14 (liquid)	Messrs. Vecom GmbH 21107 Hamburg
		Tank cleaner Nr. 4 (liquid)	Messrs. Drew Ameroid Deutschland GmbH 21107 Hamburg
	for lube oil filters	Ameroid ACC-9 (liquid)	Messrs. Drew Ameroid Deutschland GmbH 21107 Hamburg
		P3 RST, P3 SAXIN (powder)	Messrs. Henkel KGAA 40191 Düsseldorf
		Filterclean	Messrs. Vecom GmbH 21107 Hamburg

Product group	Application	Product name	Supplier
Detergent (continued)	for air filters	Soda solution 1%ig Burning kerosene Mixture of: 6,5 % trilene (german: Trichlor-Äthylen) 9,5 % Teepol (Messrs. Shell) 4,0 % Cyclohexanon 80,0 % fresh water	
	for de-preservation	Eskapon S 255	Messrs. Haug-Chemie GmbH 74889 Sinsheim
Water treatment agent	Hardness determination for cooling water	Aquamerk Art. Nr. 11129 DEUTZ ordering-no. 1215 8292	Messrs. E. Merck KGAA 64293 Darmstadt
	Cooling water hardening	Vecom CN (powder)	Messrs. Vecom GmbH 21107 Hamburg
	Cooling water softening	Trisodiumphosphate (german:Trinatriumphosphat) (powder)	Messrs. Benckiser GmbH 67001 Ludwigshafen

Tab. 4 Other auxiliary materials

5 Maintenance

Please bear in mind that the following maintenance schedule is a **Recommended maintenance schedule.**

Deviations from this maintenance schedule may be necessary under certain operating conditions. For example, frequent starting, long operating times on zero load, extremely frequent load changes, frequent overloading can lead to increased wear and accordingly to shorter maintenance intervals. The maintenance schedule must then be adapted to the operating conditions in consultation with your DEUTZ SERVICE partner.

Generally the on-site operating conditions are already taken into account in the planning phase. Ask your DEUTZ SERVICE partner when in doubt.

Continuous supervision

The normal care of your engine comprises a daily visual inspection by technically skilled persons. The appropriate activities are listed in work card B 0-1-5.

Maintenance schedule

General

The maintenance schedule lists the measures for maintaining the nominal condition and thus the operational reliability of the engine and the appropriate maintenance intervals. The maintenance work procedures are described in the specified job cards.

- The intervals prescribed in the maintenance schedule are maximum values and assume that installation, purpose and operating conditions comply with DEUTZ specifications. It must be ensured that all operating media such as fuel, lube oil and coolant have the prescribed quality. You will find information about this in Chapter 4, Expendables.
- This maintenance schedule only applies for the engine itself and the parts attached to the engine. System parts must be serviced at the intervals and according to the instructions specified by the manufacturer. You will find the appropriate information in the respective enclosed **manufacturer documents** (marked **"MD"** in the maintenance schedule).
- The work described must be performed by technically skilled persons or authorised specialists. The competencies are listed in Table 1, Deutz maintenance and service schedules.

Selection and structure

An appropriate maintenance schedule applies depending on the performance group to which the engine is assigned according to the performance abbreviation and maximum speed.

- Every maintenance schedule for a performance group consists of:
  - Overview of the Deutz maintenance and service schedules and their intervals
  - Overview of the operating hour-independent maintenance measures
  - Overview of the operating hour-dependent maintenance measures
  - Poss. overview of the operating hour-dependent maintenance measures which are outside the intervals of the Deutz maintenance and service schedules
  - Copying forms for verification

Deutz maintenance and service schedule

The operating hour-dependent maintenance work is divided into Deutz maintenance and service schedules. All the work listed must be performed carefully according to the maintenance schedule determined specifically for the engine.

Deutz maintenance and service schedules		Executed by
E10	due once respectively after commissioning and E60 and E70	Technically skilled persons
E20	Daily check	
E30	Periodic maintenance (small scope)	
E40	Periodic maintenance (medium scope)	
E50	Periodic maintenance (extended scope)	Authorised specialists
E60	Intermediate overhaul	
E70	Complete overhaul	

Tab. 1 Deutz maintenance and service schedule

Please note that Deutz maintenance and service schedules may be added or omitted depending on the performance code and maximum speed.

- Plan the due Deutz maintenance and service schedules in good time according to the number of hours your engine has been in operation.
- Arrange the probable appointment with your responsible DEUTZ SERVICE partner in good time. Notify your DEUTZ Service partner of any irregularities of your engine (see operating check log) when you arrange the appointment.
- Sign a service contract with DEUTZ SERVICE if necessary. All the due maintenance work including repairs if agreed is then planned and expertly performed by DEUTZ SERVICE according to the contract. Your responsible DEUTZ SERVICE partner will be glad to give you the details.

Specific maintenance schedule performance group A1

This engine has been built exclusively for the application specified in the scope of supply - as described by the equipment manufacturer - and is to be used only for the intended purpose. Depending on its intended purpose the engine is identified by a performance code according to DIN ISO 3046-7 which is punched into the rating plate. The rating plate is described in detail in Chapter 2, Rating plate.

This maintenance schedule is valid for the following performance code and maximum speed embossed on the rating plate:

ICXN, ICN (continuous operation, speed max. 1,800 min^{-1});
IN (variable operation, speed max. 1,500 min^{-1})
ICFN (unrestricted continuous operation, speed max. 1,800 min^{-1})

Type of application:
Electricity generator units, depending on design as double-frequency systems, water pumps, compressors.

E10 Routine Maintenance	E20 Visual inspection	E23 Maintenance work	E25 Maintenance work	E30 Maintenance (small scope)	E40 Maintenance (medium scope)	E50 Maintenance (extended scope)	E60 Intermediate overhaul	E70 Complete overhaul
once in special cases	daily	after every 250 Oh	after every 500 Oh	after every 1,500 Oh	after every 3,000 Oh	after every 6,000 Oh	after every 12,000 Oh	after every 24,000 Oh

Tab. 2 Deutz maintenance and service schedules in performance group A1

Operating hour-independent maintenance work

as required	monthly	after every 6 months	after every year	after every 2 years	Description	WC
x					Renew the suction air intake filter; when maintenance indicator is ”RED”	B 6-3-6
x					Maintain crankcase bleed valve; when maintenance indicator is ”RED”	B 3-1-9
x					Trial run; after maintenance measures[1)]	B 0-1-4
x					Run in engine; after maintenance work such as changing bearings, piston, cylinder liner [2)]	W 0-1-3
x					Clean the engine	B 0-3-6
	x				Trial run [3)]	B 0-1-4
	x				Maintain the battery [3)]	B 13-4-1
		x			Check percentage of corrosion protection agent or antifreeze in the coolant [6)]	B 9-1-1
			x		Lube oil change [4)] (engine without centrifugal lube oil filter)	B 8-1-2
			x		Lube oil change [5)] (engine with centrifugal lube oil filter)	B 8-1-2
			x		Maintain the centrifugal lube oil filter [4)]	B 8-13-1
				x	Renew the coolant [6)]	B 9-1-2

1) To be executed by maintenance officer
2) To be performed by authorized experts
3) To be performed when the engine has not been operated on standby for longer than one month. The engine must be preserved during long periods out of action, e.g. over the Winter, see chapter 7, Preservation.
4) To be performed when the engine has been in operation for less than 250 Oh within one year.
5) To be performed when the engine has been in operation for less than 500 Oh within one year.
6) Observe the operating media specifications in chapter 4, Operating Media.

Tab. 3 Operating hour-independent maintenance work

Definition of activities in the maintenance schedule

Adjust	Adjust torques, dimensions, pressures etc.; extra work may be necessary to renew parts.
Drain water	Drain condensed water, for example.
Renew	Renew parts, function groups and liquids.
Finishing work	Material removal within the permitted tolerances to reinstate a nominal condition.
Check	Check according to criteria in the work card. If not all criteria are fulfilled the cause must be found and the nominal condition reinstated.
Clean	Cleaning by hand or machine (automatic), renewal of cleaning parts (e.g. air filters) may be necessary.
Visual inspection	Visual inspection according to criteria in the job card. If not all criteria are fulfilled the cause must be found and the nominal condition reinstated.
Overhaul	Check function groups, rework or renew parts.
Maintain	Maintain according to job card. Check function, reworking or renewal of parts may be necessary.
Change	Change lube oil, for example.

Tab. 4 Definition of activities

Operating hour-dependent maintenance work

On reaching the operating hours specified in the following maintenance schedule the activities prescribed in the description must be performed. Always use the job card referred to in the maintenance schedule.

E10	E20	E23	E25	E30	E40	E50	E60	E70	Description	WC
1x after 50 Oh	every 24 hours (daily)	after every 250 Oh	after every 500 Oh	after every 1,500 Oh	after every 3,000 Oh	after every 6,000 Oh	after every 12,000 Oh	after every 24,000 Oh		
	x								Visual inspection of the system	B 0-1-5
		x	x	x	x	x	x	x	Maintain the battery	B 13-4-1
x		x	x	x	x	x	x	x	Maintain the centrifugal lube oil filter 6)	B 8-13-1
x		x	x	x	x	x	x	x	Lube oil change 1) 2) (engine without centrifugal lube oil filter)	B 8-1-2
x			x	x	x	x	x	x	Lube oil change 1) 2) (engine with centrifugal lube oil filter)	B 8-1-2
x			x	x	x	x	x	x	Renew lube oil filter cartridge	B 8-10-4
			x	x	x	x	x	x	Renew fuel filter cartridge	B 7-10-4
			x	x	x	x	x	x	Maintain the double fuel filter	B 7-10-1
			x	x	x	x	x	x	Check engine shutdown	B 11-0-1
			x	x	x	x	x		Maintain crankcase bleed valve, made by Racor 3)	B 3-1-9

1) Observe the operating media specifications in chapter 4, Operating Media .
2) Change annually if the operating hours are not reached.
3) The crankcase bleed valve must also be maintained when the maintenance indicator is ”RED”.
4) V16 engines only
5) V8 engines only
6) Clean annually if the operating hours are not reached.
MD: Manufacturer Documents

Table 4Note activity definition

E10	E20	E23	E25	E30	E40	E50	E60	E70	Description	WC
1x after 50 Oh	every 24 hours (daily)	after every 250 Oh	after every 500 Oh	after every 1,500 Oh	after every 3,000 Oh	after every 6,000 Oh	after every 12,000 Oh	after every 24,000 Oh		
			x	x	x				Check V-belts	B 12-2-1
						x	x	x	Renew V-belt	B 12-2-1
x					x	x			Check and set inlet and outlet valve clearance	B 1-1-1
					x	x	x	x	Check the injection valves	B 7-7-3
					x	x			Visually inspect arched denture clutch [4]	B 7-4-16
					x				Check the coolant pump	B 9-7-11
					x				Check the coolant pump, circuit 2	B 9-7-12
						x	x	x	Renew the coolant pump	W 9-7-8
						x	x	x	Renew the coolant pump, circuit 2	W 9-7-9
							x	x	Renew arched denture clutch [4]	W 7-4-6
						x	x	x	Check compression	W 0-2-6
							x	x	Overhaul or renew cylinder heads	W 1-4-2
						x			Clean the exhaust gas turbocharger	ME
						x			Check exhaust gas turbocharger bearing clearance	ME
							x	x	Overhaul the exhaust gas turbocharger	ME
						x			Check the charge air cooler	W 6-4-5
							x	x	Clean the charge air cooler	W 6-4-3
							x		Check cylinder liners	W 0-2-7
								x	Renew the cylinder liners	W 3-3-3
							x		Check injection pump drive	W 7-4-12
								x	Overhaul or renew injection pump drive	W 7-4-7
							x		Check pistons (piston bolt, piston rings)	W 2-9-3
								x	Renew pistons (piston bolt, piston rings)	W 2-9-3
							x	x	Water-cooled exhaust pipe, check liquid chambers [5]	W 6-1-3
							x	x	Check solid insulation [5]	W 6-1-4
							x	x	Renew fabric mat insulation of the turbocharger [5]	W 6-6-3
							x	x	Clean the lube oil cooler	W 8-8-2
							x	x	Renew the oil pressure control valve	W 8-11-3
							x	x	Renew the bypass valve	W 8-11-5
							x	x	Renew hose pipes, vibration dampers and flexible lines	W 0-3-4

1) Observe the operating media specifications in chapter 4, Operating Media .
2) Change annually if the operating hours are not reached.
3) The crankcase bleed valve must also be maintained when the maintenance indicator is ”RED”.
4) V16 engines only
5) V8 engines only
6) Clean annually if the operating hours are not reached.
MD: Manufacturer Documents

Table 4Note activity definition

E10	E20	E23	E25	E30	E40	E50	E60	E70	Description	WC
1x after 50 Oh	every 24 hours (daily)	after every 250 Oh	after every 500 Oh	after every 1,500 Oh	after every 3,000 Oh	after every 6,000 Oh	after every 12,000 Oh	after every 24,000 Oh		
							x	x	Renew injection lines	W 7-3-3
							x	x	Renew check valve in the leak fuel system	W 7-3-5
							x	x	Renew con-rod bearing	W 2-1-4
							x	x	Check con-rod geometry	W 2-3-5
							x	x	Overhaul injection pump	ME
							x	x	Overhaul dynamo	ME
								x	Check coolant chambers	W 9-0-3
								x	Renew rotary vibration dampers	W 12-1-4
								x	Renew rocker arms, valve bridges	W 1-2-2
								x	Check elastic suspension	ME
								x	Check elastic coupling	ME
								x	Renew main bearing	W 2-7-2
								x	Renew crankcase bleed valve	W 3-1-10
								x	Check crankshaft	W 2-1-7
								x	Renew camshaft and valve lifter	W 4-1-4
								x	Renew camshaft bearing	W 4-1-1
								x	Renew camshaft axial bearing	W 3-1-4
								x	Renew mass compensation shaft bearing [5)]	W 2-8-1
								x	Check stop rods	W 4-2-1
								x	Check intermediate gear wheels and bearing bush of the coolant pump	W 9-7-5
								x	Check lube oil pump	W 8-4-5
								x	Renew cooler cap	-
								x	Renew crankshaft sealing ring (drive side)	W 2-2-2
								x	Renew crankshaft sealing ring (free side)	W 2-2-4
								x	Overhaul starter	ME
								x	Check solenoid valve(s)	ME
								x	Electric sensors, solenoids	ME
									Other connected parts	ME

1) Observe the operating media specifications in chapter 4, Operating Media .
2) Change annually if the operating hours are not reached.
3) The crankcase bleed valve must also be maintained when the maintenance indicator is "RED".
4) V16 engines only
5) V8 engines only
6) Clean annually if the operating hours are not reached.
MD: Manufacturer Documents

Table 4Note activity definition

Overview of operating hour-independent maintenance work (copy form)

Date	Activity	Signature

Tab. 5 Overview of operating hour-independent maintenance work performance group A1

Overview of operating hour-dependent maintenance work (copy form)

hours	Deutz maintenance and service schedule								Date	Signature
	E10	E23	E25	E30	E40	E50	E60	E70		
50	1									
250		1								
500			1							
750		2								
1,000			2							
1,250		3								
1,500				1						
1,750		4								
2,000			3							
2,250		5								
2,500			4							
2,750		6								
3,000					1					
3,250		7								
3,500			5							
3,750		8								
4,000			6							
4,250		9								
4,500				2						
4,750		10								
5,000			7							
5,250		11								
5,500			8							
5,750		12								
6,000						1				
6,250		13								
6,500			9							
6,750		14								
7,000			10							
7,250		15								
7,500				3						
7,750		16								
8,000			11							
8,250		17								
8,500			12							
8,750		18								
9,000					2					
9,250		19								
9,500			13							
9,750		20								

hours	Deutz maintenance and service schedule								Date	Signature
	E10	E23	E25	E30	E40	E50	E60	E70		
10,000			14							
10,250		21								
10,500				4						
10,750		22								
11,000			15							
11,250		23								
11,500			16							
11,750		24								
12,000							1			
12,050	2									
12,250		25								
12,500			17							
12,750		26								
13,000			18							
13,250		27								
13,500				5						
13,750		28								
14,000			19							
14,250		29								
14,500			20							
14,750		30								
15,000					3					
15,250		31								
15,500			21							
15,750		32								
16,000			22							
16,250		33								
16,500				6						
16,750		34								
17,000			23							
17,250		35								
17,500			24							
17,750		36								
18,000						2				
18,250		37								
18,500			25							
18,750		38								
19,000			26							
19,250		39								
19,500				7						
19,750		40								

hours	Deutz maintenance and service schedule								Date	Signature
	E10	E23	E25	E30	E40	E50	E60	E70		
20,000			**27**							
20,250		**41**								
20,500			**28**							
20,750		**42**								
21,000					**4**					
21,250		**43**								
21,500			**29**							
21,750		**44**								
22,000			**30**							
22,250		**45**								
22,500				**8**						
22,750		**46**								
23,000			**31**							
23,250		**47**								
23,500			**32**							
23,750		**48**								
24,000								**1**		
Number of Deutz maintenance and service schedules up to and including complete overhaul										
Total	**2**	**48**	**32**	**8**	**4**	**2**	**1**	**1**		

Tab. 6 Overview of operating hour-dependent maintenance work performance group A1

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Specific maintenance schedule performance group A2

This engine has been built exclusively for the application specified in the scope of supply - as described by the equipment manufacturer - and is to be used only for the intended purpose. Depending on its intended purpose the engine is identified by a performance code according to DIN ISO 3046-7 which is punched into the rating plate. The rating plate is described in detail in Chapter 2, Rating plate.

This maintenance schedule is valid for the following performance code and maximum speed embossed on the rating plate:

ICFN (unrestricted continuous operation, speed max. 2,100 min^{-1})
IFN (limited continuous operation, speed max. 2,100 min^{-1})

Type of application:
Electricity generator units, water pumps, compressors, fire extinguisher pumps.

E10 Routine Maintenance	E20 Visual inspection	E23 Maintenance work	E25 Maintenance work	E30 Maintenance (small scope)	E40 Maintenance (medium scope)	E50 Maintenance (extended scope)	E60 Intermediate overhaul	E70 Complete overhaul
once in special case	daily	after every 250 Oh	after every 500 Oh	after every 1,500 Oh	after every 3,000 Oh	after every 6,000 Oh	after every 9,000 Oh	after every 18,000 Oh

Tab. 7 Deutz maintenance and service schedules in performance group A2

Operating hour-independent maintenance work

as required	monthly	after every 6 months	after every year	after every 2 years	Description	WC
x					Renew the suction air intake filter; when maintenance indicator is ”RED”	B 6-3-6
x					Maintain crankcase bleed valve; when maintenance indicator is ”RED”	B 3-1-9
x					Trial run; after maintenance measures[1)]	B 0-1-4
x					Run in engine; after maintenance work such as changing bearings, piston, cylinder liner [2)]	W 0-1-3
x					Clean the engine	B 0-3-6
	x				Trial run [3)]	B 0-1-4
	x				Maintain the battery [3)]	B 13-4-1
		x			Check percentage of corrosion protection agent or antifreeze in the coolant [6)]	B 9-1-1
			x		Lube oil change [4)] (engine without centrifugal lube oil filter)	B 8-1-2
			x		Lube oil change [5)] (engine with centrifugal lube oil filter)	B 8-1-2
			x		Maintain the centrifugal lube oil filter [4)]	B 8-13-1
				x	Renew the coolant [6)]	B 9-1-2

1) To be executed by maintenance officer
2) To be performed by authorized experts
3) To be performed when the engine has not been operated on standby for longer than one month. The engine must be preserved during long periods out of action, e.g. over the Winter, see chapter 7, Preservation.
4) To be performed when the engine has been in operation for less than 250 Oh within one year.
5) To be performed when the engine has been in operation for less than 500 Oh within one year.
6) Observe the operating media specifications in chapter 4, Operating Media.

Tab. 8 Operating hour-independent maintenance work

Definition of activities in the maintenance schedule

Adjust	Adjust torques, dimensions, pressures etc.; extra work may be necessary to renew parts.
Drain water	Drain condensed water, for example.
Renew	Renew parts, function groups and liquids.
Finishing work	Material removal within the permitted tolerances to reinstate a nominal condition.
Check	Check according to criteria in the work card. If not all criteria are fulfilled the cause must be found and the nominal condition reinstated.
Clean	Cleaning by hand or machine (automatic), renewal of cleaning parts (e.g. air filters) may be necessary.
Visual inspection	Visual inspection according to criteria in the job card. If not all criteria are fulfilled the cause must be found and the nominal condition reinstated.
Overhaul	Check function groups, rework or renew parts.
Maintain	Maintain according to job card. Check function, reworking or renewal of parts may be necessary.
Change	Change lube oil, for example.

Tab. 9 Definition of activities

Operating hour-dependent maintenance work

On reaching the operating hours specified in the following maintenance schedule the activities prescribed in the description must be performed. Always use the job card referred to in the maintenance schedule.

E10	E20	E23	E25	E30	E40	E50	E60	E70	Description	WC
1x after 50 Oh	every 24 hours (daily)	after every 250 Oh	after every 500 Oh	after every 1,500 Oh	after every 3,000 Oh	after every 6,000 Oh	after every 9,000 Oh	after every 18,000 Oh		
	x								Visual inspection of the system	B 0-1-5
		x	x	x	x	x	x	x	Maintain the battery	B 13-4-1
x		x	x	x	x	x	x	x	Maintain the centrifugal lube oil filter 6)	B 8-13-1
x		x	x	x	x	x	x	x	Lube oil change 1) 2) (engine without centrifugal lube oil filter)	B 8-1-2
x			x	x	x	x	x	x	Lube oil change 1) 2) (engine with centrifugal lube oil filter)	B 8-1-2
x			x	x	x	x	x	x	Renew lube oil filter cartridge	B 8-10-4
			x	x	x	x	x	x	Renew fuel filter cartridge	B 7-10-4
			x	x	x	x	x	x	Maintain the double fuel filter	B 7-10-1
			x	x	x	x	x	x	Check engine shutdown	B 11-0-1
			x	x	x	x	x		Maintain crankcase bleed valve, made by Racor 3)	B 3-1-9

1) Observe the operating media specifications in chapter 4, Operating Media .
2) Change annually if the operating hours are not reached.
3) The crankcase bleed valve must also be maintained when the maintenance indicator is ”RED”.
4) V16 engines only
5) V8 engines only
6) Clean annually if the operating hours are not reached.
MD: Manufacturer Documents

Table 4Note activity definition

E10	E20	E23	E25	E30	E40	E50	E60	E70	Description	WC
1x after 50 Oh	every 24 hours (daily)	after every 250 Oh	after every 500 Oh	after every 1,500 Oh	after every 3,000 Oh	after every 6,000 Oh	after every 9,000 Oh	after every 18,000 Oh		
			x	x	x				Check V-belts	B 12-2-1
						x	x	x	Renew V-belt	B 12-2-1
x				x	x	x			Check and set inlet and outlet valve clearance	B 1-1-1
				x	x	x	x	x	Check the injection valves	B 7-7-3
					x	x			Visually inspect arched denture clutch [4]	B 7-4-16
					x				Check the coolant pump	B 9-7-11
					x				Check the coolant pump, circuit 2	B 9-7-12
						x	x	x	Renew the coolant pump	W 9-7-8
						x	x	x	Renew the coolant pump, circuit 2	W 9-7-9
							x	x	Renew arched denture clutch [4]	W 7-4-6
						x	x	x	Check compression	W 0-2-6
							x	x	Overhaul or renew cylinder heads	W 1-4-2
						x			Clean the exhaust gas turbocharger	ME
						x			Check exhaust gas turbocharger bearing clearance	ME
							x	x	Overhaul the exhaust gas turbocharger	ME
						x			Check the charge air cooler	W 6-4-5
							x	x	Clean the charge air cooler	W 6-4-3
							x		Check cylinder liners	W 0-2-7
								x	Renew the cylinder liners	W 3-3-3
							x		Check injection pump drive	W 7-4-12
								x	Overhaul or renew injection pump drive	W 7-4-7
							x		Check pistons (piston bolt, piston rings)	W 2-9-3
								x	Renew pistons (piston bolt, piston rings)	W 2-9-3
							x	x	Water-cooled exhaust pipe, check liquid chambers [5]	W 6-1-3
							x	x	Check solid insulation [5]	W 6-1-4
							x	x	Renew fabric mat insulation of the turbocharger [5]	W 6-6-3
							x	x	Clean the lube oil cooler	W 8-8-2
							x	x	Renew the oil pressure control valve	W 8-11-3
							x	x	Renew the bypass valve	W 8-11-5
							x	x	Renew hose pipes, vibration dampers and flexible lines	W 0-3-4

1) Observe the operating media specifications in chapter 4, Operating Media .
2) Change annually if the operating hours are not reached.
3) The crankcase bleed valve must also be maintained when the maintenance indicator is ”RED”.
4) V16 engines only
5) V8 engines only
6) Clean annually if the operating hours are not reached.
MD: Manufacturer Documents

Table 4Note activity definition

E10	E20	E23	E25	E30	E40	E50	E60	E70	Description	WC
1x after 50 Oh	every 24 hours (daily)	after every 250 Oh	after every 500 Oh	after every 1,500 Oh	after every 3,000 Oh	after every 6,000 Oh	after every 9,000 Oh	after every 18,000 Oh		
							x	x	Renew injection lines	W 7-3-3
							x	x	Renew check valve in the leak fuel system	W 7-3-5
							x	x	Renew con-rod bearing	W 2-5-1
							x	x	Check con-rod geometry	W 2-3-5
							x	x	Overhaul injection pump	ME
							x	x	Overhaul dynamo	ME
								x	Check coolant chambers	W 9-0-3
								x	Renew rotary vibration dampers	W 12-1-4
								x	Renew rocker arms, valve bridges	W 1-2-2
								x	Check elastic suspension	ME
								x	Check elastic coupling	ME
								x	Renew main bearing	W 2-7-2
								x	Renew crankcase bleed valve	W 3-1-10
								x	Check crankshaft	W 2-1-7
								x	Renew camshaft and valve lifter	W 4-5-1
								x	Renew camshaft bearing	W 4-1-1
								x	Renew camshaft axial bearing	W 3-8-1
								x	Renew mass compensation shaft bearing [5)]	W 2-8-1
								x	Check stop rods	W 4-2-1
								x	Check intermediate gear wheels and bearing bush of the coolant pump	W 9-7-5
								x	Check lube oil pump	W 8-4-5
								x	Renew cooler cap	-
								x	Renew crankshaft sealing ring (drive side)	W 2-2-2
								x	Renew crankshaft sealing ring (free side)	W 2-2-4
								x	Overhaul starter	ME
								x	Check solenoid valve(s)	ME
								x	Electric sensors, solenoids	ME
									Other connected parts	ME

1) Observe the operating media specifications in chapter 4, Operating Media .
2) Change annually if the operating hours are not reached.
3) The crankcase bleed valve must also be maintained when the maintenance indicator is "RED".
4) V16 engines only
5) V8 engines only
6) Clean annually if the operating hours are not reached.
MD: Manufacturer Documents

Table 4Note activity definition

Overview of operating hour-independent maintenance work (copy form)

Date	Activity	Signature

Tab. 10 Overview of operating hour-independent maintenance work performance group A2

Overview of operating hour-dependent maintenance work (copy form)

hours	Deutz maintenance and service schedule								Date	Signature
	E10	E23	E25	E30	E40	E50	E60	E70		
50	1									
250		1								
500			1							
750		2								
1,000			2							
1,250		3								
1,500				1						
1,750		4								
2,000			3							
2,250		5								
2,500			4							
2,750		6								
3,000					1					
3,250		7								
3,500			5							
3,750		8								
4,000			6							
4,250		9								
4,500				2						
4,750		10								
5,000			7							
5,250		11								
5,500			8							
5,750		12								
6,000						1				
6,250		13								
6,500			9							
6,750		14								
7,000			10							
7,250		15								
7,500				3						
7,750		16								
8,000			11							
8,250		17								
8,500			12							
8,750		18								
9,000							1			
9,050	2									
9,250		19								
9,500			13							

hours	Deutz maintenance and service schedule								Date	Signature
	E10	E23	E25	E30	E40	E50	E60	E70		
9,750		20								
10,000			14							
10,250		21								
10,500				4						
10,750		22								
11,000			15							
11,250		23								
11,500			16							
11,750		24								
12,000						2				
12,250		25								
12,500			17							
12,750		26								
13,000			18							
13,250		27								
13,500				5						
13,750		28								
14,000			19							
14,250		29								
14,500			20							
14,750		30								
15,000					2					
15,250		31								
15,500			21							
15,750		32								
16,000			22							
16,250		33								
16,500				6						
16,750		34								
17,000			23							
17,250		35								
17,500			24							
17,750		36								
18,000								1		

Number of Deutz maintenance and service schedules up to and including complete overhaul								
Total	2	36	24	6	2	2	1	1

Tab. 11 Overview of operating hour-dependent maintenance work performance group A2

Specific maintenance schedule performance group B

This engine has been built exclusively for the application specified in the scope of supply - as described by the equipment manufacturer - and is to be used only for the intended purpose. Depending on its intended purpose the engine is identified by a performance code according to DIN ISO 3046-7 which is punched into the rating plate. The rating plate is described in detail in Chapter 2, Rating plate.

This maintenance schedule is valid for the following performance code and maximum speed embossed on the rating plate:

IFN (max. 1,500 min^{-1});
IN (variable operation, max. 1,800 min^{-1})

Type of application:
Electricity generator units, depending on design as double-frequency systems.

E10 Routine Maintenance	E20 Visual inspection	E23 Maintenance work	E25 Maintenance work	E30 Maintenance (small scope)	E40 Maintenance (medium scope)	E60 Intermediate overhaul	E70 Complete overhaul
once in special cases	daily	after every 250 Oh	after every 500 Oh	after every 1,500 Oh	after every 3,000 Oh	after every 6,000 Oh	after every 12,000 Oh

Tab. 12 Deutz maintenance and service schedules in performance group B

Operating hour-independent maintenance work

as required	monthly	after every 6 months	after every year	after every 2 years	Description	WC
x					Renew the suction air intake filter; when maintenance indicator is ”RED”	B 6-3-6
x					Maintain crankcase bleed valve; when maintenance indicator is ”RED”	B 3-1-9
x					Trial run; after maintenance measures[1)]	B 0-1-4
x					Run in engine; after maintenance work such as changing bearings, piston, cylinder liner [2)]	W 0-1-3
x					Clean the engine	B 0-3-6
	x				Trial run[3)]	B 0-1-4
	x				Maintain the battery [3)]	B 13-4-1
		x			Check percentage of corrosion protection agent or antifreeze in the coolant [6)]	B 9-1-1
			x		Lube oil change [4)] (engine without centrifugal lube oil filter)	B 8-1-2
			x		Lube oil change [5)] (engine with centrifugal lube oil filter)	B 8-1-2
			x		Maintain the centrifugal lube oil filter [4)]	B 8-13-1
				x	Renew the coolant [6)]	B 9-1-2

1) To be executed by maintenance officer
2) To be performed by authorized experts
3) To be performed when the engine has not been operated on standby for longer than one month. The engine must be preserved during long periods out of action, e.g. over the Winter, see chapter 7, Preservation.
4) To be performed when the engine has been in operation for less than 250 Oh within one year.
5) To be performed when the engine has been in operation for less than 500 Oh within one year.
6) Observe the operating media specifications in chapter 4, Operating Media.

Tab. 13 Operating hour-independent maintenance work

Definition of activities in the maintenance schedule

Adjust	Adjust torques, dimensions, pressures etc.; extra work may be necessary to renew parts.
Drain water	Drain condensed water, for example.
Renew	Renew parts, function groups and liquids.
Finishing work	Material removal within the permitted tolerances to reinstate a nominal condition.
Check	Check according to criteria in the work card. If not all criteria are fulfilled the cause must be found and the nominal condition reinstated.
Clean	Cleaning by hand or machine (automatic), renewal of cleaning parts (e.g. air filters) may be necessary.
Visual inspection	Visual inspection according to criteria in the job card. If not all criteria are fulfilled the cause must be found and the nominal condition reinstated.
Overhaul	Check function groups, rework or renew parts.
Maintain	Maintain according to job card. Check function, reworking or renewal of parts may be necessary.
Change	Change lube oil, for example.

Tab. 14 Definition of activities

Operating hour-dependent maintenance work

On reaching the operating hours specified in the following maintenance schedule the activities prescribed in the description must be performed. Always use the job card referred to in the maintenance schedule.

E10	E20	E23	E25	E30	E40	E60	E70	Description	WC
1x after 50 Oh	every 24 hours (daily)	after every 250 Oh	after every 500 Oh	after every 1,500 Oh	after every 3,000 Oh	after every 6,000 Oh	after every 12,000 Oh		
	x							Visual inspection of the system	B 0-1-5
		x	x	x	x	x	x	Maintain the battery	B 13-4-1
x		x	x	x	x	x	x	Maintain the centrifugal lube oil filter 6)	B 8-13-1
x		x	x	x	x	x	x	Lube oil change 1) 2) (engine without centrifugal lube oil filter)	B 8-1-2
x			x	x	x	x	x	Lube oil change 1) 2) (engine with centrifugal lube oil filter)	B 8-1-2
x			x	x	x	x	x	Renew lube oil filter cartridge	B 8-10-4
			x	x	x	x	x	Renew fuel filter cartridge	B 7-10-4
			x	x	x	x	x	Maintain the double fuel filter	B 7-10-1
			x	x	x	x	x	Check engine shutdown	B 11-0-1
			x	x	x	x		Maintain crankcase bleed valve, made by Racor 3)	B 3-1-9

1) Observe the operating media specifications in chapter 4, Operating Media .
2) Change annually if the operating hours are not reached.
3) The crankcase bleed valve must also be maintained when the maintenance indicator is ”RED”.
4) V16 engines only
5) V8 engines only
6) Clean annually if the operating hours are not reached.
MD: Manufacturer Documents

Table 4Note activity definition

E10	E20	E23	E25	E30	E40	E60	E70	Description	WC
1x after 50 Oh	every 24 hours (daily)	after every 250 Oh	after every 500 Oh	after every 1,500 Oh	after every 3,000 Oh	after every 6,000 Oh	after every 12,000 Oh		
			x	x	x			Check V-belts	B 12-2-1
						x	x	Renew V-belt	B 12-2-1
x				x	x			Check and set inlet and outlet valve clearance	B 1-1-1
				x	x	x	x	Check the injection valves	B 7-7-3
					x			Visually inspect arched denture clutch [4]	B 7-4-16
					x			Check the coolant pump	B 9-7-11
					x			Check the coolant pump, circuit 2	B 9-7-12
						x	x	Renew the coolant pump	W 9-7-8
						x	x	Renew the coolant pump, circuit 2	W 9-7-9
						x	x	Renew arched denture clutch [4]	W 7-4-6
						x	x	Check compression	W 0-2-6
						x	x	Overhaul or renew cylinder heads	W 1-4-2
								Clean the exhaust gas turbocharger	ME
								Check exhaust gas turbocharger bearing clearance	ME
						x	x	Overhaul the exhaust gas turbocharger	ME
								Check the charge air cooler	W 6-4-5
						x	x	Clean the charge air cooler	W 6-4-3
						x		Check cylinder liners	W 0-2-7
							x	Renew the cylinder liners	W 3-3-3
						x		Check injection pump drive	W 7-4-12
							x	Overhaul or renew injection pump drive	W 7-4-7
						x		Check pistons (piston bolt, piston rings)	W 2-9-3
							x	Renew pistons (piston bolt, piston rings)	W 2-9-3
						x	x	Water-cooled exhaust pipe, check liquid chambers [5]	W 6-1-3
						x	x	Check solid insulation [5]	W 6-1-4
						x	x	Renew fabric mat insulation of the turbocharger [5]	W 6-6-3
						x	x	Clean the lube oil cooler	W 8-8-2
						x	x	Renew the oil pressure control valve	W 8-11-3
						x	x	Renew the bypass valve	W 8-11-5
						x	x	Renew hose pipes, vibration dampers and flexible lines	W 0-3-4
						x	x	Renew injection lines	W 7-3-3

1) Observe the operating media specifications in chapter 4, Operating Media .
2) Change annually if the operating hours are not reached.
3) The crankcase bleed valve must also be maintained when the maintenance indicator is ”RED”.
4) V16 engines only
5) V8 engines only
6) Clean annually if the operating hours are not reached.
MD: Manufacturer Documents

Table 4Note activity definition

E10	E20	E23	E25	E30	E40	E60	E70	Description	WC
1x after 50 Oh	every 24 hours (daily)	after every 250 Oh	after every 500 Oh	after every 1,500 Oh	after every 3,000 Oh	after every 6,000 Oh	after every 12,000 Oh		
						x	x	Renew check valve in the leak fuel system	W 7-3-5
						x	x	Renew con-rod bearing	W 2-5-1
						x	x	Check con-rod geometry	W 2-3-5
						x	x	Overhaul injection pump	ME
						x	x	Overhaul dynamo	ME
							x	Check coolant chambers	W 9-0-3
							x	Renew rotary vibration dampers	W 12-1-4
							x	Renew rocker arms, valve bridges	W 1-2-2
							x	Check elastic suspension	ME
							x	Check elastic coupling	ME
							x	Renew main bearing	W 2-7-2
							x	Renew crankcase bleed valve	W 3-1-10
							x	Check crankshaft	W 2-1-7
							x	Renew camshaft and valve lifter	W 4-5-1
							x	Renew camshaft bearing	W 4-1-1
							x	Renew camshaft axial bearing	W 3-8-1
							x	Renew mass compensation shaft bearing [5)]	W 2-8-1
							x	Check stop rods	W 4-2-1
							x	Check intermediate gear wheels and bearing bush of the coolant pump	W 9-7-5
							x	Check lube oil pump	W 8-4-5
							x	Renew cooler cap	-
							x	Renew crankshaft sealing ring (drive side)	W 2-2-2
							x	Renew crankshaft sealing ring (free side)	W 2-2-4
							x	Overhaul starter	ME
							x	Check solenoid valve(s)	ME
							x	Electric sensors, solenoids	ME
								Other connected parts	ME

1) Observe the operating media specifications in chapter 4, Operating Media .
2) Change annually if the operating hours are not reached.
3) The crankcase bleed valve must also be maintained when the maintenance indicator is "RED".
4) V16 engines only
5) V8 engines only
6) Clean annually if the operating hours are not reached.
MD: Manufacturer Documents

Table 4Note activity definition

Overview of operating hour-independent maintenance work (copy form)

Date	Activity	Signature

Tab. 15 Overview of operating hour-independent maintenance work performance group B

Overview of operating hour-dependent maintenance work (copy form)

hours	Deutz maintenance and service schedule								Date	Signature
	E10	E23	E25	E30	E40	E50	E60	E70		
50	1									
250		1								
500			1							
750		2								
1,000			2							
1,250		3								
1,500				1						
1,750		4								
2,000			3							
2,250		5								
2,500			4							
2,750		6								
3,000					1					
3,250		7								
3,500			5							
3,750		8								
4,000			6							
4,250		9								
4,500				2						
4,750		10								
5,000			7							
5,250		11								
5,500			8							
5,750		12								
6,000							1			
6,050	2									
6,250		13								
6,500			9							
6,750		14								
7,000			10							
7,250		15								
7,500				3						
7,750		16								
8,000			11							
8,250		17								
8,500			12							
8,750		18								
9,000					2					
9,250		19								
9,500			13							

hours	Deutz maintenance and service schedule								Date	Signature
	E10	E23	E25	E30	E40	E50	E60	E70		
9,750		**20**								
10,000			**14**							
10,250		**21**								
10,500				**4**						
10,750		**22**								
11,000			**15**							
11,250		**23**								
11,500			**16**							
11,750		**24**								
12,000								**1**		

Number of Deutz maintenance and service schedules up to and including complete overhaul								
Total	**2**	**24**	**16**	**4**	**2**	**-**	**1**	**1**

Tab. 16 Overview of operating hour-dependent maintenance work performance group B

Specific maintenance schedule performance group C

This engine has been built exclusively for the application specified in the scope of supply - as described by the equipment manufacturer - and is to be used only for the intended purpose. Depending on its intended purpose the engine is identified by a performance code according to DIN ISO 3046-7 which is punched into the rating plate. The rating plate is described in detail in Chapter 2, Rating plate.

This maintenance schedule is valid for the following performance code and maximum speed embossed on the rating plate: **IFN (max. 1,800 min^{-1})** Type of application: Electricity generator units, depending on design as double-frequency systems.						
E10 Routine Main-tenance	E20 Visual inspection	E23 Maintenance work	E25 Maintenance work	E30 Maintenance (small scope)	E60 Intermediate overhaul	E70 Complete overhaul
once in special cases	daily	after every 250 Oh	after every 500 Oh	after every 1,000 Oh	after every 3,000 Oh	after every 6,000 Oh

Tab. 17 Deutz maintenance and service schedules in performance group C

Operating hour-independent maintenance work

as required	monthly	after every 6 months	after every year	after every 2 years	Description	WC
x					Renew the suction air intake filter; when maintenance indicator is ”RED”	B 6-3-6
x					Maintain crankcase bleed valve; when maintenance indicator is ”RED”	B 3-1-9
x					Trial run; after maintenance measures[1)]	B 0-1-4
x					Run in engine; after maintenance work such as changing bearings, piston, cylinder liner [2)]	W 0-1-3
x					Clean the engine	B 0-3-6
	x				Trial run [3)]	B 0-1-4
	x				Maintain the battery [3)]	B 13-4-1
		x			Check percentage of corrosion protection agent or antifreeze in the coolant [6)]	B 9-1-1
			x		Lube oil change [4)] (engine without centrifugal lube oil filter)	B 8-1-2
			x		Lube oil change [5)] (engine with centrifugal lube oil filter)	B 8-1-2
			x		Maintain the centrifugal lube oil filter [4)]	B 8-13-1
				x	Renew the coolant [6)]	B 9-1-2

1) To be executed by maintenance officer
2) To be performed by authorized experts
3) To be performed when the engine has not been operated on standby for longer than one month. The engine must be preserved during long periods out of action, e.g. over the Winter, see chapter 7, Preservation.
4) To be performed when the engine has been in operation for less than 250 Oh within one year.
5) To be performed when the engine has been in operation for less than 500 Oh within one year.
6) Observe the operating media specifications in chapter 4, Operating Media.

Tab. 18 Operating hour-independent maintenance work

Definition of activities in the maintenance schedule

Adjust	Adjust torques, dimensions, pressures etc.; extra work may be necessary to renew parts.
Drain water	Drain condensed water, for example.
Renew	Renew parts, function groups and liquids.
Finishing work	Material removal within the permitted tolerances to reinstate a nominal condition.
Check	Check according to criteria in the work card. If not all criteria are fulfilled the cause must be found and the nominal condition reinstated.
Clean	Cleaning by hand or machine (automatic), renewal of cleaning parts (e.g. air filters) may be necessary.
Visual inspection	Visual inspection according to criteria in the job card. If not all criteria are fulfilled the cause must be found and the nominal condition reinstated.
Overhaul	Check function groups, rework or renew parts.
Maintain	Maintain according to job card. Check function, reworking or renewal of parts may be necessary.
Change	Change lube oil, for example.

Tab. 19 Definition of activities

Operating hour-dependent maintenance work

On reaching the operating hours specified in the following maintenance schedule the activities prescribed in the description must be performed. Always use the job card referred to in the maintenance schedule.

E10	E20	E23	E25	E30	E60	E70	Description	WC
1x after 50 Oh	every 24 hours (daily)	after every 250 Oh	after every 500 Oh	after every 1,000 Oh	after every 3,000 Oh	after every 6,000 Oh		
	x						Visual inspection of the system	B 0-1-5
		x	x	x	x	x	Maintain the battery	B 13-4-1
x		x	x	x	x	x	Maintain the centrifugal lube oil filter 6)	B 8-13-1
x		x	x	x	x	x	Lube oil change 1) 2) (engine without centrifugal lube oil filter)	B 8-1-2
x			x	x	x	x	Lube oil change 1) 2) (engine with centrifugal lube oil filter)	B 8-1-2
x			x	x	x	x	Renew lube oil filter cartridge	B 8-10-4
			x	x	x	x	Renew fuel filter cartridge	B 7-10-4
			x	x	x	x	Maintain the double fuel filter	B 7-10-1
			x	x	x	x	Check engine shutdown	B 11-0-1
			x	x	x		Maintain crankcase bleed valve, made by Racor 3)	B 3-1-9

1) Observe the operating media specifications in chapter 4, Operating Media .
2) Change annually if the operating hours are not reached.
3) The crankcase bleed valve must also be maintained when the maintenance indicator is ”RED”.
4) V16 engines only
5) V8 engines only
6) Clean annually if the operating hours are not reached.
MD: Manufacturer Documents

Table 4Note activity definition

E10	E20	E23	E25	E30	E60	E70	Description	WC
1x after 50 Oh	every 24 hours (daily)	after every 250 Oh	after every 500 Oh	after every 1,000 Oh	after every 3,000 Oh	after every 6,000 Oh		
			x	x			Check V-belts	B 12-2-1
					x	x	Renew V-belt	B 12-2-1
x				x			Check and set inlet and outlet valve clearance	B 1-1-1
				x	x	x	Check the injection valves	B 7-7-3
				x			Visually inspect arched denture clutch 4)	B 7-4-16
					x	x	Renew arched denture clutch 4)	W 7-4-6
					x	x	Renew the coolant pump	W 9-7-8
					x	x	Renew the coolant pump, circuit 2	W 9-7-9
					x	x	Check compression	W 0-2-6
					x	x	Overhaul or renew cylinder heads	W 1-4-2
					x	x	Overhaul the exhaust gas turbocharger	ME
					x	x	Clean the charge air cooler	W 6-4-3
					x	x	Renew the cylinder liners	W 3-3-3
					x	x	Overhaul or renew injection pump drive	W 7-4-7
					x	x	Renew pistons (piston bolt, piston rings)	W 2-9-3
					x	x	Water-cooled exhaust pipe, check liquid chambers 5)	W 6-1-3
					x	x	Check solid insulation 5)	W 6-1-4
					x	x	Renew fabric mat insulation of the turbocharger 5)	W 6-6-3
					x	x	Clean the lube oil cooler	W 8-8-2
					x	x	Renew the oil pressure control valve	W 8-11-3
					x	x	Renew the bypass valve	W 8-11-5
					x	x	Renew hose pipes, vibration dampers and flexible lines	W 0-3-4
					x	x	Renew injection lines	W 7-3-3
					x	x	Renew check valve in the leak fuel system	W 7-3-5
					x	x	Renew con-rod bearing	W 2-5-1
					x	x	Check con-rod geometry	W 2-3-5
					x	x	Overhaul injection pump	ME
					x	x	Overhaul dynamo	ME
					x	x	Check coolant chambers	W 9-0-3
					x	x	Renew rotary vibration dampers	W 12-1-4
					x	x	Renew rocker arms, valve bridges	W 1-2-2

1) Observe the operating media specifications in chapter 4, Operating Media .
2) Change annually if the operating hours are not reached.
3) The crankcase bleed valve must also be maintained when the maintenance indicator is ”RED”.
4) V16 engines only
5) V8 engines only
6) Clean annually if the operating hours are not reached.
MD: Manufacturer Documents

Table 4Note activity definition

E10	E20	E23	E25	E30	E60	E70	Description	WC
1x after 50 Oh	every 24 hours (daily)	after every 250 Oh	after every 500 Oh	after every 1,000 Oh	after every 3,000 Oh	after every 6,000 Oh		
					x	x	Check elastic suspension	ME
					x	x	Check elastic coupling	ME
						x	Renew main bearing	W 2-7-2
						x	Renew crankcase bleed valve	W 3-1-10
						x	Check crankshaft	W 2-1-7
						x	Renew camshaft and valve lifter	W 4-5-1
						x	Renew camshaft bearing	W 4-1-1
						x	Renew camshaft axial bearing	W 3-8-1
						x	Renew mass compensation shaft bearing 5)	W 2-8-1
						x	Check stop rods	W 4-2-1
						x	Check intermediate gear wheels and bearing bush of the coolant pump	W 9-7-5
						x	Check lube oil pump	W 8-4-5
						x	Renew cooler cap	-
						x	Renew crankshaft sealing ring (drive side)	W 2-2-2
						x	Renew crankshaft sealing ring (free side)	W 2-2-4
						x	Overhaul starter	ME
						x	Check solenoid valve(s)	ME
						x	Electric sensors, solenoids	ME
							Other connected parts	ME

1) Observe the operating media specifications in chapter 4, Operating Media .
2) Change annually if the operating hours are not reached.
3) The crankcase bleed valve must also be maintained when the maintenance indicator is ”RED”.
4) V16 engines only
5) V8 engines only
6) Clean annually if the operating hours are not reached.
MD: Manufacturer Documents

Table 4Note activity definition

Overview of operating hour-independent maintenance work (copy form)

Date	Activity	Signature

Tab. 20 Overview of operating hour-independent maintenance work performance group C

Overview of operating hour-dependent maintenance work (copy form)

hours	Deutz maintenance and service schedule								Date	Signature
	E10	E23	E25	E30	E40	E50	E60	E70		
50	**1**									
250		**1**								
500			**1**							
750		**2**								
1,000				**1**						
1,250		**3**								
1,500			**2**							
1,750		**4**								
2,000				**2**						
2,250		**5**								
2,500			**3**							
2,750		**6**								
3,000							**1**			
3,050	**2**									
3,250		**7**								
3,500			**4**							
3,750		**8**								
4,000				**3**						
4,250		**9**								
4,500			**5**							
4,750		**10**								
5,000				**4**						
5,250		**11**								
5,500			**6**							
5,750		**12**								
6,000								**1**		
Number of Deutz maintenance and service schedules up to and including complete overhaul										
Total	**2**	**12**	**6**	**4**	**-**	**-**	**1**	**1**		

Tab. 21 Overview of operating hour-dependent maintenance work performance group C

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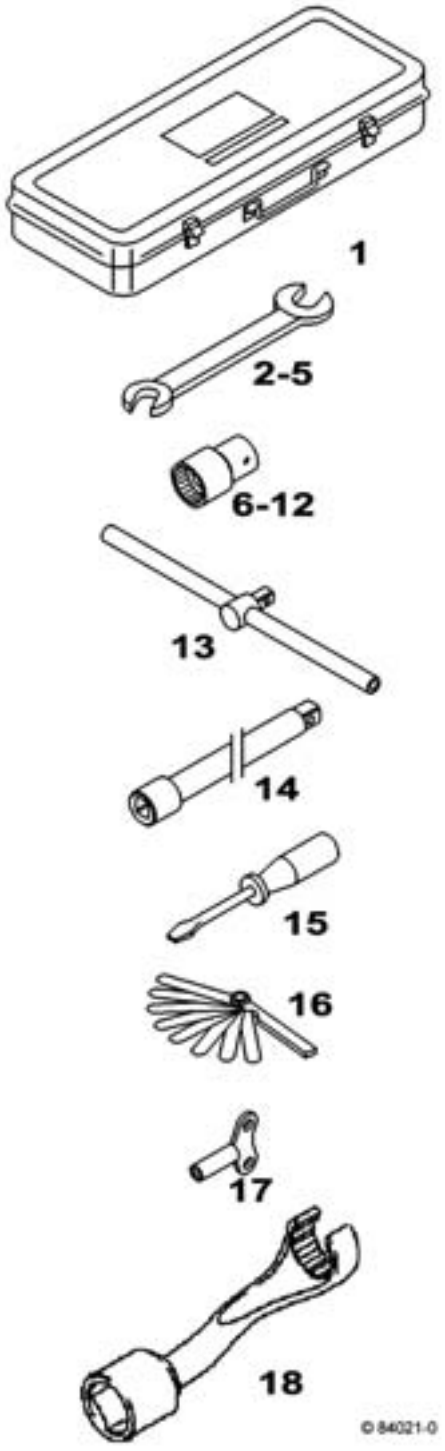
Tools for maintenance work up to E40

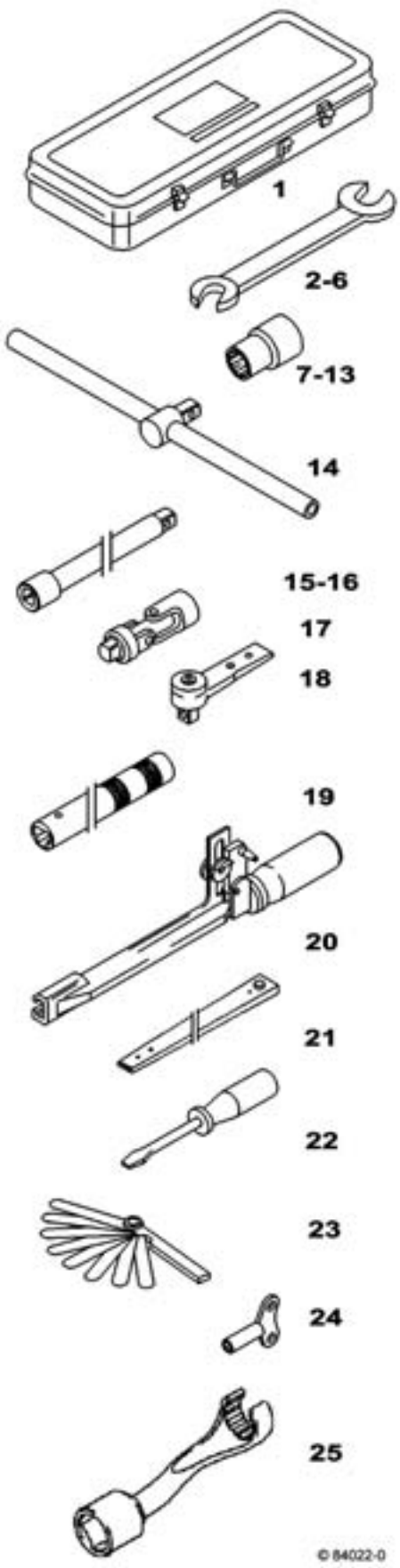
The following sections contain the data of tools required for the maintenance work till E40. You can order these from your DEUTZ Service under the part numbers.

Standard tool kits

Containing			Illustration
Small tool kit			
Order no.	Description		
12150004		Small tool kit complete	
12311002	1	Tool case empty	
01154249	2	Spanner 10 x 12 DIN 3110	
01154251	3	Spanner 13 x 17 DIN 3110	
01154252	4	Spanner 14 x 15 DIN 3110	
01154254	5	Spanner 19 x 22 DIN 3110	
01151243	6	Socket 13 x 12.5 DIN 3124	
01152880	7	Socket 15 x 12.5 DIN 3124	
01151245	8	Socket 17 x 12.5 DIN 3124	
01151246	9	Socket 19 x 12.5 DIN 3124	
07109772	10	Socket 22 x 12.5 DIN 3124	
07109773	11	Socket 24 x 12.5 DIN 3124	
01152882	12	Socket 27 x 12.5 DIN 3124	
01152906	13	T-handle A 12.5 DIN 3122	
01104327	14	Extension B 12.5 x 125 DIN 3123	
01103385	15	Screwdriver A 0.8x4.0 DIN 5265	
12158173	16	Set of feeler gauges 0.2 – 0.45	
12158115	17	Square key 3.5	
07041395	18	Open ring insert 17 x 12.5	



Containing			Illustration
Large tool kit			
Order no.	Description		
12150005		Large tool kit complete	
12158079	1	Tool case empty	
01154249	2	Spanner 10 x 12 DIN 3110	
01154251	3	Spanner 13 x 17 DIN 3110	
01154252	4	Spanner 14 x 15 DIN 3110	
01154254	5	Spanner 19 x 22 DIN 3110	
01129228	6	Spanner 24 x 27 DIN 3110	
01151243	7	Socket 13 x 12.5 DIN 3124	
01152880	8	Socket 15 x 12.5 DIN 3124	
01151245	9	Socket 17 x 12.5 DIN 3124	
01151246	10	Socket 19 x 12.5 DIN 3124	
07109772	11	Socket 22 x 12.5 DIN 3124	
07109773	12	Socket 24 x 12.5 DIN 3124	
01152882	13	Socket 27 x 12.5 DIN 3124	
01152905	14	T-handle A 12.5 DIN 3122	
01104327	15	Extension B 12.5 x 125 DIN 3123	
01102415	16	Extension B 12.5 x 250 DIN 3123	
01154232	17	Universal joint C 12.5 DIN 3123	
12030362	18	Ratchet head square 2.5 / 0-400 Nm	
12158146	19	Tubular handle	
12158139	20	Torque wrench 0-210 Nm	
12158148	21	Extension lever 0-400 Nm	
01103385	22	Screwdriver A 0.8x4.0 DIN 5265	
01154367	23	Set of feeler gauges 0.2 – 0.45	
12158115	24	Square key 3.5	
07041395	25	Open ring insert 17 x 12.5	



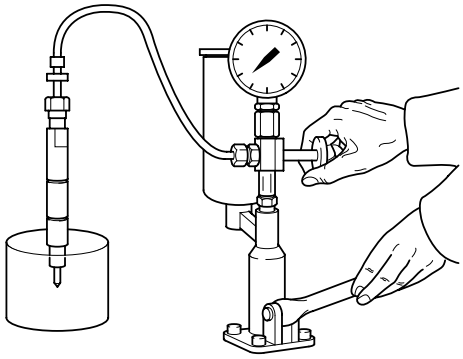
Tool kits for maintenance work

Containing	Illustration

Tool kit supplement I

Order no. Description

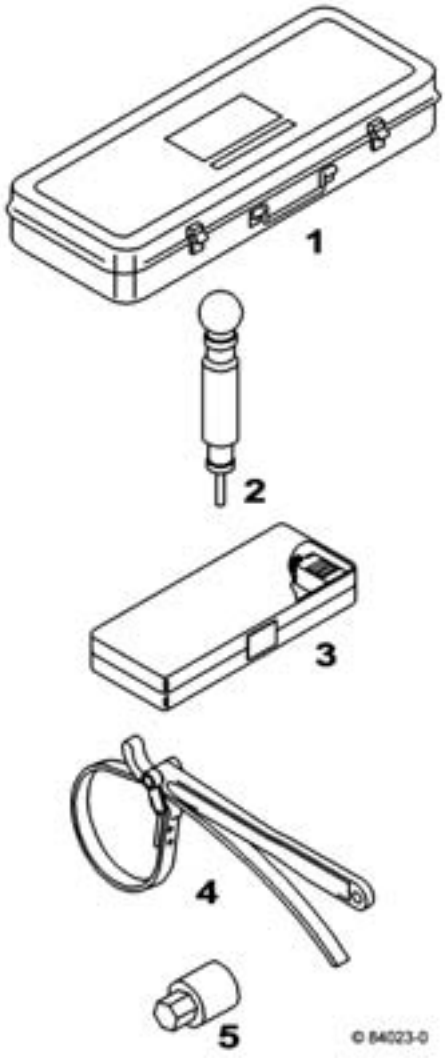
12044577 Nozzle tester



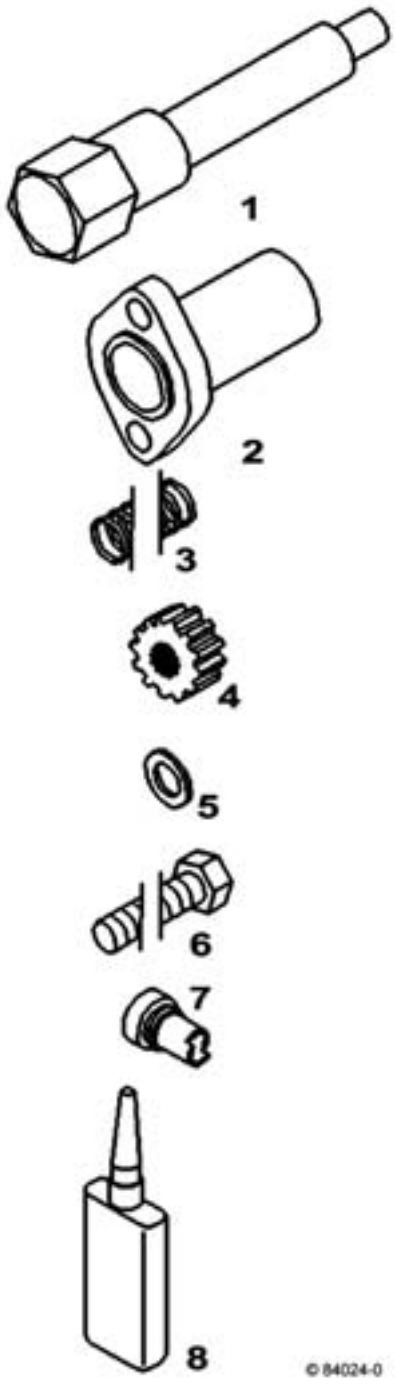
Containing	Illustration

Tool kit supplement II

Order no.		Description
12163078		Tool case complete
12311004	1	Tool case empty
12157944	2	Acid tester for battery
12158292	3	Lab case for coolant
12158153	4	Strip key for filter cartridges
01153425	5	Square key (double filter switching)



Containing			Illustration
Turning device			
Order no.	Description		
12276678		Turning gear complete	
12276679	1	Bolts	
12276680	2	Guide	
12212624	3	Pressure spring	
12212379	4	Rack	
01154439	5	Washer	
01112416	6	Hexagon head screw	
12276700	7	Screw clamp	
01009670	8	Locking agent	



Containing	Illustration
V-belt tension measuring instrument Description Tension measuring instrument, measuring range 150 - 600 N Wilbär article number: 8115 The V-belt tension measuring instrument should be ordered directly from Wilbär, Postfach 140580, 42826 Remscheid.	

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Tools for maintenance work from E50

The following sections contain the data of tools required for the maintenance work from E50. You can order these from your DEUTZ Service under the part numbers.

Order no.		Description
12313140	1	Device for removing and installing the inlet and outlet valves
12158020	2	Device for grinding in the inlet and outlet valves
12158052	3	Grinding paste for grinding in the inlet and outlet valves
12158499	4	Press-out pin for valve guides in the cylinder head
12158500	5	Pressing in pin for valve stem guides in the cylinder head
12313281	6	Press in pin for valve seat ring of the inlet valve
12313283	7	Press in pin for valve seat ring of the outlet valve
12312708	8	Device for removing the cylinder liner
12313290	9	Device for installing the radial sealing ring of the crankshaft on the drive side
12313288	10	Device for installing the radial sealing ring of the crankshaft in the face cover
12158155	11	Wrench for removing and installing the groove nut in the cylinder head (protective tube)
12158242	12	Pliers for installing the piston in the cylinder liner
12158170	13	Pliers for assembling the piston rings on the piston
01153018	14	Pliers for removing and installing the piston bolt circlips
12153474	15	Compression gauge, complete
12313141	16	Connection adapter for the compression gauge
12153475	17	Writing discs for the compression gauge
12158266	18	Serrated key wrench for removing and installing the pressure pipe connection on the injection pump
07106439	19	Dial
12158175	20	Measuring stand for measurements with the dial
12312705	21	Guide pins for aligning the cylinder heads when assembling
12313293	22	Holder for the cooling oil nozzles, complete
12188097	23	Device for lifting the tappets for removing and installing the camshaft
12313146	24	Device for pre-stroke measurement on the injection pump
12313148	25	Pressure sleeve for the piston stroke measurement
12313147	26	Bolt for the piston stroke measurement
12313142	27	Device for removing and installing the camshaft bearing
12313278	28	Guide bolt for the camshaft
12313276	29	Extractor for the arched denture clutch
12313294	30	Device for pressing the con rod liner out of and into the con rod head

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6 Troubleshooting

Faults in engine operation which could occur as well as their possible causes are listed.

The causes of the faults are listed in ascending order of effort required to localise them.

The specified job cards contain troubleshooting instructions. Please note that the work described in the workshop manual assumes a higher level of qualification of personnel and appropriate training and knowledge. Please contact your DEUTZ Service if in doubt.

Fault table

Fault table

Fault	Engine does not turn over when started	Engine does not fire or cuts out after firing a few times	Engine does not reach the prescribed performance / speed	Engine running irregularly	Engine knocking	Engine black out	Abnormal colour of exhaust gas	Oil vapour leaking from crankcase bleed valve	Water in lube oil	Low oil pressure or high oil pressure	Coolant pump leaking	Charge air temperature too high	Differential pressure of charge air cooler too high	
														Possible causes
●	●													Start switch of monitor defective
●	●				●									Monitor has responded
●														Battery discharged
●														Control current missing at starter
	●	●	●		●									Air in fuel system
	●	●			●									Dirty fuel filter
	●	●			●									Fuel pump worn, defective
	●	●	●		●									Controller system defective
	●	●				●								Start of pumping not right
	●				●									Fuel tap closed, no fuel
		●				●								Charge pressure too low
		●	●	●		●								Deviation in exhaust gas temperature or ignition pressure
		●	●		●	●								Injection pump defective
		●		●			●							Defect in valve drive
		●		●	●	●	●							Defect in drive gear
		●				●								Injection valve defective
		●	●									●		Suction air intake filter blocked
				●		●								Engine too cold
							●							Lube oil temperature too high
								●						Cylinder liner in crankcase leaking
								●						Lube oil cooler leaking
									●					Lube oil pump worn, defective
									●					Oil pressure control valve worn, defective
									●					Bypass valve worn, defective
								●		●				Coolant pump worn, defective
											●	●		Charge air cooler soiled

	Remedy
	DEUTZ Service
	DEUTZ Service
	B 13-4-1, Maintaining the battery
	DEUTZ Service
	Chapter 3, Operation
	B 7-10-4, Renewing the fuel filter cartridge; B 7-10-1, Maintaining the fuel double filter
	Workshop Manual / DEUTZ Service
	Manufacturer documents / DEUTZ Service
	Workshop Manual / DEUTZ Service
	B 7-10-4, Renewing the fuel filter cartridge; B 7-10-1, Maintaining the fuel double filter
	Workshop Manual / DEUTZ Service
	DEUTZ Service.
	Workshop Manual / DEUTZ Service
	Workshop Manual / DEUTZ Service
	Workshop Manual / DEUTZ Service
	B 7-7-3, Checking the injection valve
	B 6-3-6, Renewing the suction air intake filter
	-
	Chapter 4, Expendables
	Workshop Manual / DEUTZ Service
	Workshop Manual / DEUTZ Service
	Workshop Manual / DEUTZ Service
	Workshop Manual / DEUTZ Service
	Workshop Manual / DEUTZ Service
	Workshop Manual / DEUTZ Service
	Workshop Manual / DEUTZ Service

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7 Conservation

see Technical Circular TR 0199-99-2116.

Conservation

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8 Technical particulars

General engine data

Basic data

Type designation		TBD 616 OEM		
		V8	V12	V16
Work procedure		Four-stroke Direct injection Exhaust gas turbocharge Charge air cooling		
Cylinder arrangement		V-engine, 60° V-angle		
No. of cylinders		8	12	16
Bore	mm	132	132	132
Stroke	mm	160	160	160
Capacity per cylinder	dm^3	2.19	2.19	2.19
Total displacement	dm^3	17.52	26.28	35.04
Direction of rotation		viewing from the drive side, counterclockwise		
Compression ratio		15 : 1	15 : 1	15 : 1
Speed governing system		electronic, GAC (analog) or EMR2		
Injection valve		8-jet multi-hole nozzle		

Control data

		V8	V12	V16
Valve clearance with cold engine Inlet Outlet	 mm mm	 0.3 0.5	 0.3 0.5	 0.3 0.5

Ignition sequence

Engine																
V8	A1	B2	A3	B1	A4	B3	A2	B4								
V12	A1	B5	A5	B3	A3	B6	A6	B2	A2	B4	A4	B1				
V16	A1	B3	A3	B7	A7	B5	A5	B8	A8	B6	A6	B2	A2	B4	A4	B1

Dimensions

		V8	V12	V16
Length	mm	1800	2105	2445
Width	mm	1250	1506	1506
Height	mm	1275	1666	1666

Weights

Name		Weight [1]		
		V8	V12	V16
Basic engine without cooler, dry	kg	1,550	2,300	2,600
Cylinder head, complete	kg	19.4	19.4	19.4
Cylinder liner	kg	7.4	7.4	7.4
Cylinder head cover	kg	2	2	2
Toggle lever block	kg	1.2	1.2	1.2
Piston with ring and bolt	kg	4.1	4.1	4.1
Connecting rod	kg	3.8	3.8	3.8
Camshaft with gear wheel	kg	20	33	46
Crankshaft with counterweights and gear wheels	kg	126.5	190	228
Oil pan	kg	32.7	42.5	55
Front face cover	kg	48.2	48.2	48.2
Read face cover	kg	31.9	31.9	31.9
Flywheel housing	kg	75.7	75.7	75.7
Charge air cooler housing	kg	4.8	4.8	4.8
Injection pump drive, assembled	kg	8.9	8.9	8.9
Oil cooler	kg	33.3	33.3	44.2
Lube oil pump, assembled	kg	9	9	9
Coolant pump with gear wheel	kg	11.5	11.5	11.5
Starter	kg	18.5	18.5	18.5
Thermostat housing	kg	6	6	6
Solenoid	kg	4.6	4.6	4.6

1) all data are approximate values

Operating data

The values for temperatures and pressures given here are standard values. These standard values are adapted to the respective engine during the test stand run and are documented in the acceptance test report. Fine tuning can be performed according to the specific application during commissioning. The resulting deviations in comparison with the acceptance test report are documented in the commissioning report.

Filling volumes

		V8	V12	V16
Lube oil content in engine				
Volume for lube oil change	dm^3	47	49	70
Volume for first lube oil filling	dm^3	52	54	75
Coolant content in the engine without cooling system	dm^3	60	80	110

Temperatures

		V8	V12	V16
Coolant temperature, inlet charge air cooler	°C	25	25	25
Coolant temperature, outlet engine	°C	70 to 95	70 to 95	70 to 95
Max. lube oil temperature	°C	120	120	120
Max. aspiration air temperature without reduction in performance at relative humidity of 30 %	°C	25	25	25

Pressures

		V8	V12	V16
Lube oil pressure after lube oil filter at rated speed	bar	3.5 ... 6	3.5 ... 6	3.5 ... 6
Max. vacuum pressure in air induction pipe	mbar	30	30	30
Max. exhaust gas counterpressure in exhaust gas turbocharger	mbar	35	35	35
Air pressure of the environment on which the specified values are based	mbar	1000	1000	1000

Emission data

		V8	V12	V16
Airborne noise 1m away from the engine	dB (A)	101 to 107	101 to 107	103 to 107

Start of pumping

		V8	V12	V16
Setting of the injection pump(s)	° KW	The values should be taken from the acceptance test report or the commissioning report.		

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Tightening specifications for maintenance work up to E40

Code no.	Screw connection	Type and dimension	Strength	Tightening value	Important notes
08/3	Valve hood on cylinder head	Cylinder head screw M8 x 85	12.9	20 + 5 Nm	Insert all cylinder screws with copper ring A8 x 14.
11/3	Valve clearance setting nuts of the bridge control	Hexagon nut M10 x 1		30 + 3 Nm	
15/3	Lube oil filter on lube oil filter head	Lube oil filter		25 + 2 Nm	Wet the sealing ring of the lube oil filter with lube oil. After the trial run, check the lube oil filter for leaks and tighten if necessary.
19/1	Nozzle holder on cylinder head	Cylinder head screw M8 x 60	10.9	1st step hand tight 2nd step 15 Nm 3rd step 20 Nm	Use new sealing rings. All round sealing rings must be coated with mounting compound part-no. 01016105. When installing, make sure that the sealing rings are not damaged. Pay attention to the correct thickness of the sealing disc. Tighten the fastening screws in three stages.
21/1	Injection lines to injection pump	Sleeve nut M14 x 1.5		20 + 5 Nm	
21/2	Injection lines to injection valve	Sleeve nut M14 x 1.5		20 + 5 Nm	
37/1	V-belt tension arm on the carrier	Cylinder head screw M14 x 65	10.9	110 + 10 Nm	Note when using a new screw or tension arm: all contact surfaces including the thread and the head rest of the clamping screw must be clean and wetted with lube oil. Caution: use of molybdenum disulfide is not permissible.
37/2	Clamping roller on tension arm	Cylinder head screw M14 x 85	8.8	60 + 10 Nm	The thread in the tension arm must be free from adhesive residue and grease. Use new grease-free screw. Stick in screw with DW 59 and poss. with accelerator 12151053 in mixing ratio 1:1.
37/3	Fan on fan flange	Cylinder head screw M10 x 30	10.9	45 Nm	Tighten carefully because the fan flange is made of aluminum. Make sure that the fan is level on the fan flange.
46/1	Engine claw to crankcase	Cylinder head screw M14 x 45 Cylinder head screw M14 x 100 Cylinder head screw M14 x 140	12.9 12.9 10.9	200 Nm 200 Nm 200 Nm	
46/2	Engine suspension to crankcase	Cylinder head screw M14 x 40	10.9	160 Nm	

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Tightening specifications for maintenance work from E50

Code no.	Screw connection	Type and dimension	Strength	Tightening value	Important notes
01/1	Cylinder head on crank-case	Hexagon head screw M18	10.9	1st step 20 Nm 2nd step 100 Nm 3rd step 200 Nm 4th step 400 + 10 Nm	Wet head rests and screw thread with lube oil. Tighten the fastening screws diagonally in four steps. Mark the screws with oil-resistant paint after tightening.
01/2	Cooling oil nozzle on the crankshaft	Hexagon head screw M8 x 45 Hexagon head screw M8 x 120	8.8 8.8	30 Nm 30 Nm	
01/3	Main bearing cover of the crankshaft on crankcase	Hexagon head screw BM18 x 165	12.9	1st step 200 Nm 2nd step 90° (90° correspond to 1 ½ hexagon)	Wet head rests and screw thread with lube oil. Tighten the fastening screws from the inside to the outside in two steps for every step. Mark the screws with oil-resistant paint after tightening.
01/4	Counterweight on mass compensation shaft	Cylinder head screw M6 x 16	10.9	10 Nm	Insert and tighten fasten-ing screws with Deutz DW 62 (Loctite 640). Mark the screws with oil-resistant paint after tightening.
02/1	Oil pan on crankcase and wheel housing	Hexagon head screw M8 x 55 Hexagon head screw M8 x 130	10.9 8.8	20 + 5 Nm 20 + 5 Nm	Tighten fastening screws after six operating hours or test stand run with 20 + 5 Nm!
05/1	Counterweight on crank-shaft	Cylinder head screw M16 x 80	10.9	260 + 10 Nm	Wet head rests and screw thread with lube oil. Mark the screws with oil-resist-ant paint after tightening.
05/ 2a	Ring (holding flange for the vibration damper) on the crankshaft (V8 engines only)	Cylinder head screw M16 x 1.5 x 80	12.9	1st step 380 + 10 Nm 2nd step 60° (60° correspond to 1 hexagon) These screws may only be used once!	Wet the thread in the crankshaft and in the ring with lube oil. Clean and degrease the face of the crank-shaft and the ring with residue-free sol-vent. Wet head rests of the fastening screws drip free with lube oil. No lube oil may be allowed to get between the flanges! First tighten the screws M16 x 1.5 x 80 diagonally in two steps. Then tighten the screw M27 x 2 x 95. Mark the screws with oil-resistant paint after tightening.
		Cylinder head screw M27 x 2 x 95	10.9	1600 + 20 Nm	

Code no.	Screw connection	Type and dimension	Strength	Tightening value	Important notes
05/2b	Ring (holding flange for the vibration damper) on the crankshaft (only V12 and V16 engines)	Cylinder head screw M16 x 1.5 x 80	12.9	1st step 380 + 10 Nm 2nd step 60° (60° correspond to 1 hexagon) These screws may only be used once!	Wet the thread in the crankshaft and in the ring with lube oil. Clean and degrease the face of the crankshaft and the ring with residue-free solvent. Wet head rests of the fastening screws drip free with lube oil. No lube oil may be allowed to get between the flanges! First tighten the screws M16 x 1.5 x 80 diagonally in two steps. Then tighten the screw M30 x 2 x 100. Mark the screws with oil-resistant paint after tightening.
		Cylinder head screw M30 x 2 x 100	10.9	2350 Nm	
05/3	Flywheel on crankshaft	Cylinder head screw M16 x 1.5 x 80	12.9	380 + 10 Nm	Wet head rests and screw thread with lube oil. Mark the screws with oil-resistant paint after tightening.
06/1	Con rod cover on con rod	Hexagon head screw M16 x 1.5	12.9	1st step 90 Nm 2nd step 60° (60° correspond to 1 hexagon) Alternative: 230 + 10 Nm in two steps	Wet head rests and screw thread with lube oil. Tighten the fastening screws in two steps. Mark the screws with oil-resistant paint after tightening.
08/2	Toggle level block on cylinder head	Cylinder head screw M12 x 110 Cylinder head screw M10 x 75	12.9 12.9	140 + 5 Nm 80 + 5 Nm	Wet head rests and screw thread drip free with lube oil. Mark the screws with oil-resistant paint after tightening.
08/3	Valve hood on cylinder head	Cylinder head screw M8 x 85	12.9	20 + 5 Nm	Insert all cylinder screws with copper ring A8 x 14.
08/4	Protective tube with groove nut of the injection nozzle holder on the cylinder head	Slotted nut		45 + 5 Nm	Degrease sleeve prior to assembly and coat cone with locking agent DEUTZ DW 59 (Loctite no. 270). When mounting the sleeve the loctite may not be scraped off by the round sealing ring! Insert and tighten slotted nut with locking agent DEUTZ DW 60 (Loctite no. 582).
09/1	End face housing on crankcase	Cylinder head screw M10 x 20 Cylinder head screw M10 x 45 Cylinder head screw M10 x 55	10.9 10.9 12.9	65 + 5 Nm 65 + 5 Nm 65 + 5 Nm	
09/2	End face cover on end face housing	Cylinder head screw M8 x 80 Hexagon head screw M8 x 80 Hexagon head screw M8 x 85 Cylinder head screw M10 x 80 Cylinder head screw M10 x 90 Cylinder head screw M10 x 130 Cylinder head screw M12 x 80 Locking screw AM26 x 1.5	10.9 8.8 8.8 10.9 10.9 10.9 10.9	30 + 5 Nm 25 Nm 25 Nm 65 + 5 Nm 65 + 5 Nm 65 + 5 Nm 85 Nm 95 + 5 Nm	
09/3	Locking cover in place of Jabsco pump	Cylinder head screw M10 x 25	10.9		
09/4	Locking cover in place of hydraulic pump	Cylinder head screw M10 x 25	10.9		
09/6	Axle instead of Jabsco untreated water pump drive	Cylinder head screw M10 x 45	10.9	65 + 5 Nm	

Code no.	Screw connection	Type and dimension	Strength	Tightening value	Important notes
10/1	Double wheel of the wheel drive on camshaft	Cylinder head screw M10 x 50	10.9	80 Nm	Secure screws with locking agent DEUTZ DW 59 (Loctite no. 270). Check tooth edge clearance between camshaft wheel and end face toothed wheel of the crankshaft: 0.13 - 0.21 mm.
	Guide segment of the camshaft on the crankcase	Cylinder head screw M8 x 20	10.9	30 + 5 Nm	
11/3	Valve clearance setting nuts of the bridge control	Hexagon nut M10 x 1 Hexagon nut M10 x 1	-8 -10	30 + 3 Nm 30 + 3 Nm	
14/1	Lube oil pump on crankcase	Hexagon head screw M8 x 25 Hexagon head screw M8 x 35 Hexagon head screw M8 x 65	8.8 8.8 8.8	25 Nm 25 Nm 25 Nm	Check tooth edge clearance: 0.15 - 0.25 mm.
15/1	Oil filter head on crankcase or lube oil cooler	Cylinder head screw M10 x 140 Cylinder head screw M10 x 150 Cylinder head screw M8 x 30 Cylinder head screw M8 x 20	10.9 10.9 10.9 10.9		
15/2	Lube oil cooler on crankcase	Cylinder head screw M10 x 150 Cylinder head screw M10 x 210	10.9 10.9		
15/3	Lube oil filter on lube oil filter head	Lube oil filter		25 + 2 Nm	Wet the sealing ring of the lube oil filter with lube oil. After the trial run, check the lube oil filter for leaks and tighten if necessary.
16/1	Lube oil suction pipe on lube oil pump	Hexagon head screw M10 x 25 Hexagon head screw M8 x 20	8.8 8.8		
16/2	Lube oil line on exhaust turbocharger	Cylinder head screw M8 x 20 Cylinder head screw M8 x 30 Cylinder head screw M10 x 25 Cylinder head screw M10 x 35	10.9 10.9 10.9 10.9		
17/1	Injection pump on crankcase	Cylinder head screw M10 x 95 Cylinder head screw M10 x 100	10.9 10.9	25 + 5 Nm 25 + 5 Nm	
17/2	Pressure pipe connection (connection for the injection lines to the injection pump)			110 + 10 Nm	Use new sealing rings.
18/1	Gear wheel in wheel drive on injection pump drive	Cylinder head screw M10 x 35	10.9	80 Nm	Check tooth edge clearance between camshaft wheel and toothed wheel of the crankshaft: 0.13 - 0.21 mm.
18/2	Flange of the injection pump drive on injection pump drive	Hexagon nut M24 x 1.5		400 + 10 Nm	
18/3	Injection pump drive on crankcase	Cylinder head screw M12 x 60	10.9	115 + 5 Nm	Seal area of screws, intermediate flange and housing with DEUTZ DW 47 sealing compound.
18/4	Flange on injection pump (for mounting lamella or arched denture clutch), only RP25	Hexagon nut M20 x 1.5		300 + 10 Nm	
18/5	Arched denture clutch between the injection pumps (V16 engines only)	Hexagon head screw M10 x 35		67 Nm	

Code no.	Screw connection	Type and dimension	Strength	Tightening value	Important notes
18/6a	Laminar coupling between injection pump drive and injection pump (V8 engines only)	Hexagon head screw M10 x 30	10.9	87 Nm	Length compensated by lamellas provided.
18/6b	Laminar coupling between injection pump drive and injection pump (only V12 and V16 engines)	Hexagon head screw M10 x 30 Hexagon head screw M10 x 35	10.9 10.9	117 Nm 117 Nm	Length compensated by lamellas provided.
18/7	Control linkage between the injection pumps on control rods of the injection pumps. (V16 engines only)	Cylinder head screw M5 x 12	8.8	5.5 + 0.5 Nm	Secure thread with locking agent DEUTZ DW 60 (Loctite no. 582).
19/1	Nozzle holder on cylinder head	Cylinder head screw M8 x 60	10.9	1st step hand tight 2nd step 15 Nm 3rd step 20 Nm	All round sealing rings must be coated with mounting compound part-no. 01016105. Pay attention to the correct thickness of the sealing disc. Tighten the fastening screws in three stages.
19/2	Injection nozzle in nozzle holder	Lock nut		48 + 2 Nm	
21/1	Injection lines to injection pump	Lock nut M14 x 1.5		20 + 5 Nm	
21/2	Injection lines to injection valve	Lock nut M14 x 1.5		20 + 5 Nm	
22/1	Charge air pipe on the cylinder head	Hexagon head screw M10 x 80 Hexagon head screw M10 x 100 Cylinder head screw M10 x 75	8.8 8.8 8.8	50 + 5 Nm 50 + 5 Nm 50 + 5 Nm	Align the end face of the charge air pipe before mounting the charge air cooler.
34/1	Vibration damper on the crankshaft	Cylinder head screw M16 x 120 surface treated	10.9	250 + 10 Nm	Wet head rests and screw thread with lube oil. Mark the screws with oil-resistant paint after tightening.
		Cylinder head screw M16 x 120 surface treated and oil blackened	10.9	310 + 10 Nm	
		Cylinder head screw M16 x 100 Hexagon head screw M16 x 205 Cylinder head screw M8 x 40	10.9 8.8 10.9	310 + 10 Nm 210 + 10 Nm	
37/1	Intermediate wheel of the wheel drive for driving the coolant pump	Cylinder head screw M10 x 35 Hexagon nut M30 x 1.5		65 + 5 Nm 200 + 20 Nm	Pay attention to the correct position of the oil bore during installation! Check axial clearance: 0.087-0.2 mm. Secure hexagon nut against washer and thread with locking agent DEUTZ DW 59 (Loctite no. 270). Check tooth edge clearance between intermediate wheel and camshaft wheel: 0.1 - 0.18 mm.
41/1	PEARL exhaust pipe system V-belt clip for connecting the exhaust pipe elements	Hexagon nut or Cylinder head screw		8 Nm 6 Nm	Apply DEUTZ S1 to the contact surfaces with the exhaust pipe elements and the thread of the V-belt clip.
	Exhaust pipe element on the cylinder head	Cylinder head screw M10 x 60	X%NiCr Ti2615	50 + 5 Nm	Apply DEUTZ S1 to the thread.
46/1	Engine claw to crankcase	Cylinder head screw M14 x 45 Cylinder head screw M14 x 100 Cylinder head screw M14 x 140	12.9 12.9 10.9	200 Nm 200 Nm 200 Nm	

Code no.	Screw connection	Type and dimension	Strength	Tightening value	Important notes
52/1	Flywheel housing on crank-case	Cylinder head screw M12 x 55 Cylinder head screw M12 x 60 Cylinder head screw M12 x 85 Hexagon head screw M12 x 125 Cylinder head screw M8 x 50 Cylinder head screw M8 x 85	12.9 12.9 12.9 10.9 12.9 12.9	140 + 5 Nm 140 + 5 Nm 140 + 5 Nm 115 + 5 Nm 40 + 5 Nm 40 + 5 Nm	

9 Job Cards

Explanation of symbols

You will find there are various symbols used on the Job Cards, in order to designate information not relating directly to the actual work sequence involved.

Tools
- The tools normally required are listed against this symbol.

Equipment
- Things like pressure gauges, lube oil and hydraulic oil

Spare parts
- Seals, locking parts, etc.

Cross-references
- Documents, reports or Job Cards to which reference is made in the Job Card concerned.

Overviews

Arranged alphabetically

Arranged by Job Card Numbers

Job Card	Jobs
B 0-0-3	Safety regulations for handling components made of elastomers containing fluoride (e.g. Viton)
B 0-0-4	Specifications for cutting, grinding, soldering and welding work
B 0-1-4	Test run
B 0-1-5	Visual inspection of the system
B 0-3-6	Cleaning the engine
B 1-1-1	Checking and setting inlet and outlet valve clearance
B 3-1-9	Racor Crankcase Ventilation System, Service
B 6-3-6	Renewing the suction air intake filter
B 7-3-1	Removing and installing injection lines
B 7-4-16	Visual inspection of the arched denture clutch
B 7-7-1	Removing and installing the injection valve
B 7-7-3	Checking the injection valve
B 7-10-1	Maintaining the fuel double filter
B 7-10-4	Renewing the fuel filter cartridge
B 8-1-2	Changing the lube oil
B 8-10-4	Renew the lube oil filter cartridge
B 8-13-1	Maintaining the centrifugal lube oil filter
B 9-0-4	Emptying and filling the cooling system
B 9-1-1	Checking corrosion protection agent or antifreeze in coolant
B 9-1-2	Renewing coolant
B 9-7-11	Check coolant pump
B 9-7-12	Checking the coolant pump, 2nd cooling circuit
B 10-7-1	Draining water from and filling the air bottle (starter air tank)
B 11-0-1	Checking engine shutdown
B 11-0-2	Regulations for working on the electronic engine control EMR2
B 11-6-1	Reading out the fault memory 1 of the EMR2
B 12-2-1	Checking, renewing V-belts
B 13-4-1	Maintaining the battery

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Safety regulations for handling components made of elastomers containing fluoride (e.g. Viton)

Crass references

- Chapter 1, Rules for disposal

Gaskets, round sealing rings and moulded parts are manufactured partly from elastomers containing fluoride (FPM) to withstand high thermal stress.

At unscheduled temperatures above 315 °C (caused for example by an engine fire) the material decomposes and forms caustic acids. The residue is tacky and black in appearance.

Touching the residue with your hands, even after cooling down, may be damaging to health.

Proceed as follows if high temperatures have caused damage to gaskets or round sealing rings:

- Check all gaskets which have suffered from the heat visually.
- Wear gloves (neoprene).
- Remove all residue material and dispose of it, see also Chapter 1, Rules for disposal.
- Destroy clothing which has been contaminated by residue of the gaskets.

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Specifications for cutting, grinding, soldering and welding work

Cross references

- Accident prevention regulations

The contractor of cutting, grinding, soldering and welding work must alert the persons enlisted to do the work to the dangers and ensure that the points listed below are observed and executed.

Persons entrusted with cutting, grinding, soldering and welding work must be familiar with and observe the valid regulations and specifications, especially the rules for accident prevention of the respective national legislations.

The following points must be observed additionally to the specified regulations and specifications.

Electrics / electronics

The following points apply for welding work and work where electrical and electronic components may be at risk (e.g. due to high temperatures or electrical short-circuits).

- Disconnect the battery ground and remove and stow away the battery safely if necessary.
- Pull out the plugs of electrical and electronic components (e.g. TEM switch cabinet, MKS junction box, EMR 2-control unit, ignition system, sensors).
- Sensitive parts in the immediate vicinity of the welding point (e.g. control units, ignition system, sensors, cables) must be removed after unplugging.
- Always connect the ground terminal of the welding gear in the immediate vicinity of the welding point to avoid vagrant currents. Pay attention to perfect ground connection. The paint may have to be removed in this area.

Failure to do so can lead to serious damage to the engine electronics.

Sparks / danger of fire

- Keep all inflammable materials away from the danger area.
- Remove inflammable objects (e.g. cables, compensators) or cover with non-conductive, non-flammable material.
- Cover sensitive surfaces (e.g. air filter) with non-conductive and non-flammable material.
- Seal openings in the engine.
- Seal off and cover openings to other work areas.
- Keep a sufficient number of fire extinguishers close by.

Danger of explosion

- Shut off gas pipes and fuel pipes.
- Work which could lead to a strong development of heat on gas or fuel pipes and vessels may only be carried out when these have been completely emptied and bled or flushed.

Health hazard

- Air well, suck off fumes and dust particles.
- Cordon off the working area during arc welding to protect bystanders against the harmful effects of optical radiation.

Test run

Tools
- Normal tools

References
- Chapter 5, Maintenance
- B 0-1-5, Visual inspection of the system
- B 11-0-1, Checking engine shutdown

The test runs must be conducted to meet requirements as described in Chapter 5, Maintenance.

Prior to the test run

Check over the system visually, see job card B 0-1-5, Visual inspection of the system.

Start the engine

- Check engine shutdown, see work card B 11-0-1, Checking engine shutdown.
- Start cooling water pre-heating (optional).
- Open the fuel taps (if available).
- Switch on the engine control system's main switch.
- Set speed governor to low speed.
- **Pre-lubrication pump (optional)**

  Electrical pre-lube pump:
  Depending on the design, the electric pre-lubrication pump is controlled by the engine control system, otherwise switch on manually.

  Pre-lubrication time
  - Pre-lubricate for at least 10 minutes after changing the lube oil.
  - Pre-lubricate for at least 10 minutes after an engine standstill of > 3 hours.
  - Pre-lubricate for at least 2 minutes after an engine standstill of < 3 hours.

  Check the lube oil level again, fill up to the top mark if necessary.

  Wait until the pre-lubrication is complete.

  Mechanical pre-lubrication pump:
  The mechanical pre-lubrication pump must be actuated manually for about two minutes.
- Press the Start button. The engine is started.
  - The engine is levelled at the specified speed by the speed controller.

If the engine races (speed increases all the time), stop the engine immediately with the emergency stop switch. Determine and eliminate the cause.

Engine run

During the entire engine run, the operating values should be tracked via the engine control system and compared with the values in the acceptance test report or commissioning log. If values are outside the permissible tolerance, stop the engine, and determine and eliminate the cause.

- Load the engine with max. 20 % immediately after starting.
- Increase the load after about 10 minutes.
- When the engine has reached operating temperature, reduce the load and the speed and leave the engine running for about another five minutes at increased idling speed.

Switch off engine

- Switch off the engine.
- Check over the system visually, see job card B 0-1-5, Visual inspection of the system.

Visual inspection of the system

Tools

- Normal tools

References

- Commissioning log
- Chapter 4, Expendables
- B 3-1-9, Racor Crankcase Ventilation System, Service
- B 6-3-6, Renewing the suction air intake filter
- B 9-1-1, Checking corrosion protection agent or antifreeze in coolant
- B 10-7-1, Draining water from and filling the air bottle (starter air tank)

General

When checking or refilling coolant or lube oil, please consult Chapter 4, Expendables.

Cooling system

Check coolant level

- Depending on the structure of the system, the coolant level should be checked at the appropriate place and topped up if necessary.
- If coolant needs to be refilled, the percentage of antifreeze or corrosion protection agent must be taken into account, see work card.

The anti-corrosion agent is inflammable in its non-hardened state!

The cooling system is under pressure depending on the engine temperature. Be careful when opening the cap. Risk of scalding!

- Open the coolant cap.
- Fill coolant up to the appropriate mark.
- Check the gasket of the cap for damage and renew if necessary.
- Close the coolant cap.

Coolant circuit

Check for leaks:

- hoses
- hose clips;
- pipe unions;
- flanges;
- compensators;
- and other components connected with the cooling system.

If leaks are discovered during the inspection, these must be eliminated immediately.

Lube oil system

Check the lube oil level in the oil pan

- Pull out the dipstick and check the lube oil level. If the bottom limit is reached (Min.), top up lube oil according to Chapter 4, Expendables up to the upper limit (Max.).

Danger of burst!

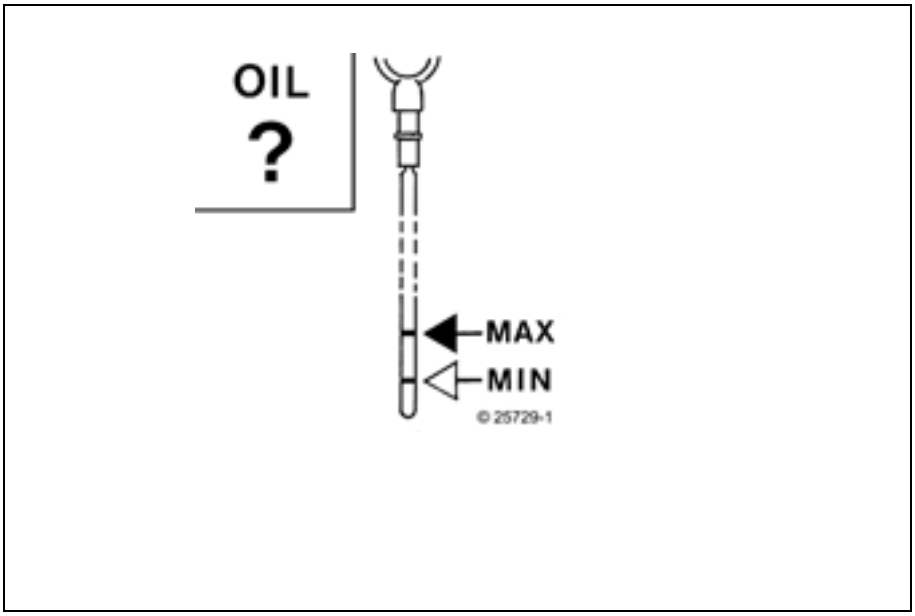

Figure 1 Dipstick

- To refill lube oil open the cap (arrow) and fill in lube oil.

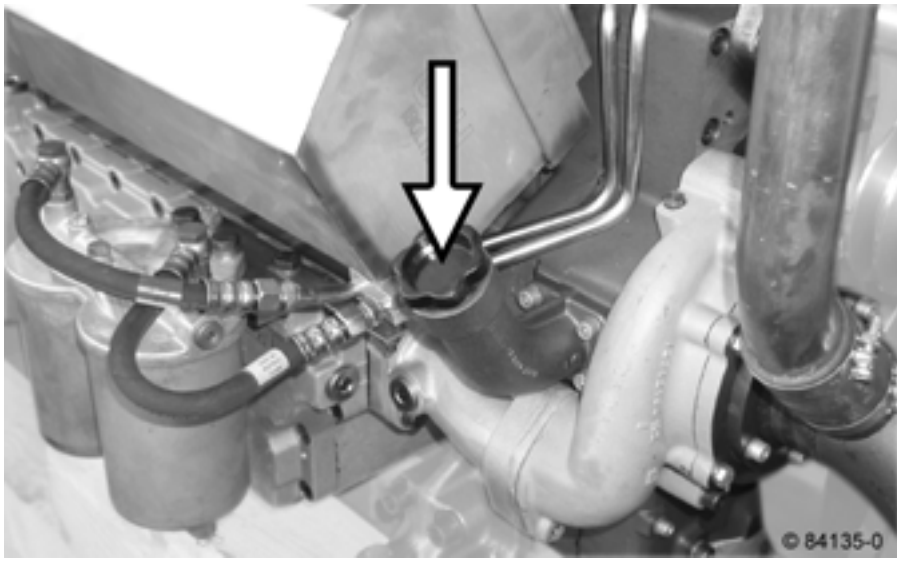

Figure 2 Lube oil filling nozzle (depending on the installation position of the engine, the lube oil filling nozzle is on the side with easier access)

- Check the gasket of the cap for damage and renew if necessary.
- Close the cap.
- Pull out the dipstick and check the lube oil level again.

Lube oil circuit

Check for leaks:

- hoses
- hose clips;
- pipe unions;
- flanges;
- compensators;
- and other components connected with the lube oil system.

If leaks are discovered during the inspection, these must be eliminated immediately.

- All other operating values of the lube oil system must be checked by the MKS in connection with the values in the acceptance test report or commissioning log.

Start system

- If the engine is equipped with a compressed air starter, the compressed air bottle must be drained of water and filled, see work card B 10-7-1, Draining water from and filling the air bottle (starter air tank).

Suction air intake system

- Check that the hose clips and air filter holders are fitting snugly and repair if necessary.
- Check the maintenance indicator 1 of the suction intake air filter. If this has responded the suction air intake filter must be renewed, see work card B 6-3-6, Renewing the suction air intake filter.

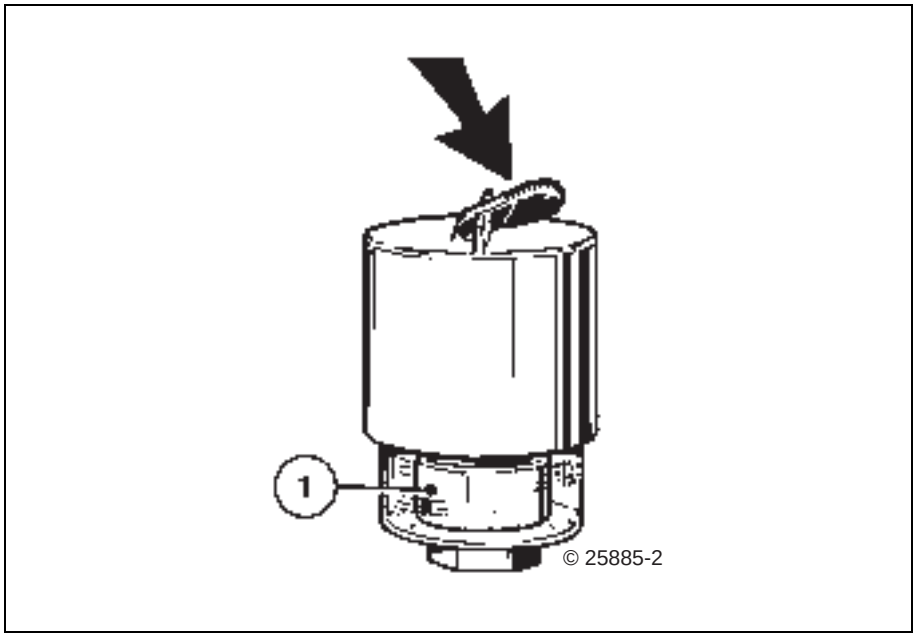

Figure 3 Maintenance indicator suction air intake filter

Crankcase bleed valve

- Check the maintenance indicator 1 of the crankcase bleed valve visually. If this has responded the crankcase bleed valve must be serviced, see work card B 3-1-9, Racor Crankcase Ventilation System, Service.

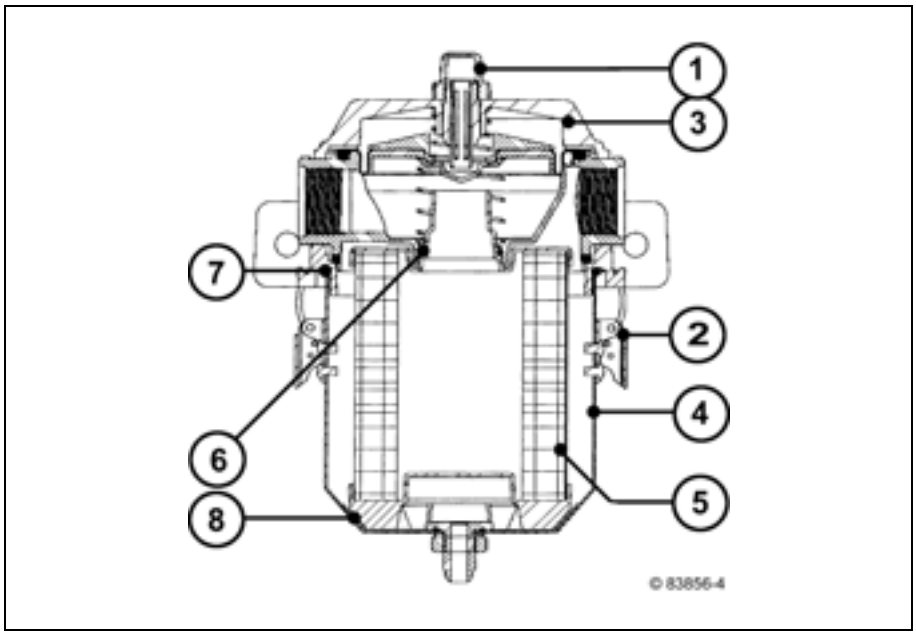

Figure 4 Filter of the crankcase bleed valve (section)

Exhaust gas system

Danger of burst!

Check for leaks:

- V-belt clips;
- pipe unions;
- flanges;
- compensators;
- and other components connected with the exhaust gas system.

- If leaks are discovered during the inspection, these must be eliminated immediately.
- Check the turbocharger, see manufacturer documents.

Engine

- Check the engine for smooth running and noise. If the engine is not running smoothly or abnormal noise can be heard, the causes must be eliminated immediately.

Engine Monitoring System

- The operating values should be taken from the engine monitoring system and compared with the values in the acceptance test report or commissioning log. If values are out of tolerance, find the cause and repair the engine.
- Check control lamps. See the operating manual of the engine monitoring system.

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Cleaning the engine

Auxiliary equipment

- Cleaning agents
- Compressed air
- Stoppers
- Covers

Cross references

- Chapter 4, Auxiliary materials

Carry out this work only when the engine has been shut down.

Wear protective goggles and gloves.

Care for sufficient ventilation!

Exhaust vapours,do not inhale!

Preparation

- Switch off the engine and wait for it to cool down. See Chapter 4, Auxiliary materials for selection of cleaning agents.
- Disconnect the battery.
- Remove protective covers.
- Remove heat shields from the exhaust pipes.
- Cover the air filter water-tight. If the air filters are removed, seal the inlets water-tight.
- Cover electric components such as three-phase current generators and starter.

If the engine is partly disassembled, seal open channels and lines.

Cleaning

When working with high-pressure cleaning systems, sensitive parts such as filters, rubber bushes, sealing rings and cables could be damaged. These should therefore never be cleaned with high-pressure cleaning systems.

Joints and bearings which are coated with a lubricant or filled with grease should not be cleaned with high-pressure cleaning systems.

- Blow out all places which are difficult to access with compressed air.

Cleaning with cold cleaner

- Spray engine with cold cleaner. Exposure time according to manufacturer instructions.
- Clean protective covers and heat shields separately.
- Spray or wash down engine with a powerful water jet.
- Repeat procedure if necessary.

Dry the exhaust pipe heat shields before replacing. Otherwise there is a danger of fires being causes by gas build-up and deflagration inside the housing.

Finishing work

- Blow out spaces where water has accumulated with compressed air.
- Remove the covers from the sensitive batteries.
- Dry the exhaust pipe heat shields and remove.
- Fit protective covers after cleaning separately.
- Install filters if they were removed.
- Connect the battery.

Checking and setting inlet and outlet valve clearance

Tools

- Normal tools
- Turning bar
- 2 feeler gauges

References

- B 7-3-1, Removing and installing injection lines

General

Inlet and outlet valves can definitely only close tightly when a certain clearance is set in the valve drive between the camshaft and the valve shaft. Valves which do not close tight can lead to burning of the valve seat and the valve head. On the other hand too much clearance causes considerable wear. Exact setting and observation of the valve clearance therefore prolongs the life and increases the operational reliability of the engine.

Check valve clearance

Only check and set the valve clearance on a cold engine.

Observe the test and setting order.

- Disconnect the injection lines, see work card B 7-3-1, Removing and installing injection lines.
- Remove cylinder head hood.

Example: Engine V16

- Turn the engine in the direction of rotation until the valves are overlapping on cylinder A8. Cylinder A 1 is in the upper dead point (OT).

The engine may only be turned in the direction of rotation. Turning against the direction of rotation will damage components. Direction of rotation: Looking onto the drive side – in counterclockwise direction ”left hand rotation”.

- Check the valve clearance of cylinder A1 with a feeler gauge. The feeler gauge must slip between the valve bridge and the toggle lever 8 with low resistance.

Valve clearance:	Inlet valve	0.3 mm
	Outlet valve	0.5 mm

The valve clearance must be reset in case of deviations.

If a large valve clearance was determined, this is due to wear in the valve drive. Depending on the difference between the actual value and the nominal value, the valve clearance curve of the cylinder concerned must be monitored and the cause examined immediately. The actual values must be noted in the table ”Valve clearance actual values table”. A copy of the table is enclosed.

Set valve clearance

- Loosen lock nut 7 and set valve clearance compensation between the valves with setting screw 8, whereby two feeler gauges with a thickness of 0.05 mm should be inserted at pos. 2 (arrows).

  If the clearance compensation is correct, the feeler gauges can be moved with the same amount of force with simultaneous pressure on the valve bridge (pos. 9 arrow).
- Tighten lock nut 7. Tightening torque 30 + 3 Nm. Hold with a size 17 open-ended wrench at pos. 10.
- Check the clearance compensation again.
- Loosen lock nut 3.
- Set the setting screw 4 with a screwdriver until correct valve clearance is reached; the feeler gauge must be movable against the suction.
- Tighten lock nut 3, tightening torque 30 + 3 Nm.
- Check the valve clearance again.
- Check the gasket of the cylinder head hood and renew if necessary.
- Fit the cylinder head hoods and tighten the screws, tightening torque 20 + 5 Nm. Make sure the gasket fits properly.
- Connect the injection lines, see job card B 7-3-1, Removing and installing injection lines.

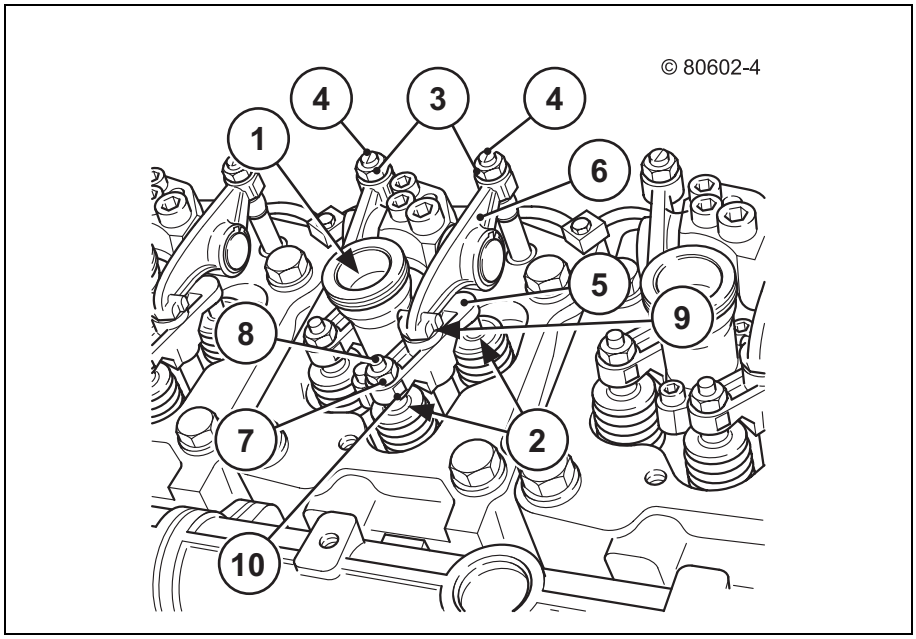

Figure 1 Components in the valve drive

Positions of Figure 3:

1 Drive side

2 Start of first crankshaft rotation

3 Start of 2nd crankshaft rotation

Bring valves to overlap one after another according to the ignition order.

Start with cylinder A4.

Ignition dead point	A1 B2 A3 B1 A4 B3 A2 B4
Overlapping	A4 B3 A2 B4 A1 B2 A3 B1

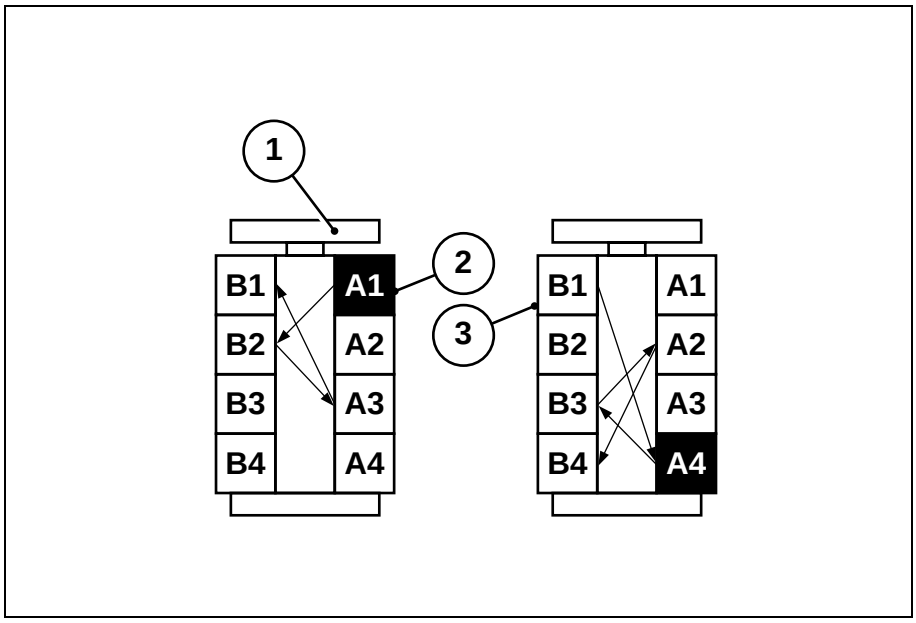

Figure 2 8 cylinder engine

Test and setting order engine V12

Positions of the Figure 3:

1 Drive side

2 Start of 1stcrankshaft rotation

3 Start of 2nd crankshaft rotation

Bring valves to overlap one after another according to the ignition order.

Start with cylinder A6.

Ignition dead point	A1 B5 A5 B3 A3 B6 A6 B2 A2 B4 A4 B1
Overlapping	A6 B2 A2 B4 A4 B1 A1 B5 A5 B3 A3 B6

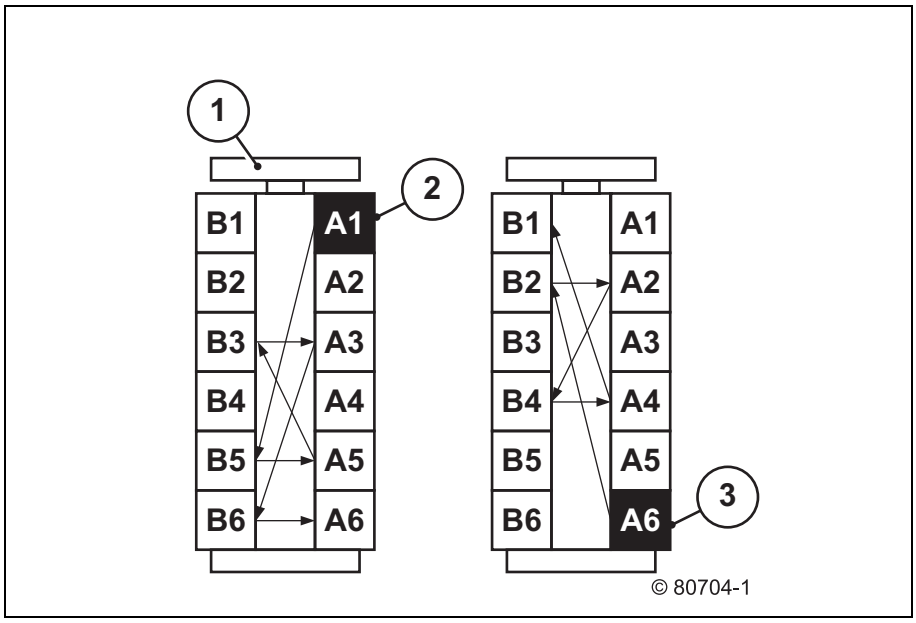

Figure 3 12 cylinder engine

Positions of the Figure 4:

1 Drive side

2 Start of 1st crankshaft rotation

3 Start of 2nd crankshaft rotation

Bring valves to overlap one after another according to the ignition order.

Start with cylinder A8.

Ignition dead point	A1 B3 A3 B7 A7 B5 A5 B8 A8 B6 A6 B2 A2 B4 A4 B1
Overlapping	A8 B6 A6 B2 A2 B4 A4 B1 A1 B3 A3 B7 A7 B5 A5 B8

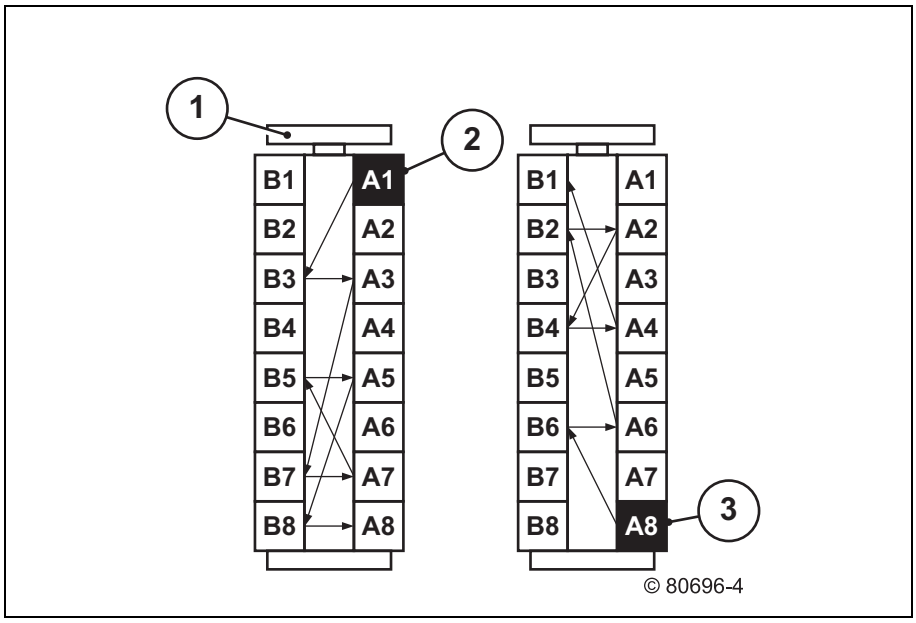

Figure 4 16 cylinder engine

Valve clearance actual values table

	Cylinder	A1		A2		A3		A4		A5		A6		A7		A8		A9		A10	
	Valve	I	A	I	A	I	A	I	A	I	A	I	A	I	A	I	A	I	A	I	A
OH	Date																				

Tab. 1 Valve clearance actual values table of cylinder series A

	Cylinder	B1		B2		B3		B4		B5		B6		B7		B8		B9		B10	
	Valve	I	A	I	A	I	A	I	A	I	A	I	A	I	A	I	A	I	A	I	A
OH	Date																				

Tab. 2 Valve clearance actual values table of cylinder series B

The total adjustment time can be determined by the actual value data. This can tell you something about the previous wear in the valve drive.

Racor Crankcase Ventilation System, Service

The crankcase ventilation system must be serviced if the red indicator button is fully visible on the maintenance indicator 1 or if the number of operating hours indicated in the maintenance schedule has been reached.

If the engine is fitted with two crankcase ventilation systems, the procedure described applies, as appropriate, to both systems.

The Racor oil separators used on the TBG 620 do not have internal bypass valves. The TBG 620 must not be fitted with designs that have bypass valves (such as those currently used on the 632 model series).

Washing out and re-using the filter element is not permitted.!

Auxiliary equipment

- Diesel fuel

Replacement parts

- Filter element (with O-rings)
- base insert, if required

Service filter

- Release the four locks 2 of the filter. Carefully remove container 4 downwards..

There may still be lubricating oil in the container, do not spill it.

- Pull filter element 5 from upper section of filter 3.
- Remove base insert 8 from container 4, do a visual check and replace it if necessary. **If a base insert is not fitted, this must be retrofitted.**
- Check the base of the container 4 for damage and replace it if necessary.
- Check that the oil outlet is free and that the return valve, if fitted, facilitates free drainage.

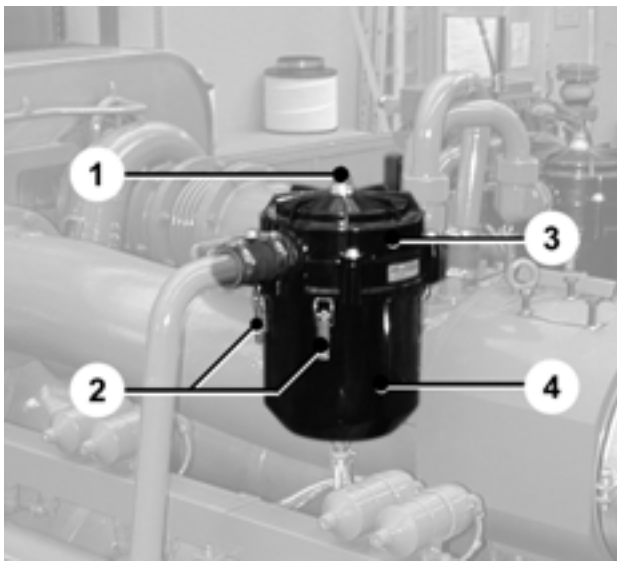

Figure 5 The filter of the crankcase ventilation system, example shown is installed in the TBG 620

- Check diaphragm of pressure regulating valve for damage.

Dispose of filter element and, where required, the base insert in accordance with regulations.

- In the course of the service, visually check all parts of the crankcase ventilation system for damage, in particular check the hoses and rubber parts of the connection and drainage pipes.
- Remove O-rings 6 and 7.
- Clean container 4 with diesel fuel.
- Insert new O-ring 7 in upper section of filter 3.
- Insert new filter element 5, together with new O-ring 6, into the opening of the upper section of the filter 3.
- Insert base 8 into container 4, ensuring that it matches the shape of the container.
- Wet the new filter element with lub oil.
- Put container 4 back in position and fasten with the four locks 2.

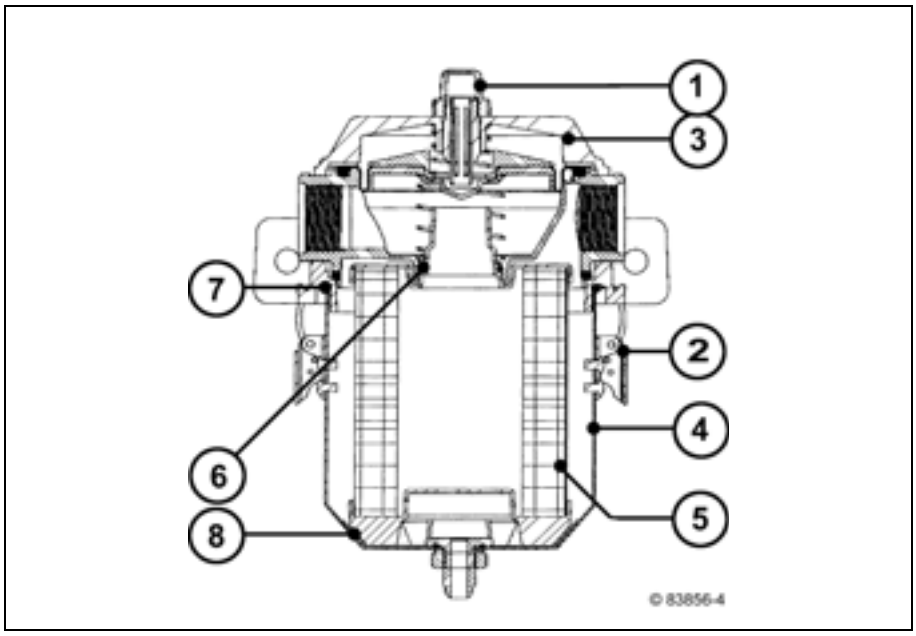

Figure 6 Filter (cross-sectional diagram)

- Check the position of the flexible drain hose. This must not chafe on other components and must be a sufficient distance away from hot components, in particular the exhaust gas cladding. If necessary, correct the hose routing.

- Depending on the design, back absorption through the oil drainage pipe can be prevented by a return valve, a siphon trap or an oil outlet that ends below the oil level (submerged pipe). Before operating for the first time, the siphon trap must be filled with oil. Where there are separate collectors with submerged pipes, a check must be made to ensure that the pipe is actually below the oil level. If necessary, top up the oil in the collector until there is a sufficient amount.

Instructions for putting (returning) the system into operation

Resetting the maintenance indicator

- Unscrew cap of maintenance indicator 1.
- Push in the red indicator button.
- Screw cap back on.

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Renewing the suction air intake filter

Tools
- Normal tools

Spares
- Suction air intake filter

References
- Chapter 5, Maintenance

Soiling of the suction air intake filters depends on the dust content in the air. See Chapter 5, Maintenance for intervals for renewing the suction air intake filters.

Renewing the suction air intake filter

- Loosen wing nuts 1 and remove the cover from the housing.
- Unscrew the suction air intake filter fastening screw 2 and remove the suction air intake filter. Clean the housing.
- Insert and fasten the new suction air intake filter in the housing.
- Place the cover on the housing and tighten the wing nuts 1.

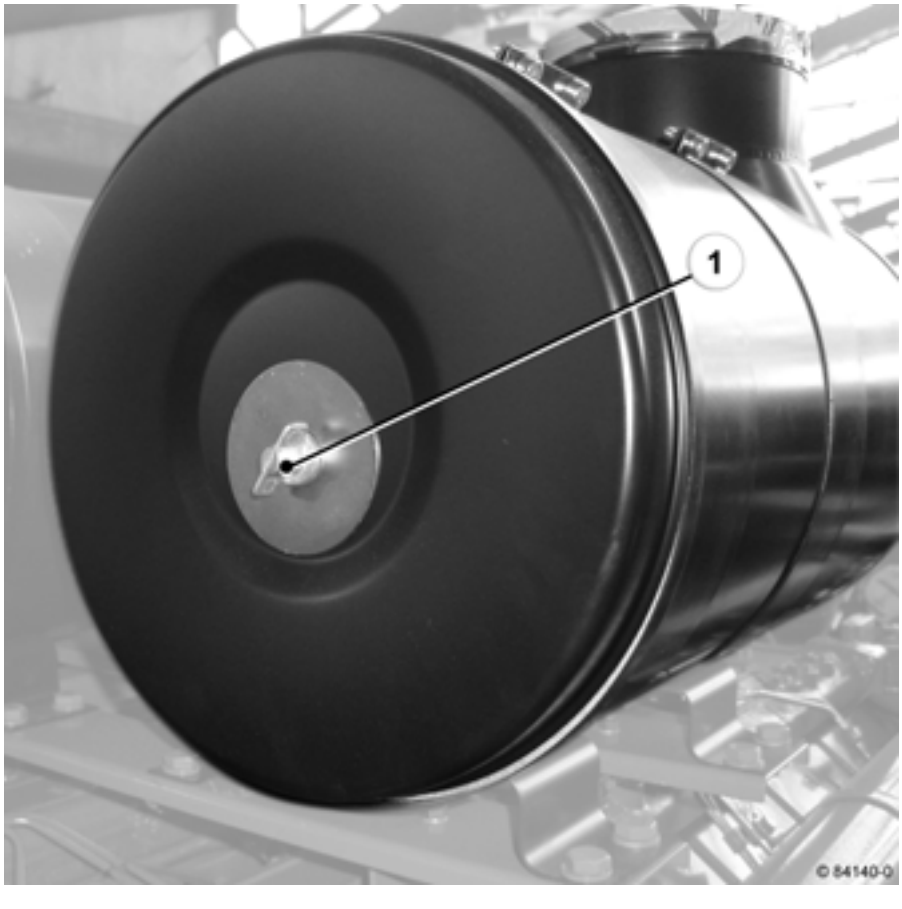

Figure 1 Housing cap

Figure 2 Fastening suction air intake filter

Removing and installing injection lines

Tools
- Normal tools
- Key wrench for injection lines order no.: 0704 1395

Auxiliary material
- Cleaning cloth

Carry out this work only when the engine has been shut down.

Before dismantling,shut off the fuel feed and secure engine against start-up.

Remove injection lines

- Loosen the hose clip 1.

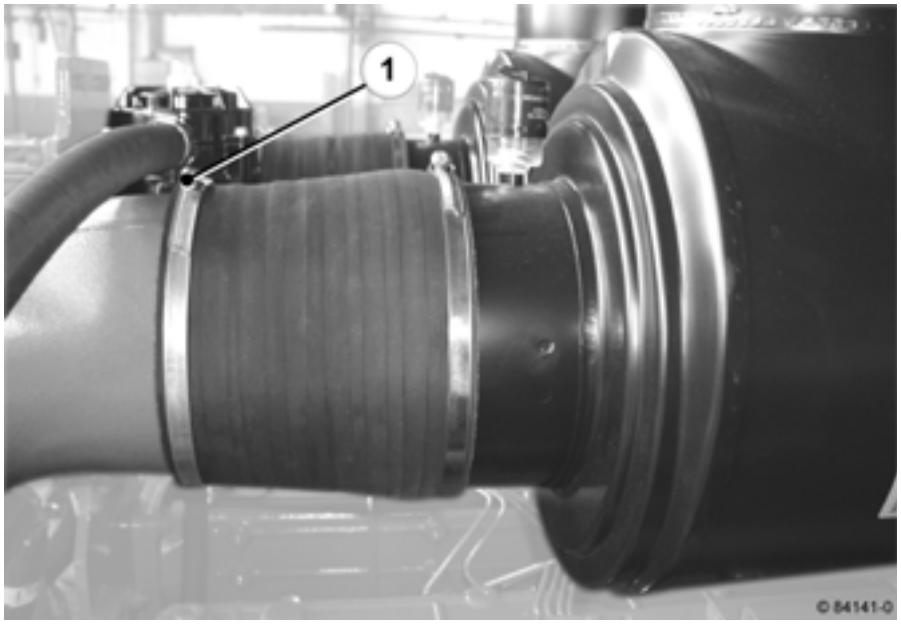

Figure 1 Connection air filter housing to air intake manifold

- Remove the fastening screws 2 of the air filter housing and remove the air filter housing.

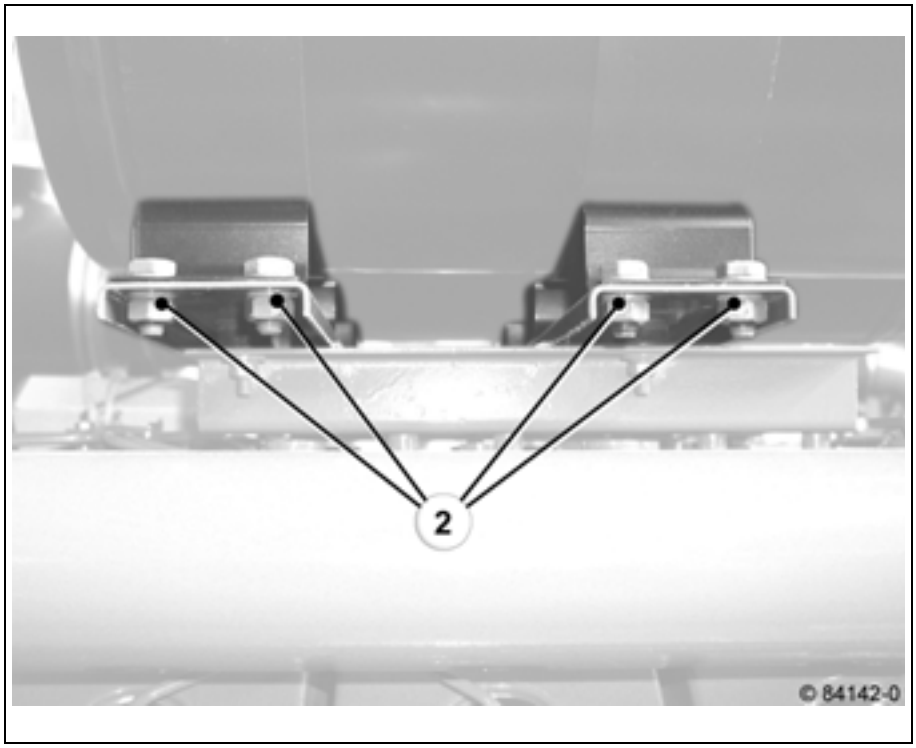

Figure 2 Fastening air filter housing

- Remove V-belt clip 4 of the charge air pipe.

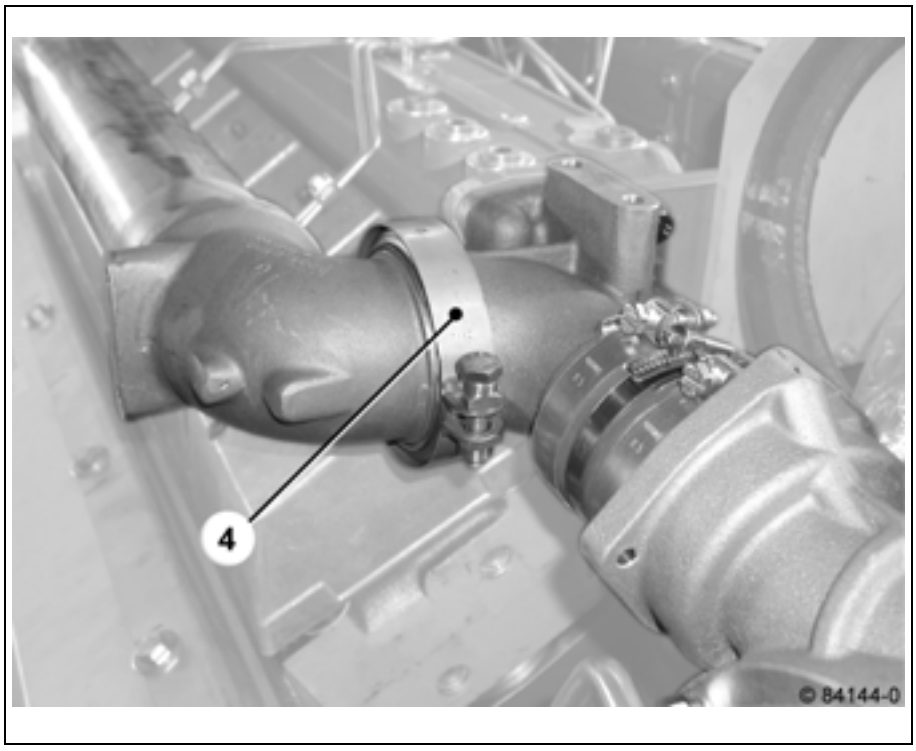

Figure 3 Charge air pipe removal

- Remove fastening screws 5 and pull out the charge air pipe in the direction of the arrow.
- Remove the fastening screws 6 and remove the air filter housing carrier.

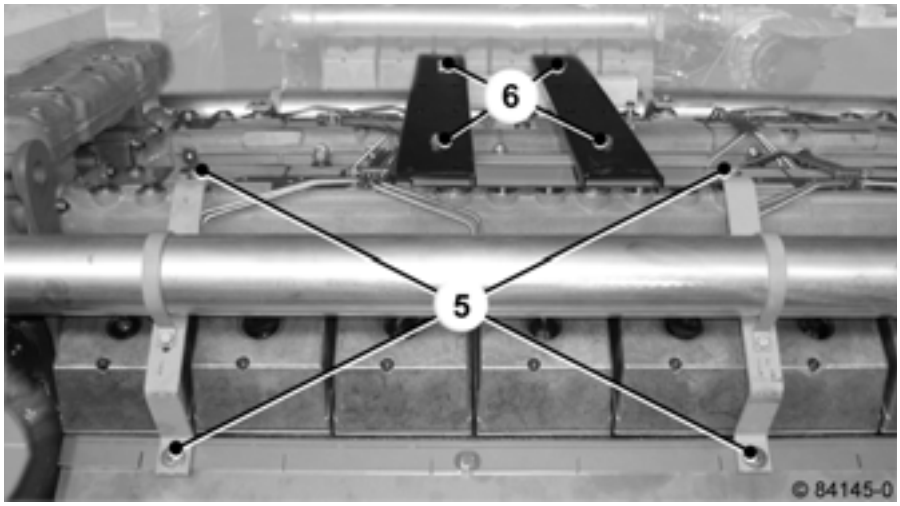

Figure 4 Holders charge air pipe

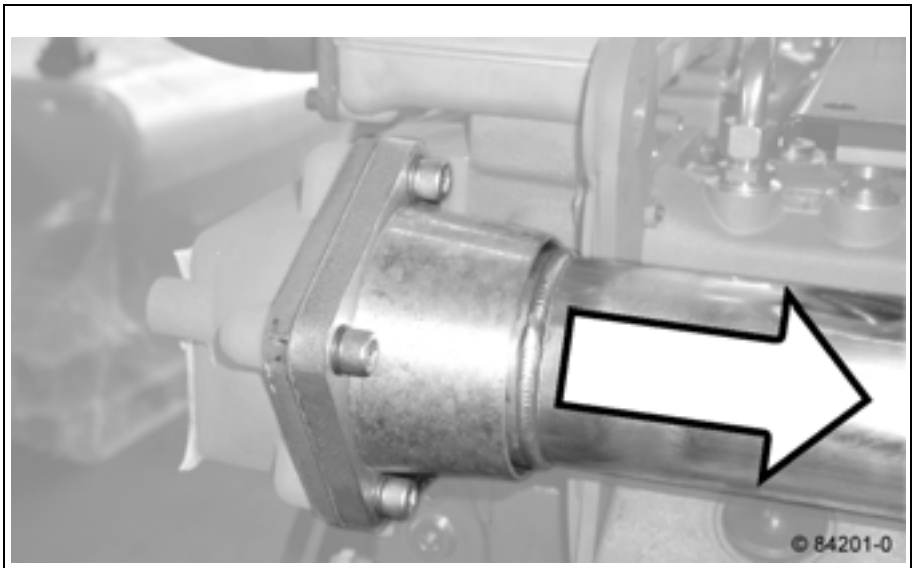

Figure 5 Charge air pipe plug-in system

- Note down the allocation of the line bundles 1 from the injection pump to the injection valves.
- Push up the rubber seals 2 on the injection lines.

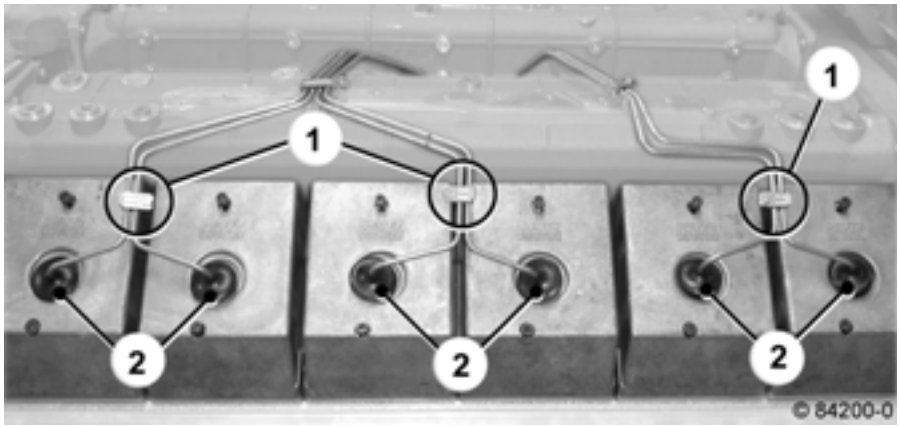

Figure 6 Injection lines

- Loosen the additional holder of the line bundle 1 from the charge air pipe.
- Unscrew the lock nuts on the injection pump and the injection valves with a wrench.

Collect emerging fuel. Ensure absolute cleanliness!

- Remove the complete line bundle 1.

Install injection lines

- Fit new rubber seals to the injection lines 2.
- Fit new line bundle 1 as described above.
- Turn the locknuts of the line bundles hand tight and tighten with wrench with 20 + 5 Nm.
- Mount the injection lines additional holder.
- Check all screw connections of the injection lines on the injection pump and injection valves for leaks with the engine running, adjust the sealing taper of the injection lines if necessary.
- Insert rubber seals 2 in the cylinder head hoods.

- Mount the carrier of the air filter housing and tighten the fastening screws 6.
- Coat the new sealing rings of the charge air pipe with vaseline.
- Insert the charge air pipe in the direction of the arrow. When installing, make sure that the sealing rings are not damaged. Tighten fastening screws 5.

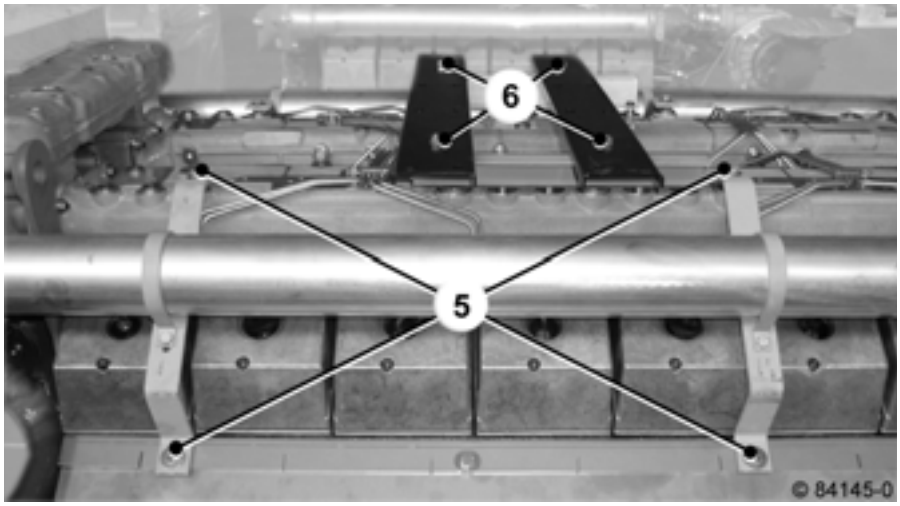

Figure 7 Holders charge air pipe

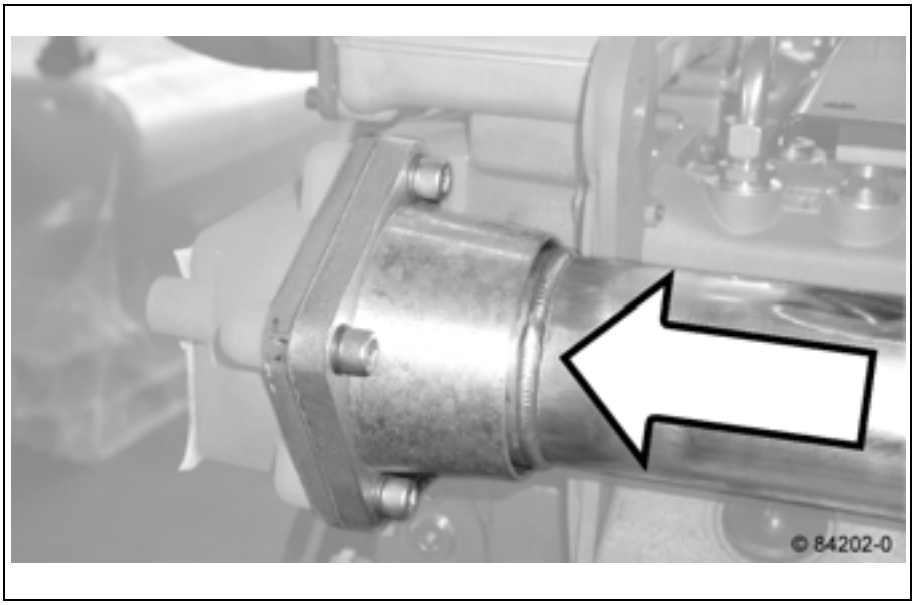

Figure 8 Charge air pipe plug-in system

- Install V-belt clip 4 of the charge air pipe.

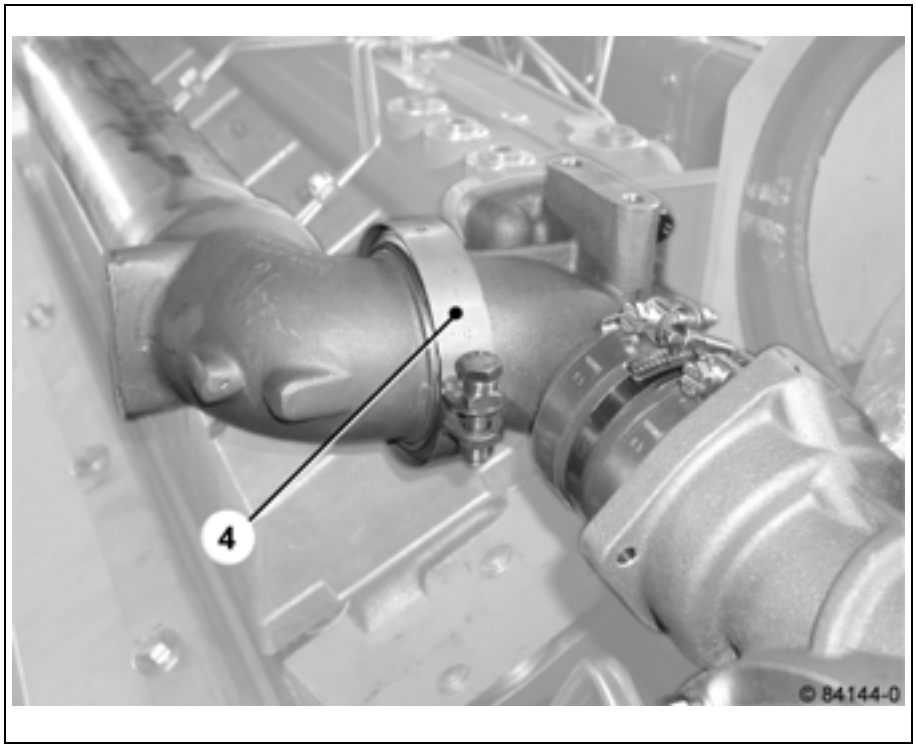

Figure 9 Charge air pipe installation

- Fit air filter housing and tighten the fastening screws 2.

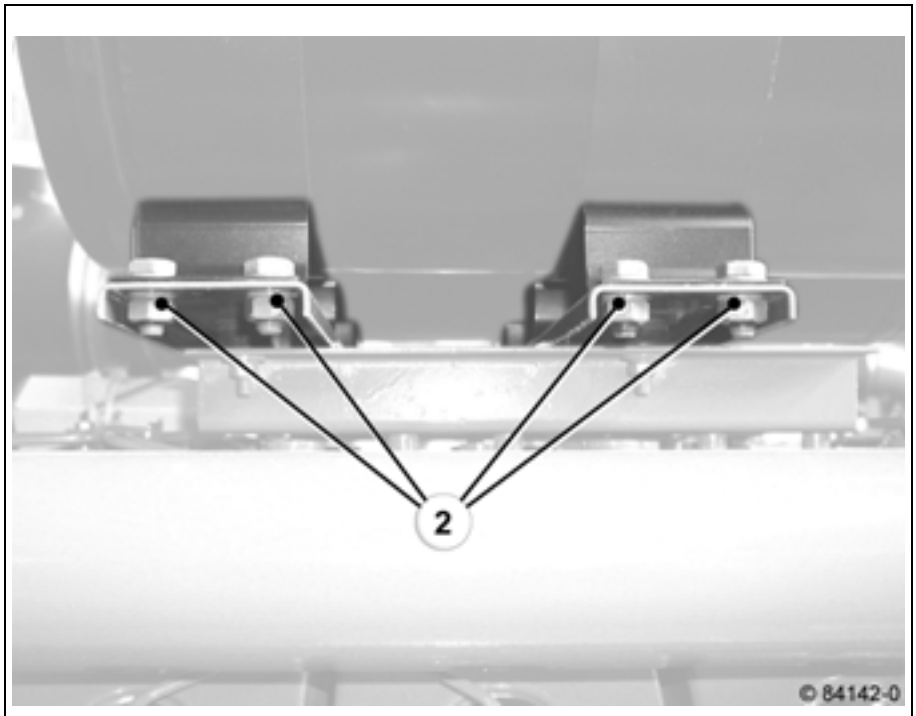

Figure 10 Fastening air filter housing

- Mount the hose clip 1.

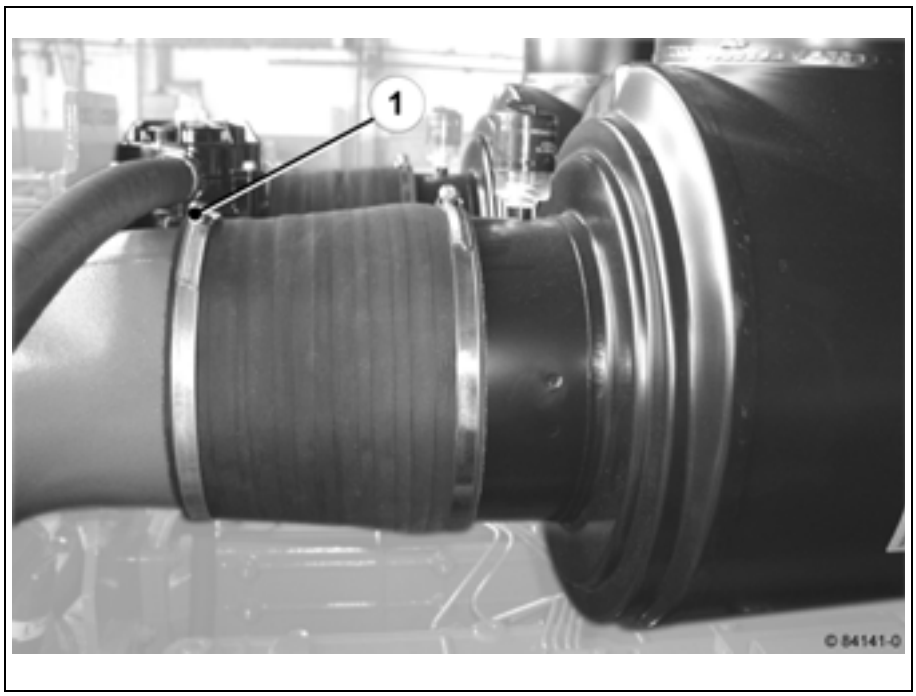

Figure 11 Connection air filter housing to air intake manifold

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Visual inspection of the arched denture clutch

Auxiliary material
- Lamp

References
- W 7-4-9 Check arched denture clutch and change grease filling.

Carry out this work only when the engine has been shut down.

Visual inspection

Check whether grease has leaked from the arched denture clutch 1. It should be noted that grease will be flung aside by the centrifugal force.

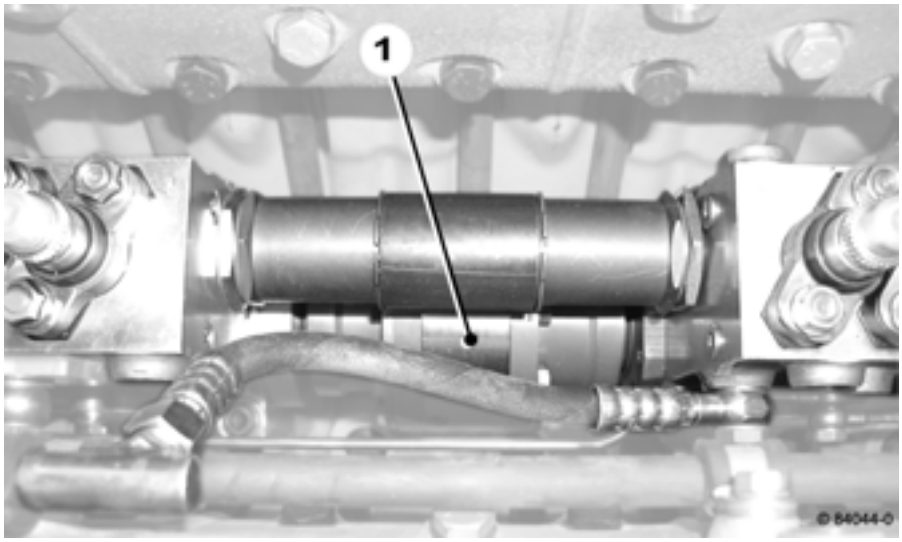

Figure 1 Arched denture clutch

If grease has leaked from the arched denture clutch, check this, see job card W 7-4-9.

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Removing and installing the injection valve

Tools
- Normal tools
- Turning gear order no. 12276678
- Socket wrench order no. 07041395

Spares
- Sealing rings

References
- B 7-3-1, Removing and installing injection lines

Remove the injection valve

- Disconnect the injection lines, see work card B 7-3-1, Removing and installing injection lines.
- Remove cylinder head hood.
- Blow out the injection valve shaft thoroughly with compressed air.

Particles of dirt can cause injury when cleaning with compressed air. Wear goggles and tight fitting clothing.

- Turn the engine so that the ram of the valve drive of the cylinder unit concerned is relieved and the valves are closed, i.e. the piston is in the ignition dead point.

The engine may only be turned in the direction of rotation. Turning against the direction of rotation will damage components. Direction of rotation: Looking onto the drive side – in counterclockwise direction "left hand rotation".

- Unscrew hexagon socket head screw 2 and remove sleeve 1 with injection valve.

Pay attention to the toggle lever and valve bridges so that the round sealing rings of the injection valve sleeve 1 are not damaged during removal.

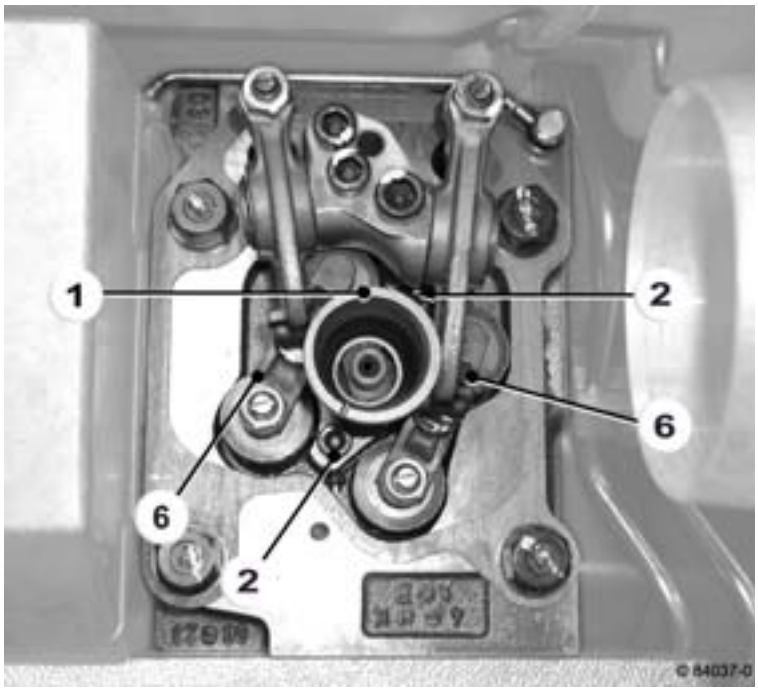

Figure 1 Removal of the injection valve sleeve

- Pull the injection valve out of the sleeve.

- Clean the valve seat in the cylinder head.
- Check all the round sealing rings 3 and the round gasket on the injection valve for damage, renew if necessary.
- Coat all round sealing rings with DEUTZ S4 lubricant.

Figure 2 Round sealing rings

Install the injection valve

- Install the injection valve carefully in the sleeve. Do not damage round sealing ring.
- Renew the lower sealing ring.
- Install sleeve 1 with injection valve. Tighten fastening screws 2. Tightening torque:
  - 1st step hand tight
  - 2nd step 15 Nm
  - 3rd step 20 Nm

Pay attention to the toggle lever and valve bridges 6 so that the round sealing rings of the injection valve sleeve 1 are not damaged during installation.

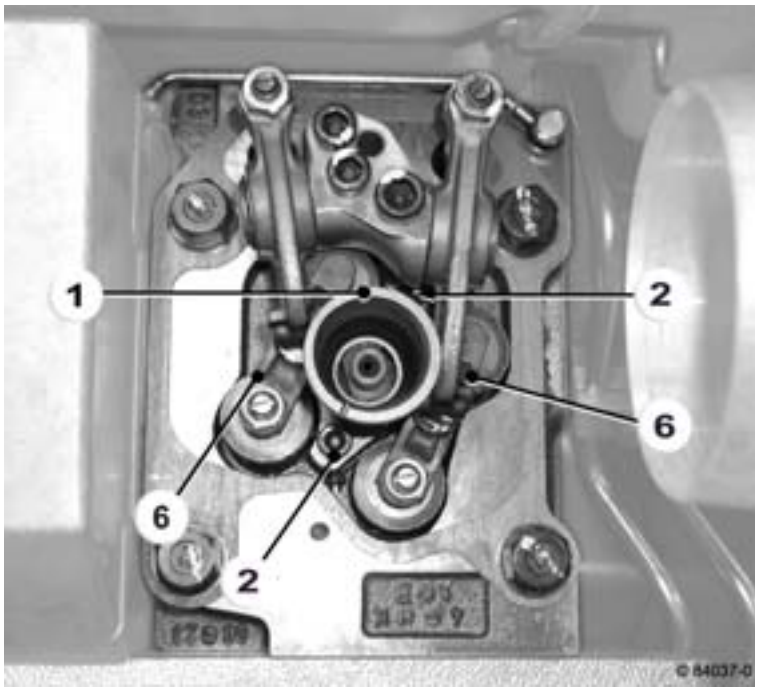

Figure 3 Installation of the injection valve sleeve

- Check the injection valve in the installed state again.
- Attach cylinder head cover. Check the sealing rings of the fastening screws, renew if necessary. Tighten the fastening screws. Tightening torque 20 + 5 Nm.
- Connect the injection lines, see job card B 7-3-1, Removing and installing injection lines.

Checking the injection valve

Tools

- Normal tools
- Nozzle tester order no. 12044577

Auxiliary material

- Transparent container
- Compressed air

References

- B 7-3-1, Removing and installing injection lines
- B 7-7-1, Removing and installing the injection valve
- W 7-7-4, Removing, installing, renewing injection nozzle

Check the injection valve in the installed state

- Disconnect the injection lines, see work card B 7-3-1, Removing and installing injection lines.
- Connect the injection valve to the nozzle tester with an adapted line.
- Evacuate air from the line and the injection valve by pumping.
- Check whether there is an audible buzz during injection by fast pumping.
- If the buzz is not clearly audible, the injection valve must be checked in the removed state.
- Determine the injection pressure during slow pumping.

Bosch No.	Injection pressure
DLLA 150 P 545	292 - 300 bar
DLLA 150 P 545/	310 -320 bar
DLLA 150 P 885	280 -288 bar

- If the pressure deviates from the setpoint, the nozzle must be adjusted, see job card W 7-7-4, Removing, installing, renewing the injection nozzle.
- Removing the nozzle tester.
- Connect the injection lines, see job card B 7-3-1, Removing and installing injection lines.

Check injection valve in the removed state

Remove injection valves, see work card B 7-7-1, Removing and installing the injection valve.

- Connect the injection valve to the nozzle tester and place a transparent container big enough for the fuel underneath it, see Figure 1.
- Evacuate air from the line and the injection valve by pumping.

Take care not to get any fuel on your skin.

Risk of skin damage !

- Determine the shape of the jet by fast pumping. Eight jets must emerge evenly spreading in a funnel shape! A buzz must be audible during injection.

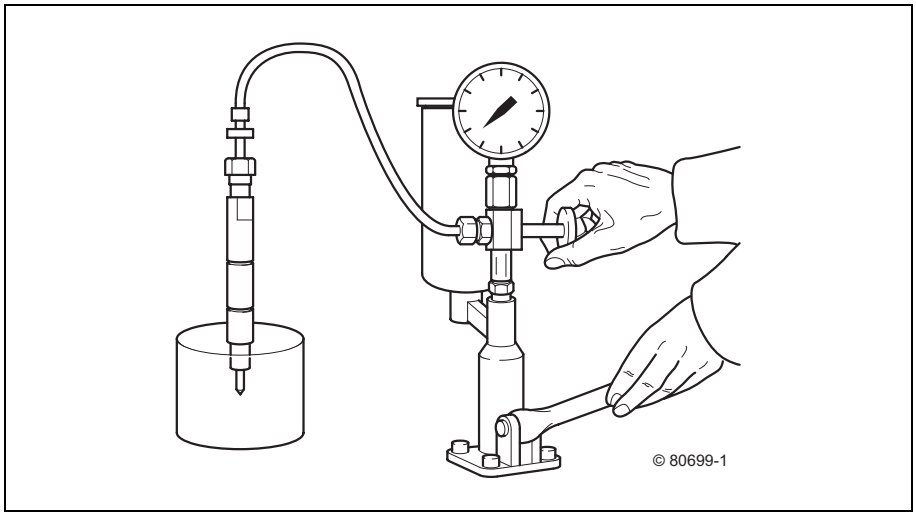

Figure 1 Checking the injection valve

- The nozzle must be renewed if the injection is not perfect, see job card W 7-7-4, Removing, installing, renewing the injection nozzle.
- Determine the injection pressure during slow pumping.

Bosch No.	Injection pressure
DLLA 150 P 545	292 - 300 bar
DLLA 150 P 545/	310 -320 bar
DLLA 150 P 885	280 -288 bar

- If the pressure deviates from the setpoint, the nozzle must be adjusted, see job card W 7-7-4, Removing, installing, renewing the injection nozzle.
- Install injection valves, see work card B 7-7-1, Removing and installing the injection valve.

Maintaining the fuel double filter

Tools
- Normal tools

Auxiliary material
- Fuel collector tray

Spares
- Filter cartridges

Renew fuel double filter cartridges (not switchable)

- Loosen fastening screws 1 and remove filter housing 2 carefully.
- Dispose of fuel in the filter housing 2.
- Remove filter cartridges from the filter housing 2.
- Clean filter housing 2 with fuel.
- Clean any dirt from the filter carrier sealing surface.
- Wet new gaskets slightly with fuel.
- Insert filter cartridge in the filter housing 2.
- Mount the filter housing 2 on the filter carrier and tighten the fastening screws 2.
- Bleed the fuel system through the bleed valve (arrow).
- Check the fuel double filter for leaks.

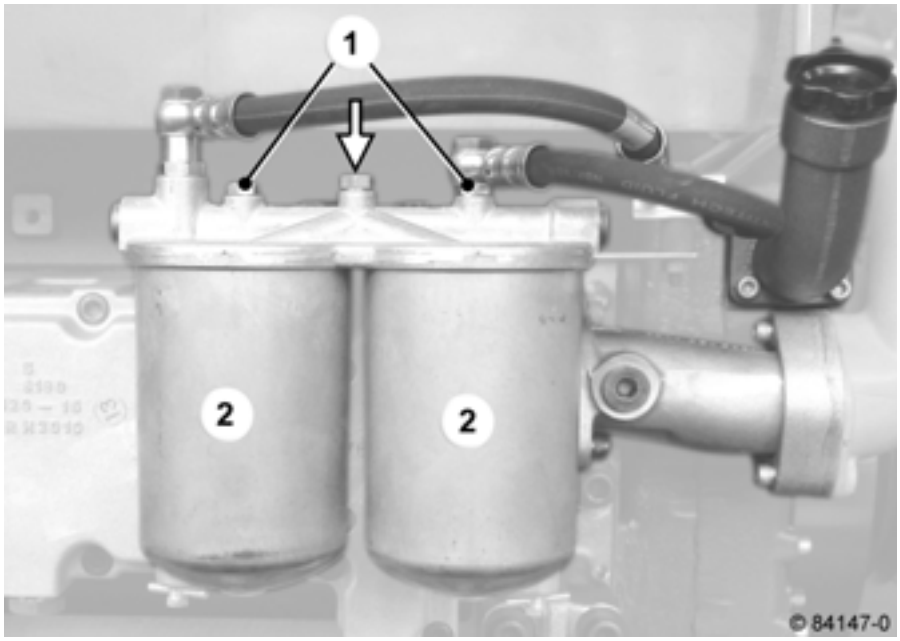

Figure 1 Double fuel filter (not switchable)

Renew fuel double filter cartridges (switchable)

Filter circuits

The filter cartridges can be replaced with the engine running at low speed.

Only switch off the appropriate filter when renewing it. Leave both filters switched on in normal operation.

Adjust the tap.

- Tap adjustment 1 left filter closed
- Tap adjustment 2 both filters open
- Tap adjustment 3 right filter closed

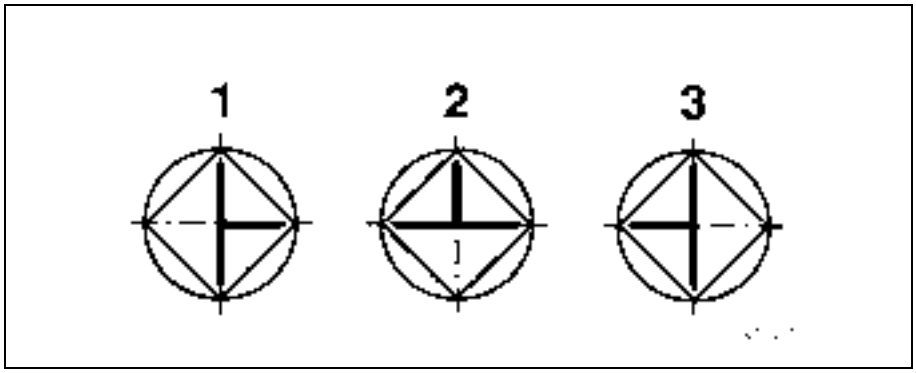

Figure 2 Tap settings

- Unscrew wing nuts 1 and remove cover 2, be careful with the gasket.

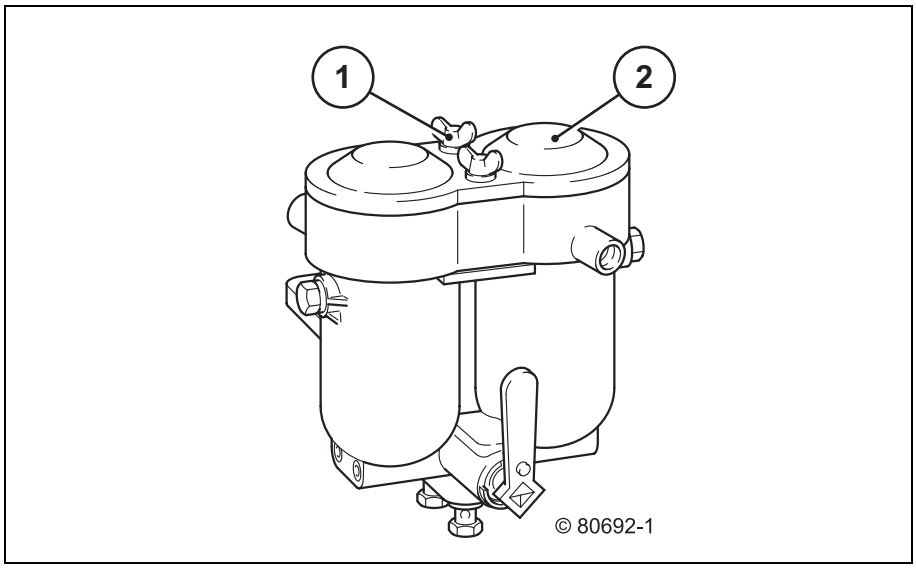

Figure 3 Fuel filter cap

- Turn the filter circuit to the desired setting.
- Loosen the middle screws 3 and remove the cover 4.
- Drain fuel from the side of the filter.

- Open the bleeding screws 8.

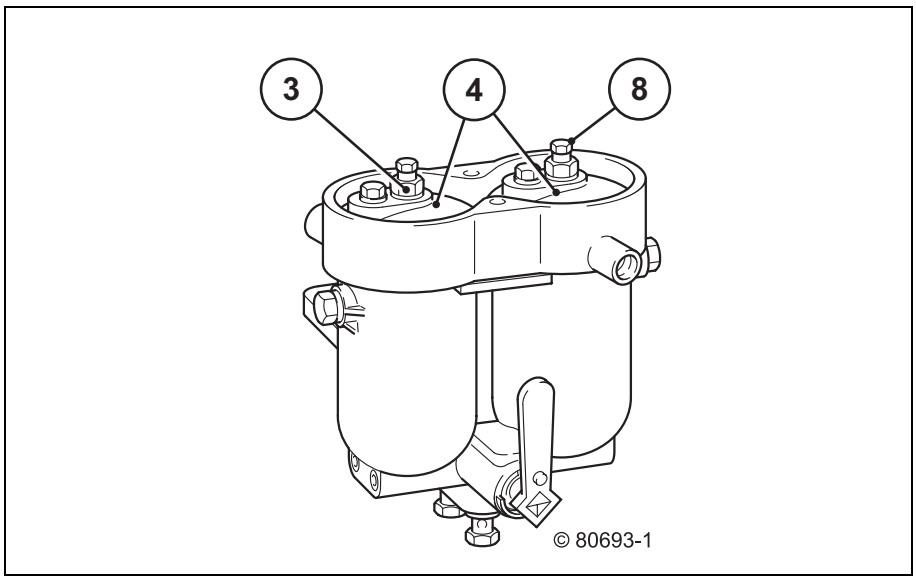

Figure 4 Middle screws and cover

- Remove the filter cartridges 5 from the filter housing and clean the inside of the filter housing.

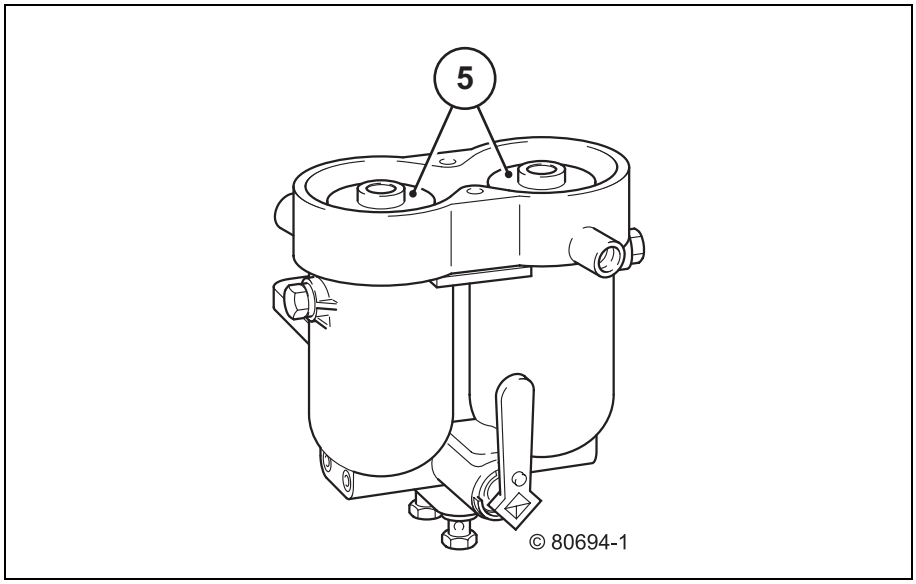

Figure 5 Filter cartridges

- Insert new filter cartridges in the housing and replace the covers in reverse order, be careful with the gaskets.
- Open the bleeding screws 8 and run the hand pump until fuel emerges without air bubbles. Close the bleeding screws 8 again whilst continuing pumping. Drain surplus fuel from the side.
- Set the tap on both filters to open.
- Check the filters for leaks during operation.

- Fit cover 2, be careful with the gasket. Screw in wing nuts 1.

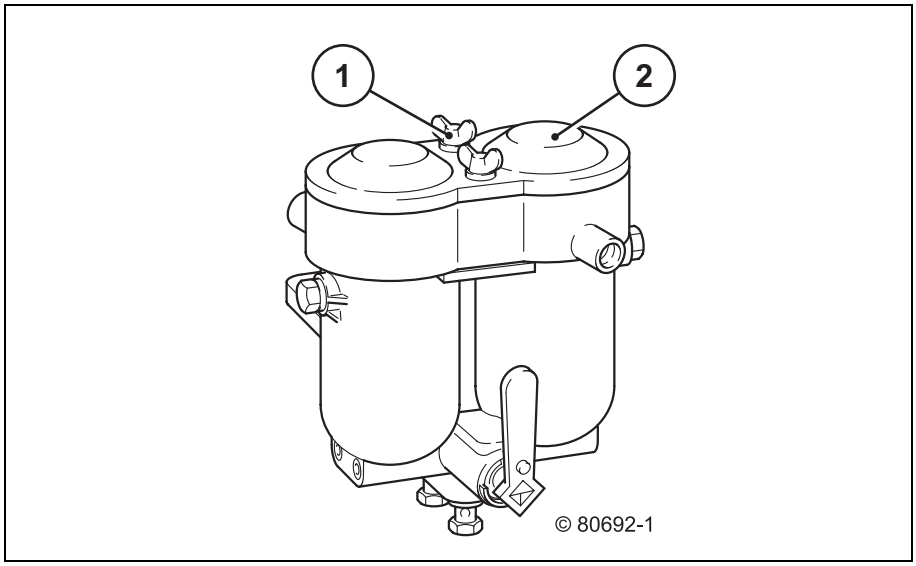

Figure 6 Fuel filter cap

Renewing the fuel filter cartridge

Tools
- Normal tools
- Strip key order no. 12158153

Auxiliary material
- Fuel collector tray

Spares
- Fuel filter cartridge

Renew fuel single filter

- Loosen fuel filter cartridge 2 with strip key, unscrew and dispose of fuel.
- Catch any escaping fuel.
- Clean any dirt from the filter carrier sealing surface.
- Wet the sealing ring of the new fuel filter cartridge 2 slightly with fuel.
- Manually screw in the fuel filter cartridge 2 until the gasket is flush.
- Tighten the fuel filter cartridge by hand.
- Bleed the fuel system through bleed valve 1 and the fuel hand pump.
- Check the fuel filter cartridge 2 for leaks.

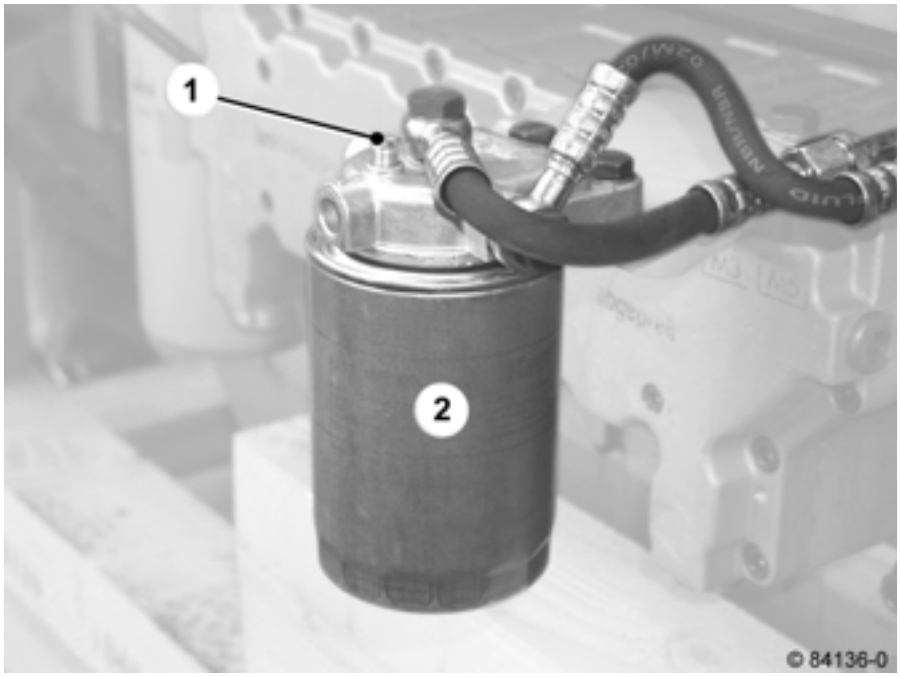

Figure 1 Fuel filter cartridge

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Changing the lube oil

Tools
- Normal tools

Auxiliary material
- Container for waste oil

Spares
- lube oil
- Sealing rings

References
- B 8-10-4, Renew the lube oil filter cartridge
- Chapter 4, Expendables

Carry out this work only when the engine has been shut down.

When draining off hot lube oil:

Risk of scalding!

Collect the used oil,do not allow it to seep into the soil.

Dispose of in accordance with the relevant regulations.

Drain lube oil

- Allow engine to warm up.
  - Lube oil temperature approx. 80 °C.

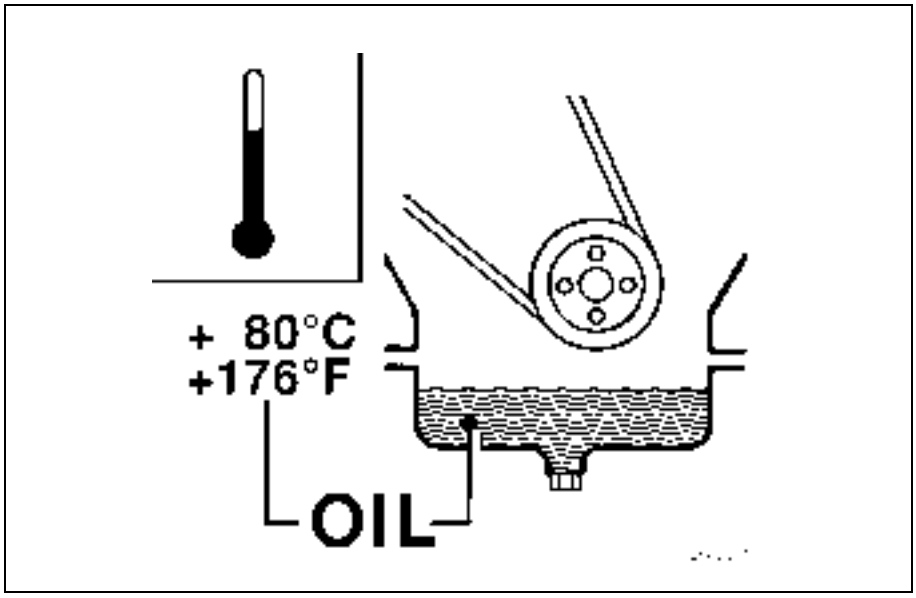

Figure 1 Lube oil temperature

- Switch off the engine.
- Place lube oil tray under the engine.
- Unscrew all the lube oil drain screws.
- Drain lube oil.

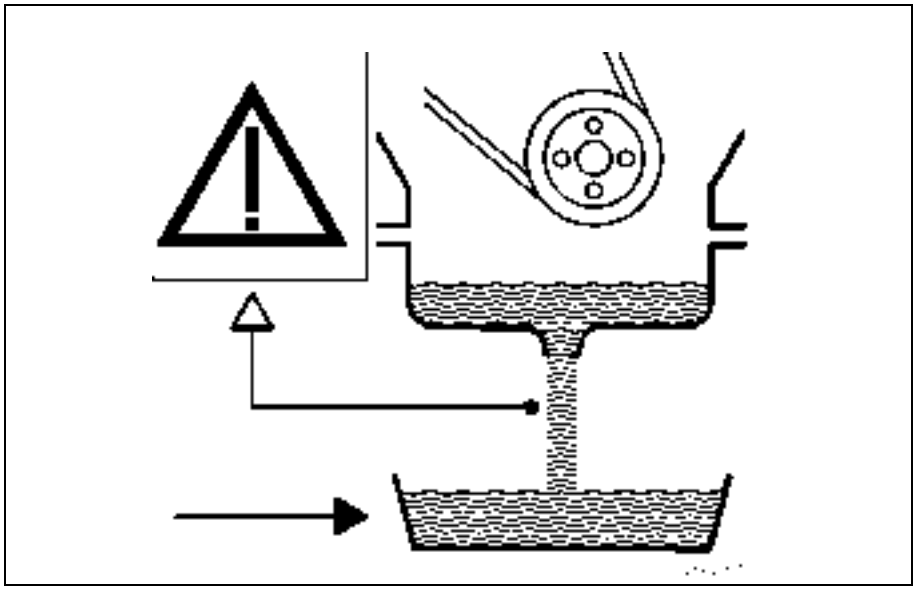

Figure 2 Lube oil drain

- Replace lube oil filter cartridge, see job card B 8-10-4, Renew the lube oil filter cartridge.
- Fit lube oil drain screws with new sealing ring.

Pour in lube oil

- Pour in lube oil according to the filling system.
  - For grade / viscosity see Chapter 4, Expendables.
- Start the engine and run at low speed.
- Switch off engine.
- Check the lube oil level.
  - Refill lube oil up to the top mark if necessary.

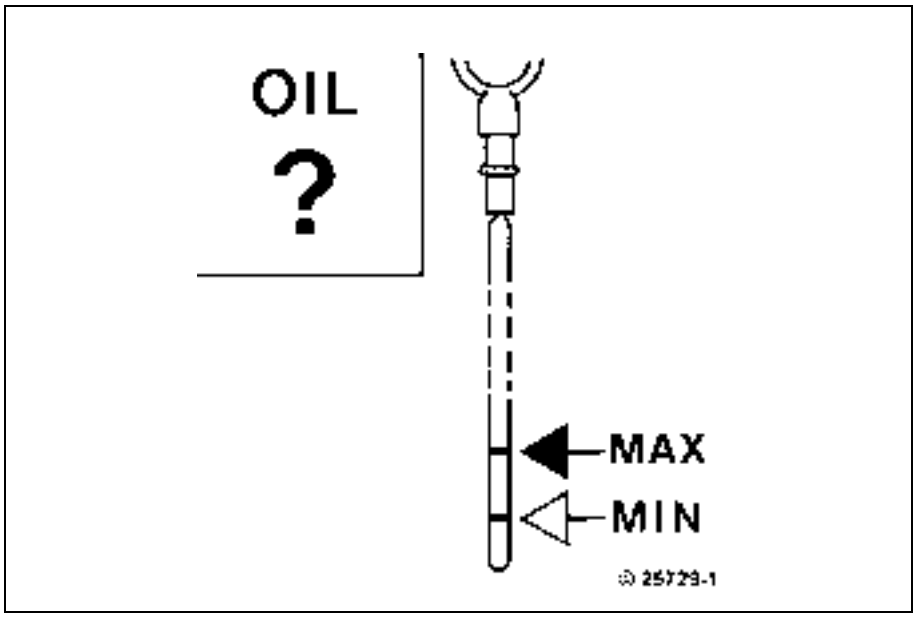

Figure 3 Dipstick

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Renew the lube oil filter cartridge

Tools
- Strip key order no. 12158153

Auxiliary material
- Lube oil collecting tray

Spares
- Lube oil filter cartridge

When draining off hot lube oil:

Risk of scalding!

Collect the used oil,do not allow it to seep into the soil.

Dispose of in accordance with the relevant regulations.

Remove lube oil filter cartridge

- Loosen lube oil filter cartridge 4 with strip key, unscrew and drain oil.

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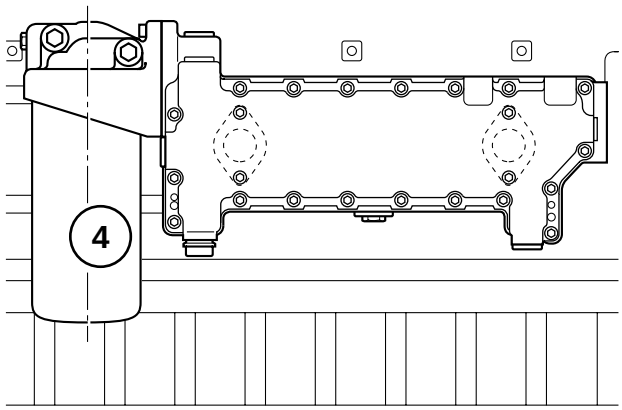

Figure 1 Lube oil filter cartridge

- Catch any escaping lube oil.

When unscrewing the lube oil filter cartridge 4 fine plastic chips are produced when the catch is released. These chips do not get into the lube oil system and pose no danger.

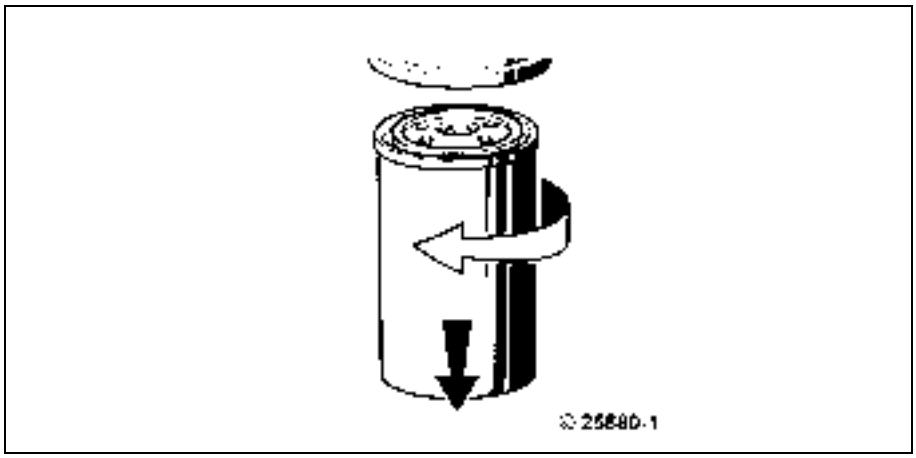

Figure 2 Removing the lube oil filter cartridge

Mount lube oil filter cartridge

- Clean any dirt from the filter carrier sealing surface.
- Lightly oil the rubber gasket of the new lube oil filter cartridge.

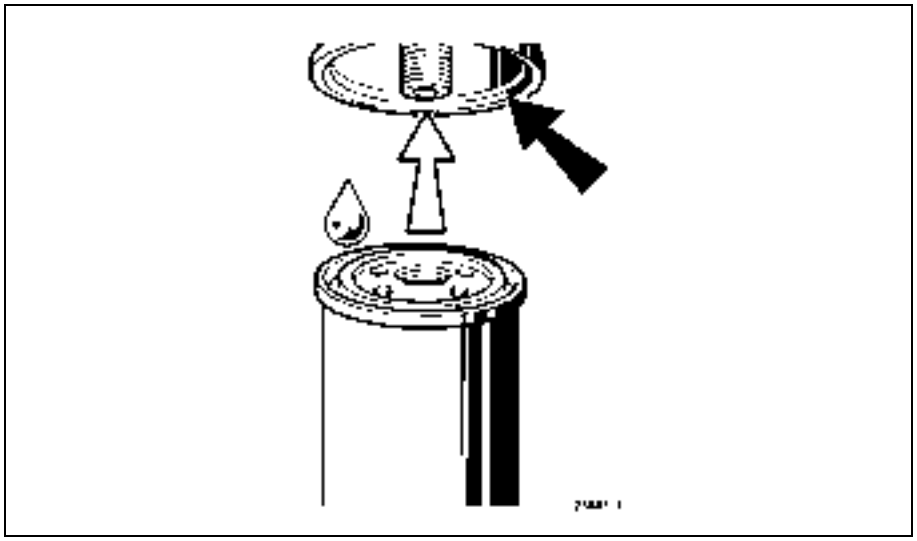

Figure 3 Removing the lube oil filter cartridge

- Manually screw in the new cartridge until the gasket is flush.
- Tighten the lube oil filter cartridge, tightening torque 25 + 2 Nm.

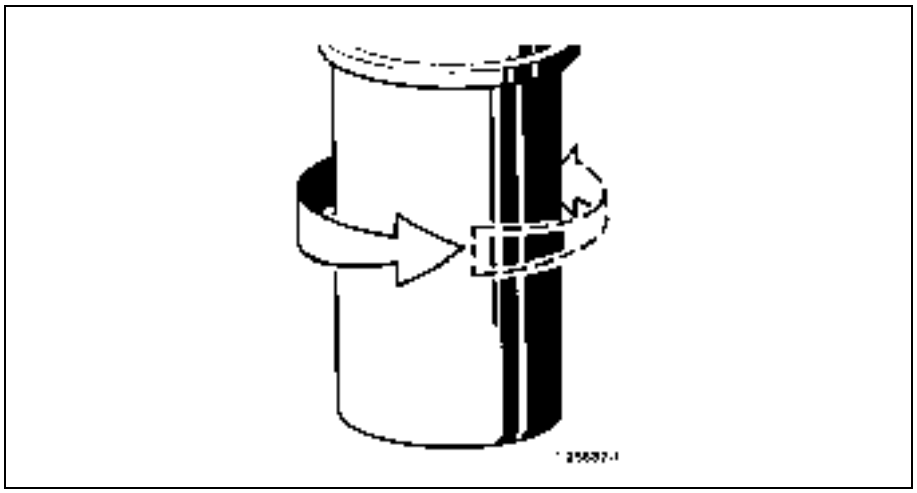

Figure 4 Removing the lube oil filter cartridge

- Check the lube oil level.
- Check the lube oil pressure.
- Check the lube oil filter cartridge for leaks.

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Maintaining the centrifugal lube oil filter

Tools
- Normal tools
- Hard brush
- Wooden scraper

Carry out this work only when the engine has been shut down.

When draining off hot lube oil:

Risk of scalding!

Collect the used oil,do not allow it to seep into the soil.

Dispose of in accordance with the relevant regulations.

The centrifugal lube oil filter should be cleaned according to the maintenance schedule. The paper sleeve must be renewed.

Ensure absolute cleanliness!

Model with V-belt clip

Dismantle the centrifugal lube oil filter

- Loosen V-belt clip 1, remove housing cover 2 and take rotor 3 assembled out of the housing.

Do not damage the bearing and bearing journal.

Do not use clamps on the bearing journal.

- Dismantle the rotor 3.
- Remove the paper sleeve 4 with layer of dirt.

Clean the centrifugal lube oil filter

- Clean individual parts with compressed air or a hard brush.

Assemble the centrifugal lube oil filter

- Insert the new paper sleeve 4 in the bottom part of the rotor.
- Assemble the rotor 3.
- Insert rotor 3 and mount housing cover 2. Fit V-belt clip 1.
- Check for leaks.

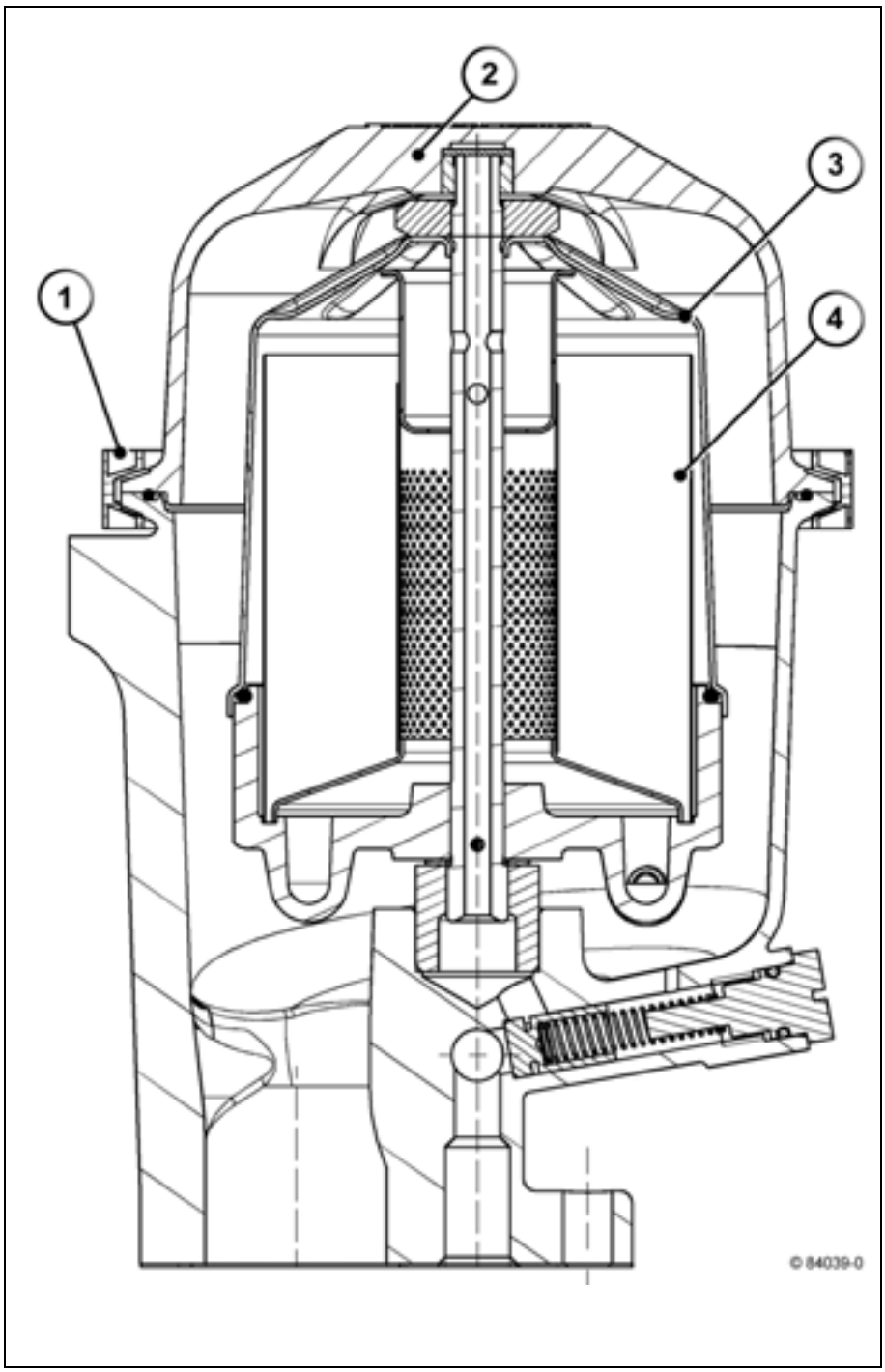

Figure 1 Centrifugal lube oil filter (lock with V belt clip)

Model with hinged screws

Dismantle the centrifugal lube oil filter

- Remove the housing cover 1 and remove rotor in the assembly, 2 to 8, from the housing.

Do not damage the bearing and bearing journal.

Do not use clamps on the bearing journal.

- Loosen the nut 2 and remove the rotor cap 3.
- Clamp the rotor carefully in a vice at floor height of the rotor bottom part 7.
- Remove the paper sleeve 4 with layer of dirt.

Clean the centrifugal lube oil filter

- Clean sieves 5, stand pipe 6 and nozzles 8 with compressed air or hard brush.

Assemble the centrifugal lube oil filter

- Insert new paper sleeve 4 in the bottom rotor part 7.
- Assembly the rotor.
- Insert the rotor and housing cover and tighten with the hinged screws.
- Check for leaks.

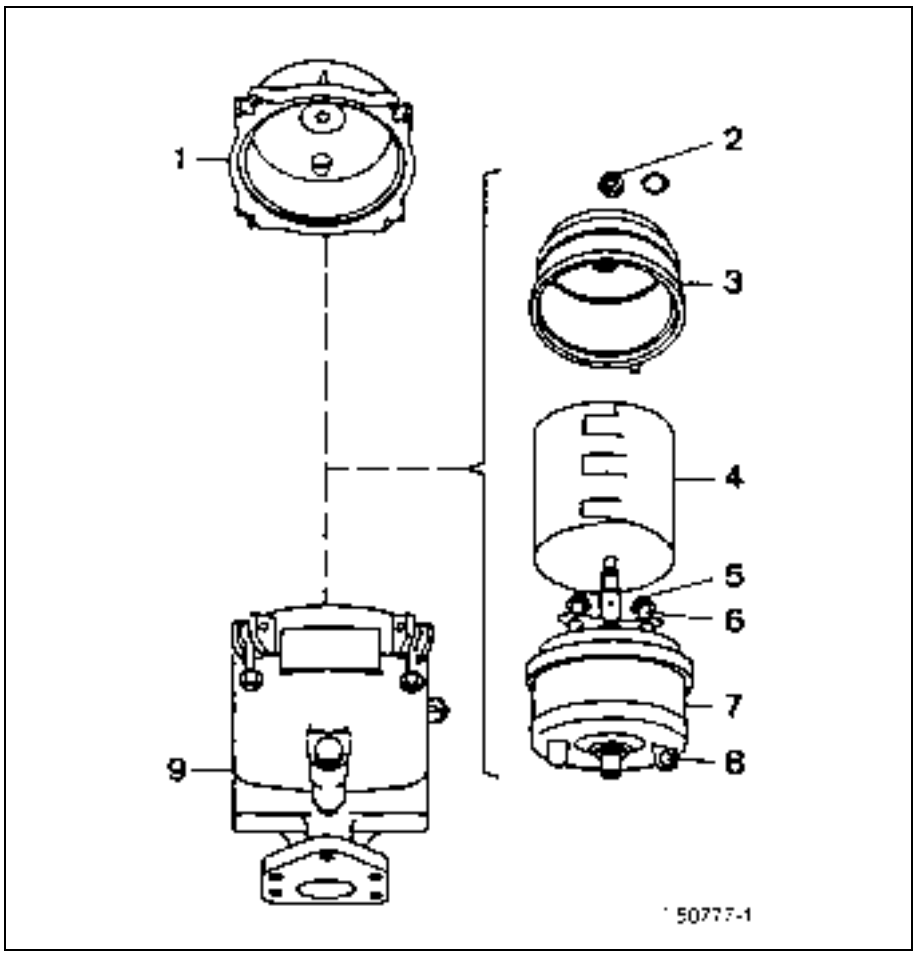

Figure 2 Centrifugal lube oil filter (lock with hinged screws)

Emptying and filling the cooling system

Tools
- Normal tools

Auxiliary material
- Collecting vessel for cooling fluid

Spares
- Seals

References
- Chapter 4, Expendables
- Chapter 7, Conservation
- B 0-1-4, Test run

Carry out this work only when the engine has been shut down.

Secure engine against start-up.

The anti-corrosion agent is inflammable in its non-hardened state!

For various work, e.g. on the cylinder head, crankcase, heat exchanger and pipelines it is necessary to drain the coolant partially or completely.

If no antifreeze is added, the coolant must be drained completely from the engine and attached parts when the engine is taken out of operation for longer periods or if there is a danger of frost. The engine must also be preserved, see Chapter 7, Conservation.

There is a danger of scalding when working on the cooling system. Allow the engine to cool down sufficiently, wear protective overalls and gloves.

For engine side designations see Chapter 2, Designation of the engine sides, cylinder and direction of rotation.

Drain cooling system

- Open the cap of the cooling system.

The coolant must be drained at various points of the cooling system marked by arrows in the figures.

A collecting vessel must be placed underneath the appropriate points.

- Loosen the pre-heater drain screw if installed.

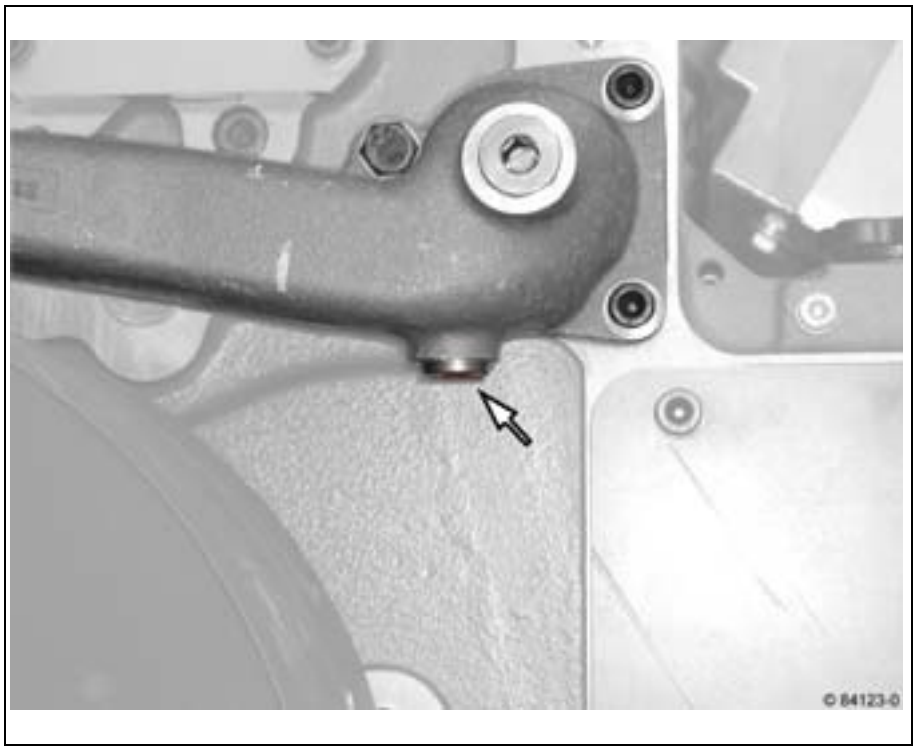

Figure 1 Coolant pipe on the damper side (free side)

- Open the drain screw on the coolant pipe (arrow).

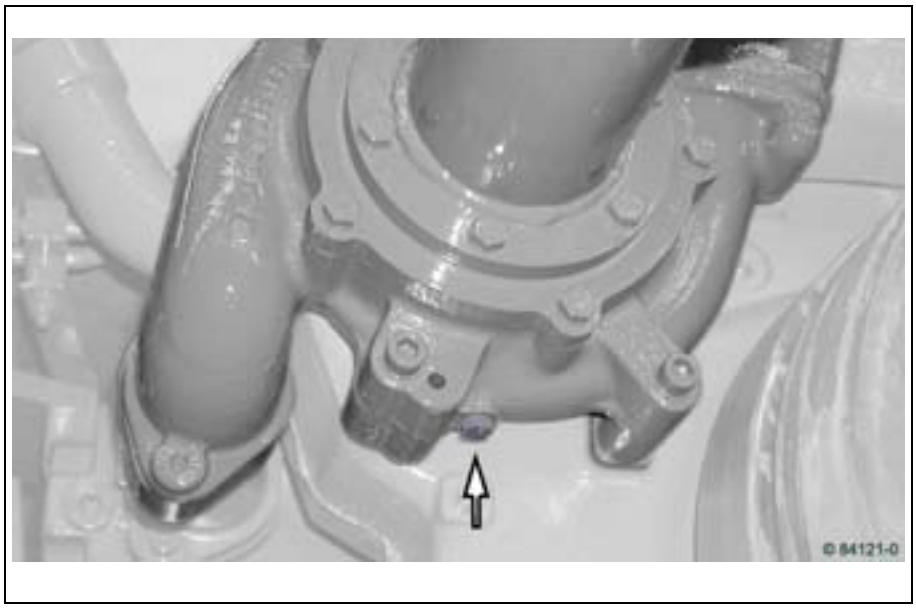

Figure 2 Coolant pump on the damper side (free side)

- Open the drain screw on the coolant pump (arrow).

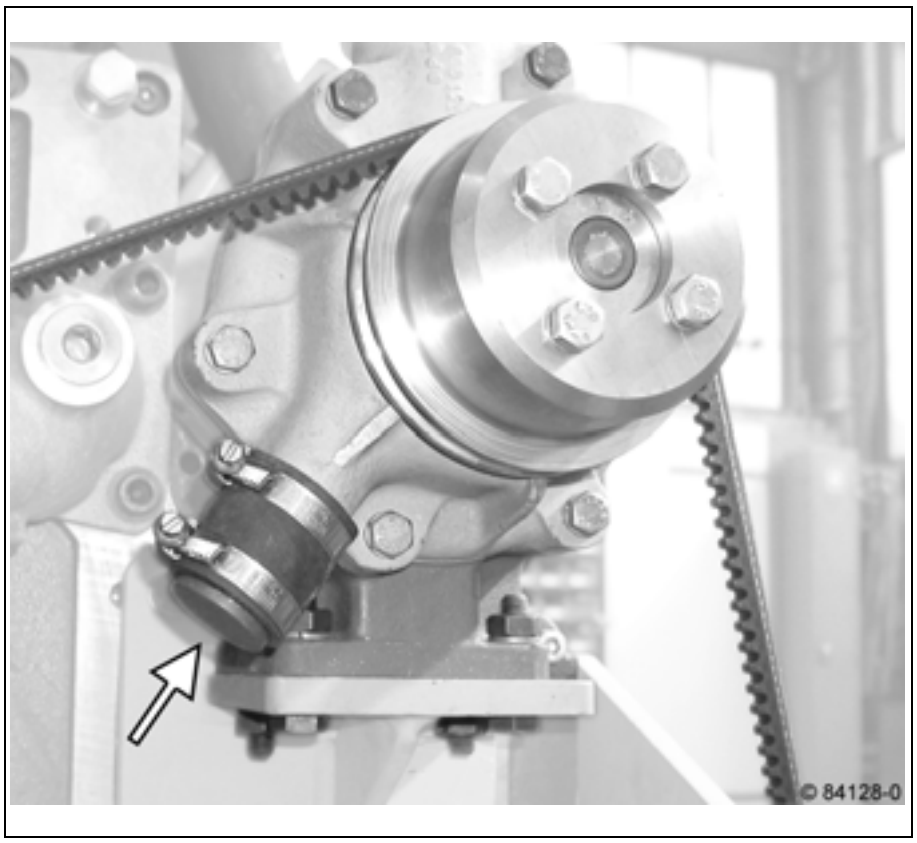

Figure 3 Coolant pump on the damper side (free side)

- Open the drain screw on the coolant pump (arrow).

Figure 4 Crankcase on the cylinder row A (left hand side)

- Open the drain tap on the crankcase (arrow).

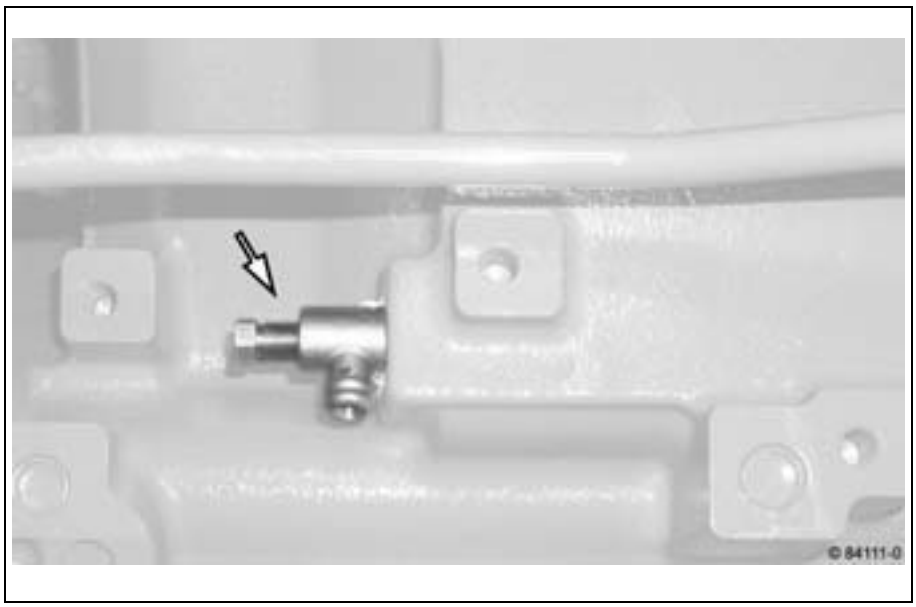

Figure 5 Crankcase on the cylinder row B (right hand side)

- Open the drain tap on the crankcase (arrow). 8 and 12-cylinder engines only.

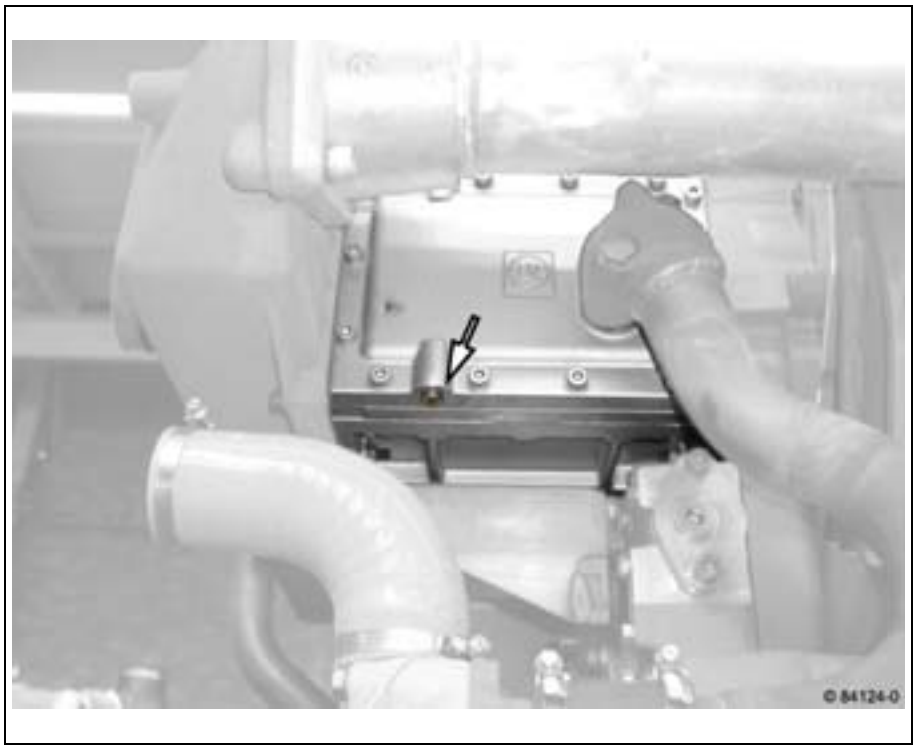

Figure 6 Charge air cooler on the damper side (free side)

- Open the drain screw on the charge air cooler (arrow).

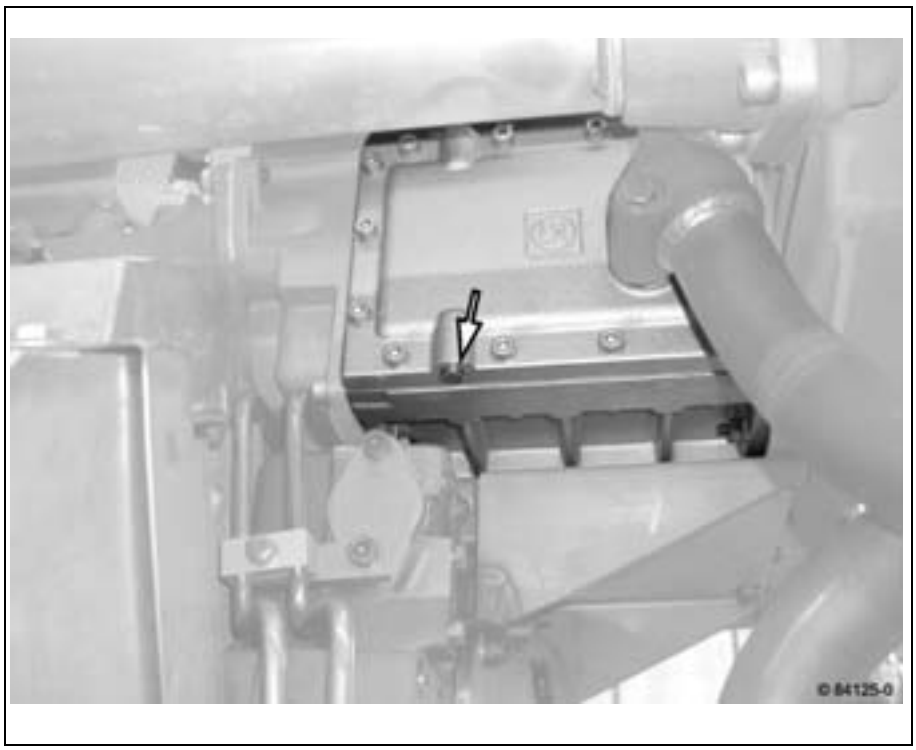

Figure 7 Charge air cooler on the damper side (free side)

- Open the drain screw on the charge air cooler (arrow).

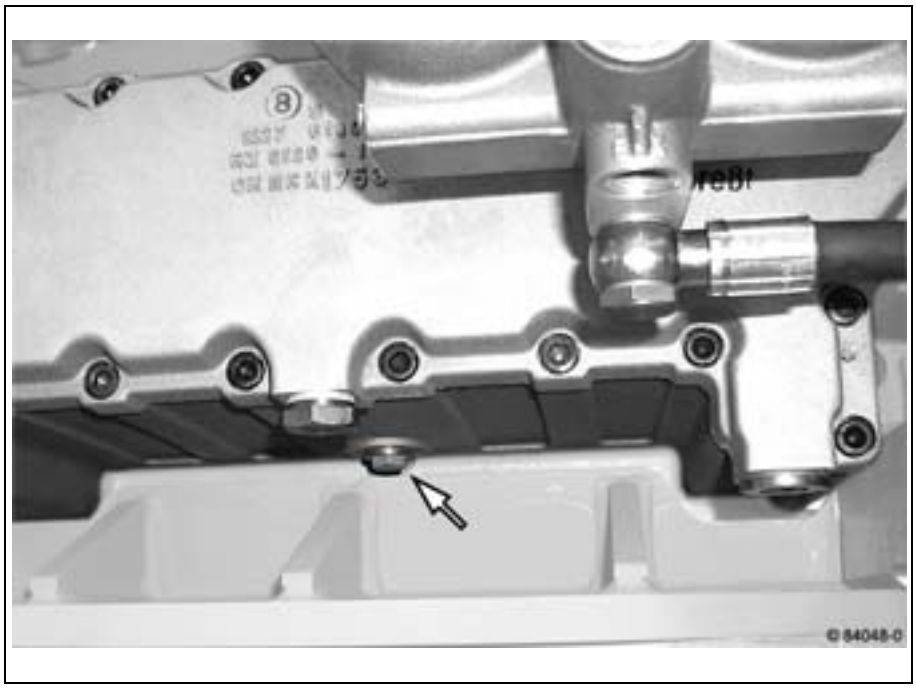

Figure 8 Lube oil heat exchanger on the cylinder row B (right hand side)

- Open the drain screw on the lube oil heat exchanger (arrow).
- Then close all open drain points. Use new sealing rings for screw caps.

Filling the cooling system

Observe the necessary quality of the operating media according to operating media specifications Chapter 4, Expendables.

- Open engine bleeding screw (arrow).
- Open the valves in the coolant pipes if available

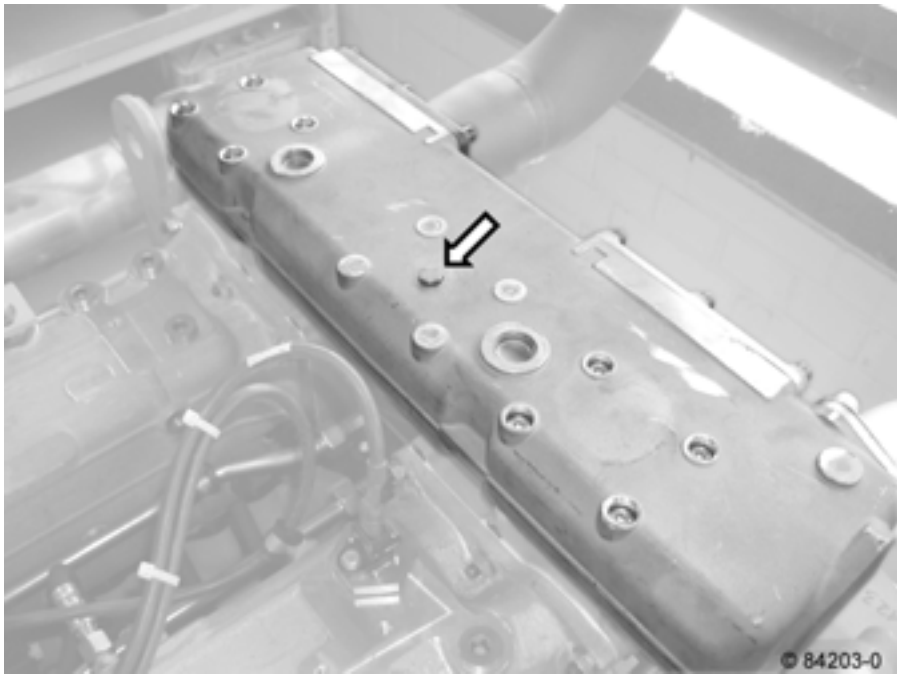

Figure 9 Engine bleeding screw thermostat housing.

- Fill up the engine's cooling system with prepared coolant through the filling nozzle on the cooler until the coolant emerges from the engine bleeding valve without bubbles. Seal the engine bleeding screw (arrow) with a new sealing ring.
- The filled cooling system does not bleed automatically depending on the structure of the external cooling system. It may be necessary to remove the highest coolant hose until the coolant emerges without bubbles. Collect the emerging coolant.

Coolant level

- Check the coolant level in the compensation tank. The test marks may vary depending on the system structure.
- Pipes, connecting elements and engine must be checked for leaks after filling and repaired if necessary.
- Make a test run, see job card B 0-1-4, Test run.
- Check the coolant after shutting off the engine and refill if necessary.

The cooling system is under pressure, danger of scalding!

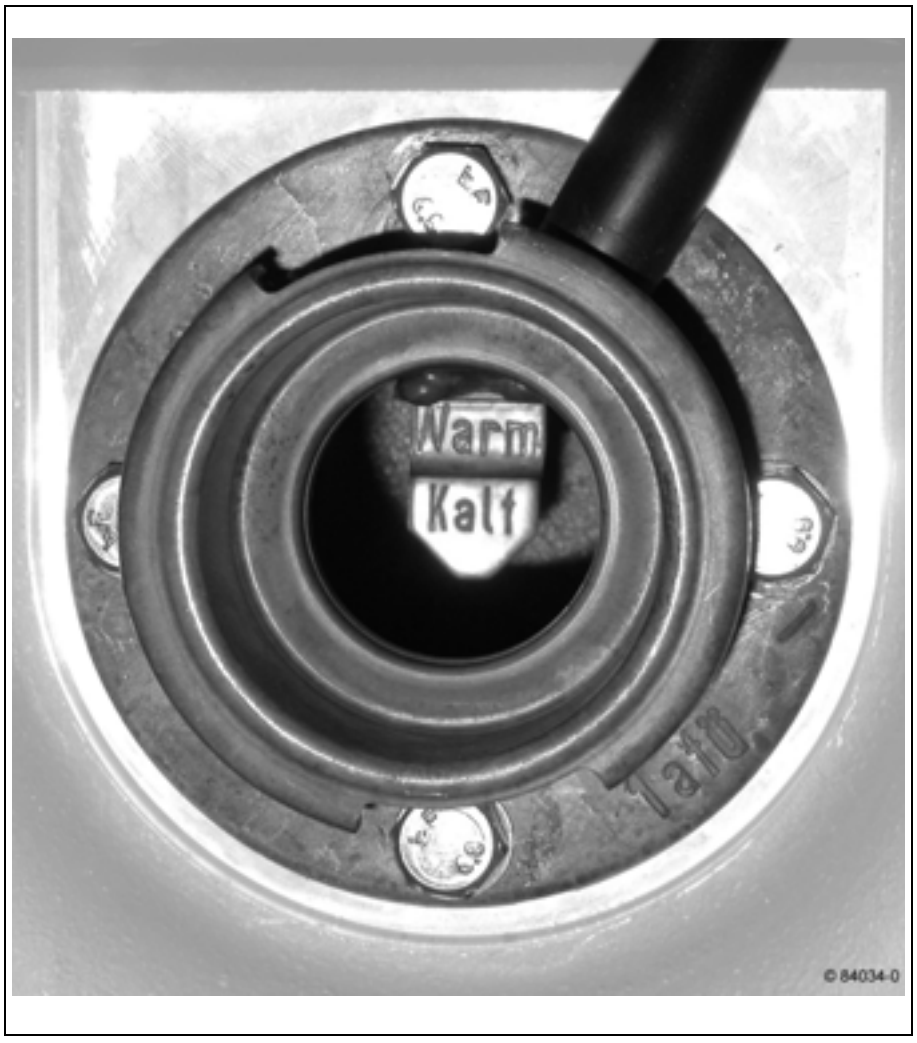

Figure 10 Coolant level in the compensation tank/cooler (example).

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Checking corrosion protection agent or antifreeze in coolant

Tools

- Test case order no. 12158292

Cross references

- Chapter 4, Expendables

Corrosion protection agent is added to the coolant to protect the coolant areas from corrosion. However, this protection is only given when a certain minimum content of corrosion protection agent is not exceeded. If there is more corrosion protection agent than necessary in the coolant, the cooling effect is reduced.

If an antifreeze is added to the coolant, this should also have corrosion protection properties. A corrosion protection agent does not need to be added in this case. The antifreeze percentage must be dosed accordingly for the above mentioned reasons.

If the cooling system needs refilling, the percentage of antifreeze or corrosion protection agent in the coolant must be measured. Then the coolant should be corrected according to the following description.

Check the corrosion protection agent and antifreeze percentage

- Remove the coolant sample from the cooler, compensation tank or draining tap.
- Check the percentage additive with the measuring instrument.
- Setpoint according to Chapter 4, Expendables.

Percentage additive too low:

Correct the corrosion protection agent and antifreeze percentage

$$\text{quantity of additiv required additionally} = \frac{\text{total filling quantity} \times (\text{nominal value - measured value})}{100}$$

To refill, drain coolant, mix well with the amount of additive to be refilled and then pour in the mixture again.

Percentage additive too high:

Drain the amount of coolant and fill up with pure water (quality according to Chapter 4, Expendables).

$$\text{coolant to be drained} = \left(1 - \frac{\text{nominal value}}{\text{measured value}}\right) \times \text{total filling quantity}$$

- Bleed the cooling system.

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Renewing coolant

Tools
- Normal tools

Auxiliary material
- Collecting vessel for cooling fluid

Spares
- Seals

References
- Chapter 4, Expendables
- B 9-0-4, Emptying and filling the cooling system
- B 9-1-1, Checking corrosion protection agent or antifreeze in coolant

The coolant must be renewed according to the maintenance schedule depending on the cooling medium. You will find a detailed description of the various cooling media in Chapter 4, Expendables.

The new coolant must be prepared before pouring it in, see Chapter 4, Expendables and job card B 9-1-1, Checking corrosion protection agent or antifreeze in coolant.

For emptying and filling the cooling system, see job card B 9-0-4, Emptying and filling the cooling system.

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Check coolant pump

Check

- The coolant pump must be repaired or renewed when coolant leaks from the inspection hole (arrow).

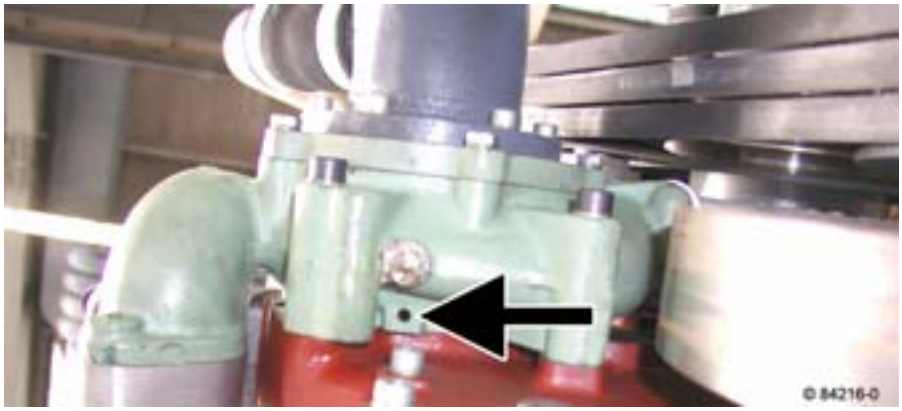

Figure 1 Inspection hole

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Checking the coolant pump, 2nd cooling circuit

Check

- The coolant pump must be renewed when:
  - shaft 8 of the coolant pump has a tangible bearing clearance or
  - coolant leaks from the inspection hole 9.

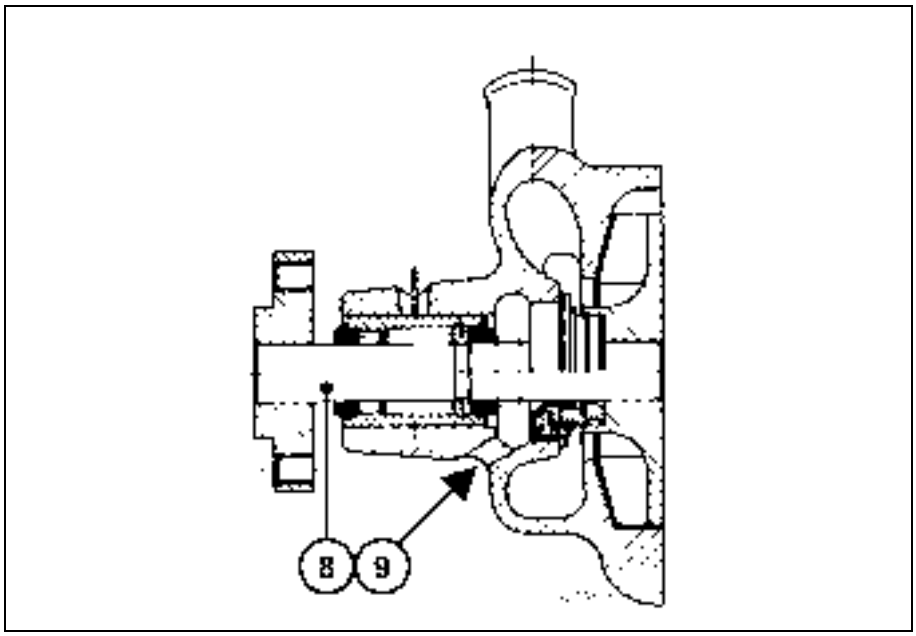

Figure 1 Inspection hole

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Draining water from and filling the air bottle (starter air tank)

Tools
- Standard tools

- Open the drain valve 1 slowly until water emerges. If no water emerges, close the drain valve again.

Do not open the drain cock too far because water is displaced if the flow speed is too great and only air escapes. A riser 2 is installed on vertically erected air bottles. The air pressure in the air bottle presses the water through out through the riser into the open.

If no water emerges for several maintenance periods, have the air bottle checked.

- Fill up the air bottle to 30 bar every time before switching off the engine.

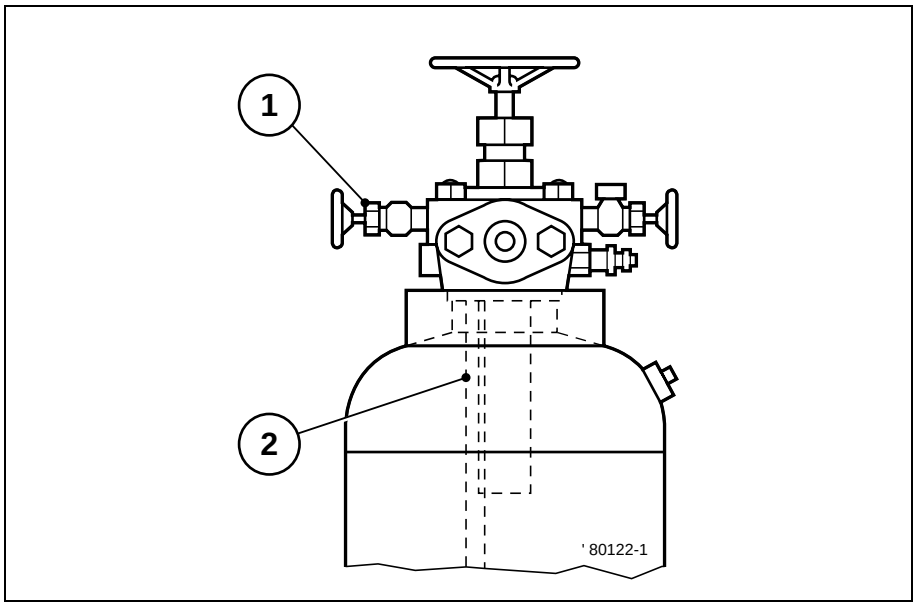

Figure 1 Starter air bottle

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Checking engine shutdown

Carry out this work only when the engine has been shut down.

To avoid damage in the lubricating or cooling system in the event of malfunctions for example, the engine is monitored by a control system. The solenoid valve interrupts the fuel flow to the injection pump as soon as it is triggered. Check the solenoid valve.

Check the solenoid valve

- Switch off the engine.
- Press the emergency stop switch.
- The solenoid valve 1 must be released when the emergency stop switch is pressed. A clicking must be audible.
- If the solenoid valve 1 has not released, the cause must be found and eliminated.

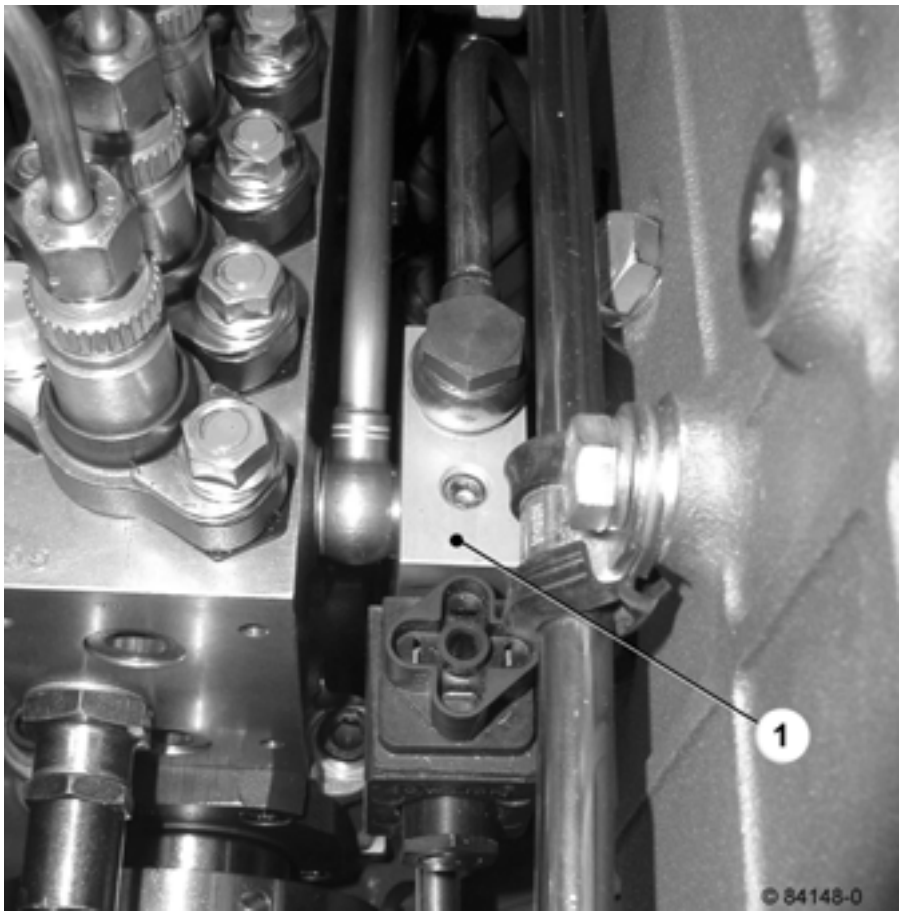

Figure 1 Solenoid valve

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Regulations for working on the electronic engine control EMR2

Observe these regulations when working with the electronic engine control DEUTZ EMR2:

- The power supply must be switched off when working on the EMR2.
- It is not permitted to pull out the 25-pin control device plug when the control device is switched on, i.e. when the power supply is on.
- Reverse polarity must be avoided despite reverse polarity protection in the control devices. The control devices may be damaged by reverse polarity.
- Sensors and actuators may not be connected to or between external power sources neither for inspection or test purposes alone but only in connection with the EMR2 otherwise there is a danger of damage or destruction!
- The connections of the control devices are only dustproof and waterproof when the mating plug is plugged in. The control devices must be protected against splash water until the mating plug is plugged in.

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Reading out the fault memory 1 of the EMR2

In the EMR2 it is possible to read out the existing faults with the diagnosis key and the fault lamp as flashing codes and to delete the fault memory 1.

Reading out the fault memory 1

The fault lamp signals an error, i.e. it flashes or lights steadily.

Press the diagnosis key for the time period from 1 s to 3 s.

The EMR2 detects the read request and starts to display the fault (see Flashing code overview).

It is only possible to read out the fault flashing code after the fault lamp goes out or after the initialization phase of the operating program. This means that the fault lamp may also light steadily after switching on if a fault has already been detected after initialization.

The EMR2 only outputs **active** faults as flashing codes.

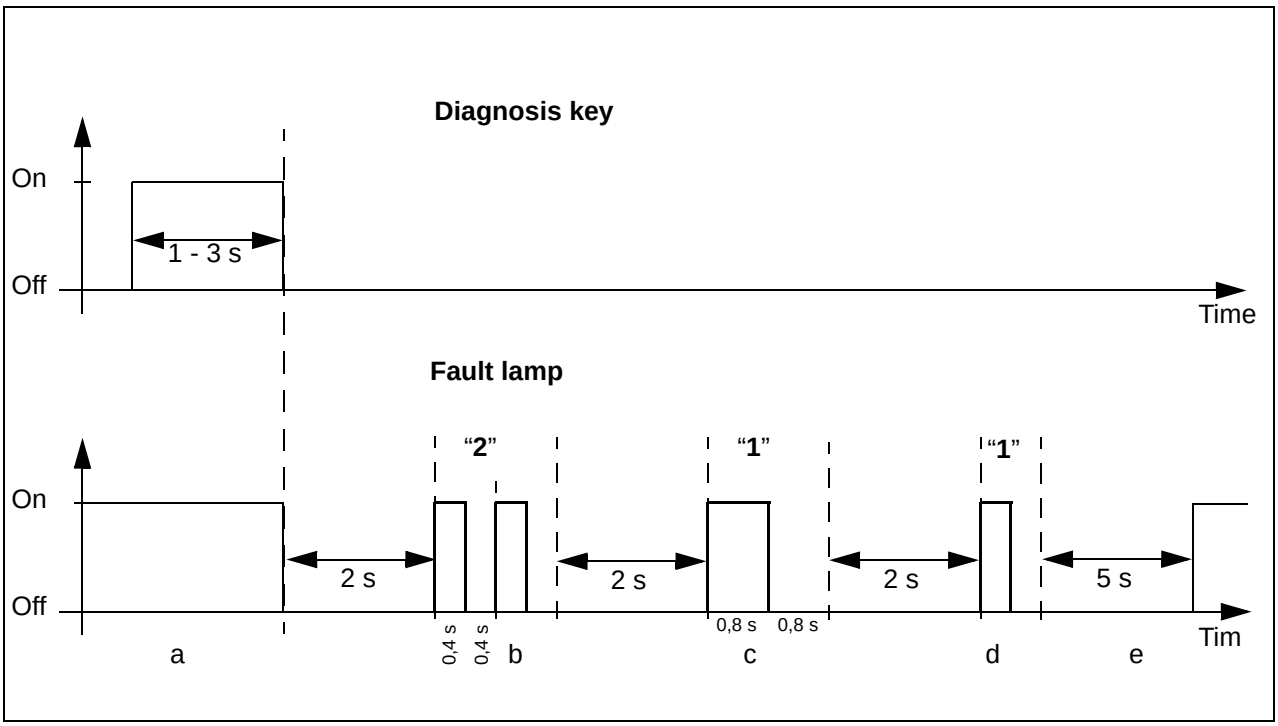

Figure 1 Read out fault flashing codes

Below the steps for reading out the first fault flashing code:

a The fault lamp signals an error, i.e. it flashes or lights steadily.
- Press diagnosis key 1 to 3 s:
  Flashing light or steady light of the fault lamp goes out.

b After 2 s:
Detection of the EMR2 (2x short flash)
- Output of the flashing sequence of the first saved fault
  (Example: fault number 01, "speed sensor 1"):
  c After 2 s: 1x long
  d After 2 s: 1x short
- After fault code output:
  e 5 s pause, then display of flashing or steady light.

Steps for reading out the next fault code:

a The fault lamp signals an error, i.e. it flashes or lights steadily.
- Press diagnosis key 1 to 3 s:
  Flashing light or steady light of the fault lamp goes out

b After 2 s:
Detection of the EMR2 (2x short flash)
- The next flashing code is output (**c**, **d**)
- After fault code output
  e 5 s pause, then display of flashing or steady light.

The steps can be repeated until the last saved fault code is output. Then the first fault is output again.

Delete fault memory 1

The EMR2 has two fault memories (1 and 2). Every fault is saved in both memories at once. Using the diagnosis key it is possible to delete **passive** faults in the fault memory 1. The fault memory 2 can only be deleted with SERDIA.

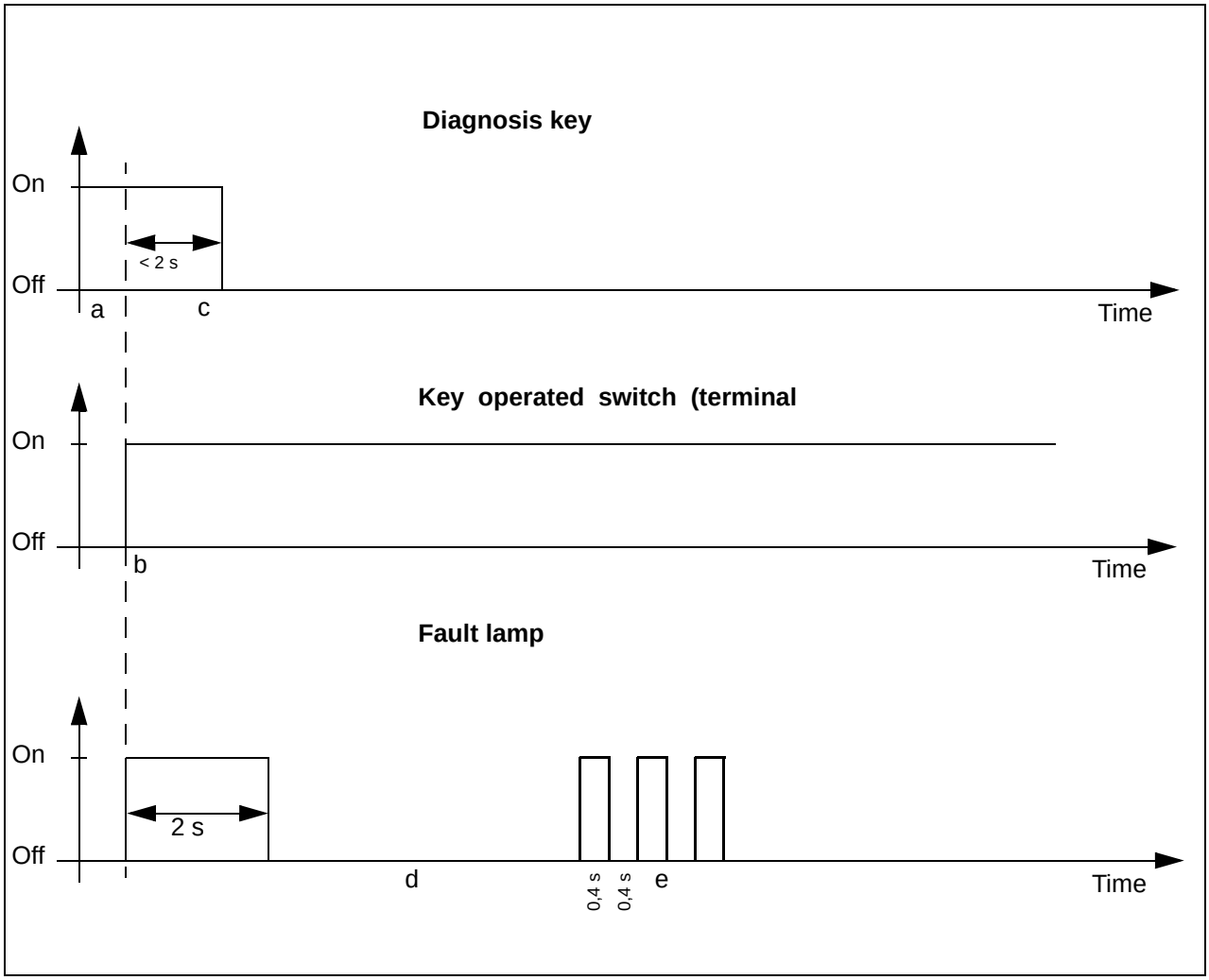

Figure 2 Delete fault memory 1

Below the steps for deleting the fault memory 1:

a Press and hold diagnosis key.
b Switch on the ignition.
c Release the diagnosis key while the fault lamp is alight (duration 2 s).
d All **passive** faults are deleted in the fault memory 1.
e The deletion process is confirmed by three short flashing pulses.

Flashing code overview

Fault group	Fault no. (in SERDIA)	Fault location / Fault description	Flashing code short 0.4 s	Flashing code long 0.8 s	Flashing code short 0.4 s	Cause	Remark	Remedy
Zero fault display	-	No fault	**2**	**-**	**-**	No active faults exist		
Revs/ speed measurement	01	Speed sensor 1	**2**	**1**	**1**	Sensor failed. Too far from gear wheel. Additional fault pulses. Cable connection interrupted.	Controller in emergency mode (if sensor 2 available). Emergency cut-off (if sensor 2 is not available or failed).	Check distance. Check cable connection. Check and replace sensor if necessary.
	02	Speed sensor 2	**2**	**1**	**2**		Controller in emergency mode (with sensor 1). Emergency cut-off (if sensor 1 is not available or failed).	
	03	Speed sensor	**2**	**1**	**3**	Tachometer failed. Additional fault pulses. Cable connection interrupted.	Controller in emergency mode. (see system description EMR2, chapter 4.15).	Check cable connection and tachometer, replace if necessary.
	04	Overspeed Shutdown	**2**	**1**	**4**	Speed was/is above the (over)speed limit	Engine stop. (see system description EMR2, chapter 4.3.3)	Check parameter (21). Check speed setting.
						Check PID setting. Check linkage. Check actuator, change if necessary. Check cable to the actuator. Check speed sensor (pulses for wrong speed). Check number of teeth. Check vehicles for possible linear drive.		
Sensors	05	Setpoint potentiometer 1 (accelerator)	**2**	**2**	**1**	Fault at the corresponding sensor input (e.g. short-circuit or cable break)	See system description EMR2, Chapter 4.15 Influencing fault reaction. The corresponding monitoring function is deactivated when the sensor fails	Check sensor cable. Check sensor and replace if necessary. Check fault limits for sensor.
	06	Setpoint potentiometer 2 (hand throttle)	**2**	**2**	**2**			
	07	Charge air pressure	**2**	**2**	**3**			
	08	Oil pressure	**2**	**2**	**4**			
	09	Coolant temperature	**2**	**2**	**5**			
	10	Charge air temperature	**2**	**2**	**6**			
	11	Fuel temperature	**2**	**2**	**7**			

Fault group	Fault no. (in SERDIA)	Fault location / Fault description	Flashing code short 0.4 s	Flashing code long 0.8 s	Flashing code short 0.4 s	Cause	Remark	Remedy
Functional faults Warning	30	Oil pressure warning	2	3	1	Oil pressure below speed-dependent warning characteristic.	Fault message (disappears when oil pressure falls back below the recovery limit). At the end of a delay time filling limit.	Check engine (oil level, oil pump). Check oil pressure sensor and cable. Check oil pressure warning characteristic.
	31	Coolant temperature warning	2	3	2	Coolant temperature has exceeded the warning limit.	Fault message (disappears when coolant temperature falls back below the recovery limit). At the end of a delay time filling limit.	Check coolant. Check coolant temperature sensor and cable.
	32	Charge air temperature warning	2	3	3	Charge air temperature has exceeded the warning limit	Fault message (disappears when charge air temperature falls back below the recovery limit). At the end of a delay time filling limit.	Check charge air. Check charge air temperature sensor and cable.
	34	Coolant level warning	2	3	5	Switching input "Coolant level too low" is active	Fault message.	Check coolant level. Check coolant level sensor and cable.
	35	Speed warning (in linear operation)	2	3	6	Speed was/is above the (over)speed limit "Linear operation" function is active.	See system description of EMR2, chapter 4.3.3 Overspeed protection	Check parameter (21). Check speed setting.
						Check PID setting. Check linkage. Check actuator, change if necessary. Check cable to the actuator. Check speed sensor (pulses for wrong speed). Check number of teeth. Check vehicles for possible linear drive.		
	36	Fuel temperature warning	2	3	7	Fuel temperature has exceeded the warning limit.	Fault message (disappears when fuel temperature falls back below the recovery limit).	Check fuel. Check fuel temperature sensor and cable.
Functional faults Shutdown	40	Oil pressure shut-off	2	3	1	Oil pressure below shut-off limit.	Emergency shut-off.	Check engine (oil level, oil pump). Check oil pressure sensor and cable. Check oil pressure shut-off limit.
	41	Coolant temperature shut-off	2	3	2	Coolant temperature has dropped below the shut-off limit.		Check coolant. Check coolant temperature sensor and cable. Check the shut-off limit.
	42	Charge air temperature shut-off	2	3	3	Charge air temperature has exceeded the shut-off limit.		Check charge air. Check charge air temperature sensor and cable. Check the shut-off limit.
	44	Coolant level shut-off	2	3	5	Switching input "Coolant level too low" is active.	Emergency shut-off. Start lock.	Check coolant level. Check coolant level sensor and cable.

Fault group	Fault no. (in SERDIA)	Fault location / Fault description	Flashing code			Cause	Remark	Remedy
			short 0.4 s	long 0.8 s	short 0.4 s			
Actuator	50	Feedback	2	5	1	Actuator not connected. Fault in actuator feedback.	Emergency shut-off. Controller cannot be started.	Check actuator, replace if necessary, check cable. Check fault limits for "feedback".
	52	Reference feedback						Check actuator, replace if necessary, check cable. Check fault limits for "reference feedback".
	53	Control path difference				Injection pump / actuator stuck or not connected. Difference between nominal/actual control path > 10 % of total control path.	Fault message (disappears when difference is < 10 %).	Check actuator/ actuator linkage/ injection pump, replace if necessary, check actuator cable.
	59	Autocalibration BOSCH EDC pumps failed	2	5	2	No automatic actuator calibration possible. Input error in actuator reference values.	Engine stop / start block. Controller cannot be started. EDC actuator calibration necessary (see system description EMR2, chapter 8.4).	Check actuator, replace if necessary, check feedback cable. Check power supply/cable. Check fault limits and reference values of the feedback. Program fault limits for feedback, save values, switch ignition off and back on. Check again. Inform DEUTZ Service in the case of a fault and repeat automatic calibration. Reset fault limits.
Hardware inputs/ outputs	60	Digital output 3 (shut-off magnet, pin M 2)	2	6	1	Fault (short-circuit / cable break) at the digital output.	Driver stage switched off.	Check the cable of the digital output (cable break or short-circuit).
	62	Digital output 6, pin M 7	2	6	2		Fault message.	
	63	Overcurrent shut-off magnet	2	6	1			
	67	Error Hand Setp1	2	6	2			
	68	Error CAN Setp1						

Fault group	Fault no. (in SERDIA)	Fault location / Fault description	Flashing code short 0.4 s	Flashing code long 0.8 s	Flashing code short 0.4 s	Cause	Remark	Remedy
Communication	70	CAN-bus controller	2	7	1	CAN controller for CAN bus supplies fault. Fault cannot be eliminated permanently despite re-initialization.	Application-dependent	Check CAN connection, check terminating resistor (see system description EMR2, chap. 12.4), check control device.
	71	CAN interface SAE J1939				Overflow in input buffer or a transmission cannot be placed on the bus.		
	74	Cable break, short-circuit or serious bus fault.						Check CAN connection, cable connection. Check and replace sensor if necessary.
Memory	76	Parameter programming (write EEPROM)	2	8	1	Error in parameter programming to the controller memory.	Emergency shut-off. Engine cannot be started.	Switch ignition off and back on. Check again. Inform DEUTZ Service in case of error.
	77	Cyclic program test				Continuous monitoring of the program memory reveals an error (so-called "flash test").		
	78	Cyclic RAM test				Continuous monitoring of the RAM reveals an error.		Note the values of the parameters (3895 and 3896). Switch ignition off and back on. Check again. Inform DEUTZ Service in case of error.
Hardware control device	80	Power supply (actuator)	2	9	1	Power supply for controller not in permissible range.	Fault message (disappears when current is back in normal range).	Switch ignition off and back on. Check again. Inform DEUTZ Service in case of error.
	83	Reference voltage 1	2	8	2	Reference voltage for controller not in permissible range.	Fault message (disappears when voltage is back in normal range). Substitute value 5 V	Check power supply. Switch ignition off and back on. Check again. Inform DEUTZ Service in case of error.
	84	Reference voltage 2						
	85	Reference voltage 4						
	86	Internal temperature	2	9	2	Internal temperature for control device not in the permissible range.	Fault message (disappears when temperature is back in normal range).	Switch ignition off and back on. Check again. Inform DEUTZ Service in case of error.
	87	Atmospheric pressure				Atmospheric pressure is not in the permissible range.	Fault message (disappears when pressure is back in normal range). Atmospheric pressure monitoring function deactivated.	

Fault group	Fault no. (in SERDIA)	Fault location / Fault description	Flashing code			Cause	Remark	Remedy
			short 0.4 s	long 0.8 s	short 0.4 s			
Program logic	90	Parameter error (read EEPROM or checksum faulty)	2	10	1	No data found or checksum of the data incorrect. (Note: error only occurs in parameter setting/saving or reset).	Engine cannot be started.	Check data for correct setting. Save parameter, switch ignition off and back on. Check again. Inform DEUTZ Service in case of error.
	93	Stack overflow				Internal computing error (so-called "Stack Overflow" error).	Emergency shut-off. Engine cannot be started.	Note the values of the parameters (3897 and 3898). Switch ignition off and back on. Check again. Inform DEUTZ Service in case of error.
	94	Internal error						

Checking, renewing V-belts

Tools

- Normal tools
- V-belt tension measuring instrument

Arbeiten nur bei abgestelltem Motor durchführen.

The V-belts on the **free side** serve to drive the dynamos and the fan depending on the structure of the drive.

Check the V-belt and V-belt pulley

- Remove V-belt guard (if available)
- Check the whole length of the V-belts for damage.

  Criteria for assessment:

  - Tears on the toothed inside
  - Teeth missing
  - Wear on the belt edges
  - Oily
  - Porous
- Renew the V-belt if one or more of these criteria apply. All V-belts must be renewed in the case of parallel running V-belts.
- Check V-belt pulley for wear. Worn V-belt pulleys must be renewed.

V-belt tension values

The V-belt tension values (pre-tension forces) are determined according to the specifications of the V-belt manufacturer OPTBELT.

The V-belt tension value may on no account be above the maximum permissible value. Too high a V-belt value exerts an extreme load on the crank drive which can lead to serious damage up to as far as a broken crankshaft.

Fan drive

Fan drive TBD 616 V12	
V-belt profile: XPB, edge open, inside toothing	
Number of V-belts	3
Fan diameter	1133 mm
Number of blades	16
Max. engine speed	1500 rpm^{-1}
V-belt tension value of the single V-belt	
- in initial installation (new V-belt)	≈ 390 N
- in worn state 1)	≈ 300 N
Max. engine speed	1800 rpm^{-1}
V-belt tension value of the single V-belt	
- in initial installation (new V-belt)	≈ 570 N
- in worn state 1)	≈ 440 N

1) The run-in state is not reached until after a few operating hours.

Fan drive TBD 616 V16	
V-belt profile: XPB, edge open, inside toothing	
Number of V-belts	4
Fan diameter	1524 mm
Number of blades	8
Max. engine speed	1500 rpm^{-1}
V-belt tension value of the single V-belt	
- in initial installation (new V-belt)	≈ 320 N
- in worn state 1)	≈ 245 N
Max. engine speed	1800 rpm^{-1}
V-belt tension value of the single V-belt	
- in initial installation (new V-belt)	≈ 450 N
- in worn state 1)	≈ 350 N

1) The run-in state is not reached until after a few operating hours.

Dynamo drive

A three-phase current generator with 28 V / 55 A	
V-belt profile: XPZ, edge open, inside toothing	
Number of V-belts	1
Max. engine speed	2100 rpm^{-1}
V-belt tension value	
- in initial installation (new V-belt)	≈ 195 N
- in worn state 1)	≈ 150 N

1) The run-in state is not reached until after a few operating hours.

A three-phase current generator with 28 V / 140 A	
V-belt profile: XPA, edge open, inside toothing	
Number of V-belts	2
Max. engine speed	2100 rpm^{-1}
V-belt tension value	
- in initial installation (new V-belt)	≈ 240 N
- in worn state 1)	≈ 185 N

1) The run-in state is not reached until after a few operating hours.

Use of the V-belt tension measuring instrument

- Press display arm A completely into the scale face.
- Measuring point:
  - Choose the longest V-belt distance between two V-belt pulleys.
    - Measure the tension of both V-belts and calculate the average in the case of two parallel V-belts.
    - Measure the tension of the middle V-belt on three parallel running V-belts
    - Measure the tension of the two middle V-belts of four parallel running belts and calculate the average.
- Place the V-belt tension measuring instrument B loosely on the V-belt D to be measured.
- Press slowly on the pressing surface with one finger in loop C until a clicking is clearly audible or tangible. Then relieve the pressure immediately. The display arm comes to rest in the measured position.

Avoid touching the V-belt tension measuring instrument with more than one finger during the measuring process.

- Lift the V-belt tension measuring instrument carefully without moving the display arm.
- Read the belt tension at the point of intersection of the top edge of the display arm with the scale face.

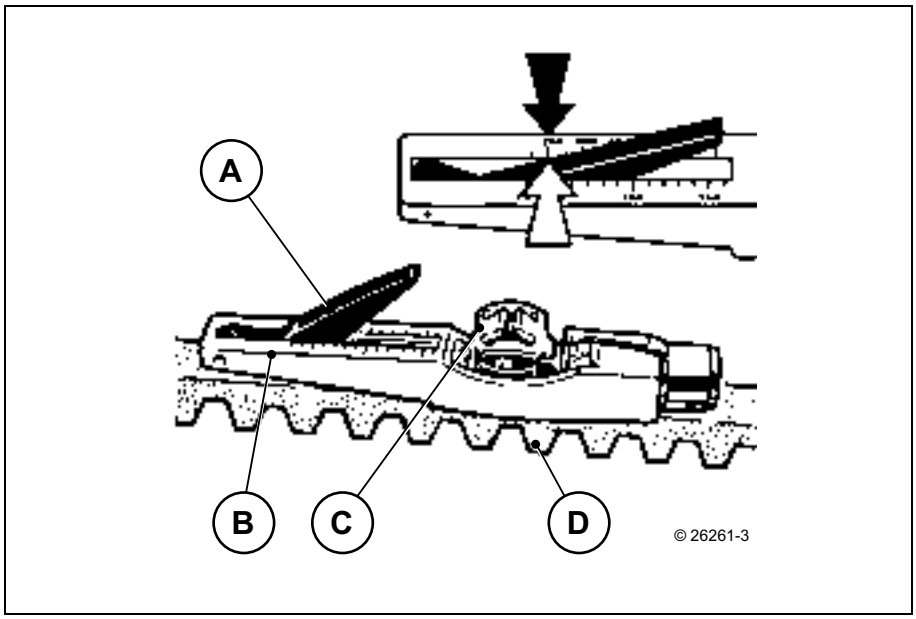

Figure 1 V-belt tension measuring instrument

Renew the V-belt of the dynamo

- Remove V-belt guard (if installed)
- Loosen lock nut 1 and unscrew nut 2 of the V-belt tensioning device until it is possible to remove the V-belt.

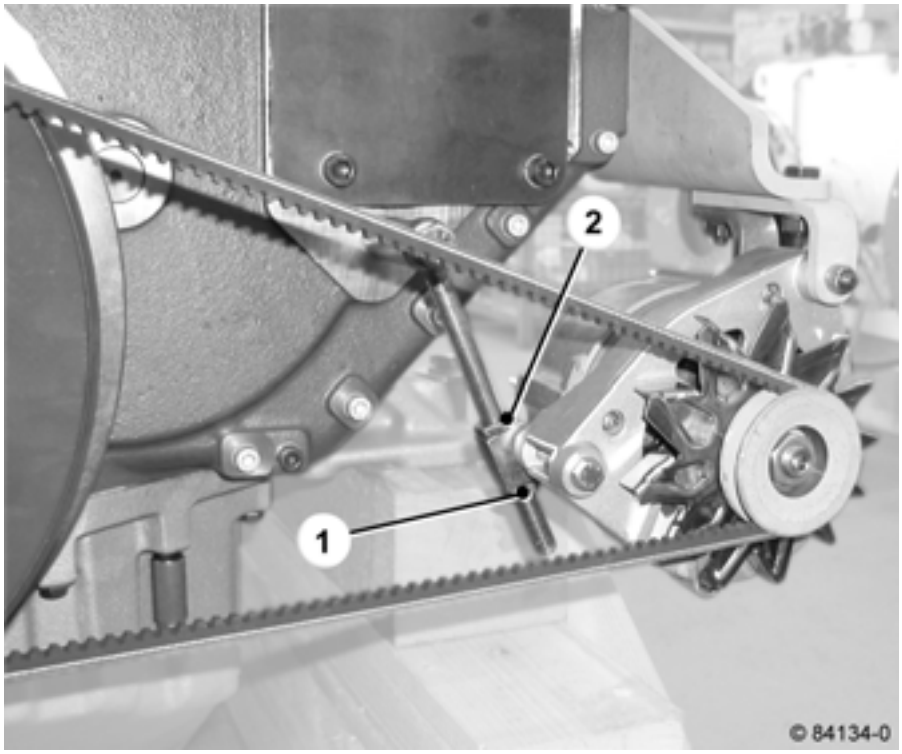

Figure 2 V-belt tension measuring instrument

- Fit the V-belt and turn the nut 2 of the V-belt tensioning device until the V-belt has the appropriate tension.

- Check the V-belt tension with the V-belt tension measuring instrument.

Figure 3 V-belt tension measuring instrument

- Tighten lock nut 1.
- After a trial run, check the V-belt tension again and correct it if necessary.

Renew the V-belt of the fan drive (V12 engine)

- Remove the V-belt of the three-phase current generator, see above.
- Remove the fastening screws of the fan 3 and remove the fan.

Place the fan on a soft base. The fan may never be placed on its blades.

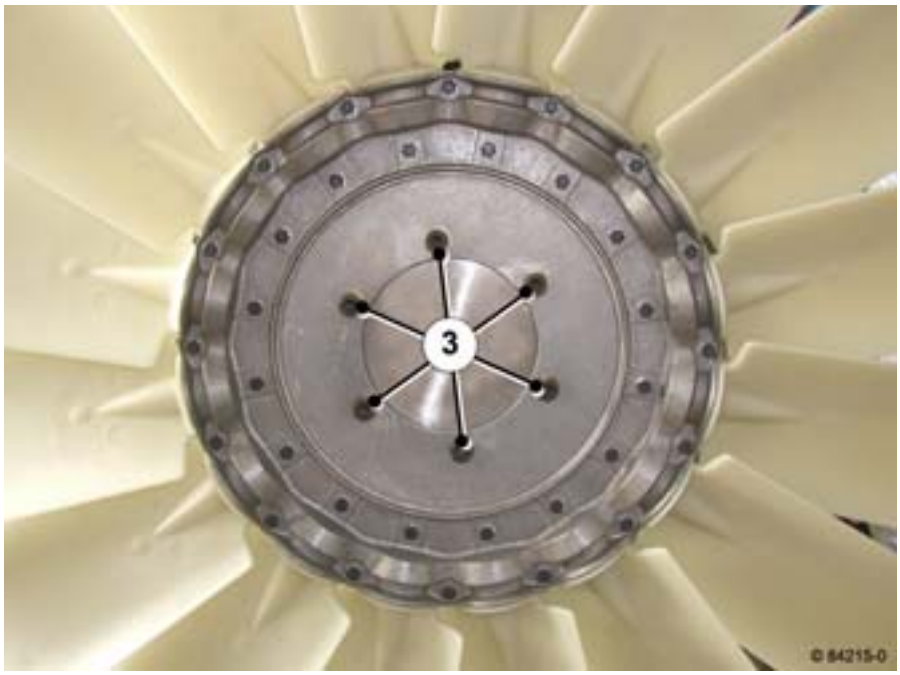

Figure 4 Fan

- Loosen the fastening screw 4 of the tension arm and press the tension arm inwards.

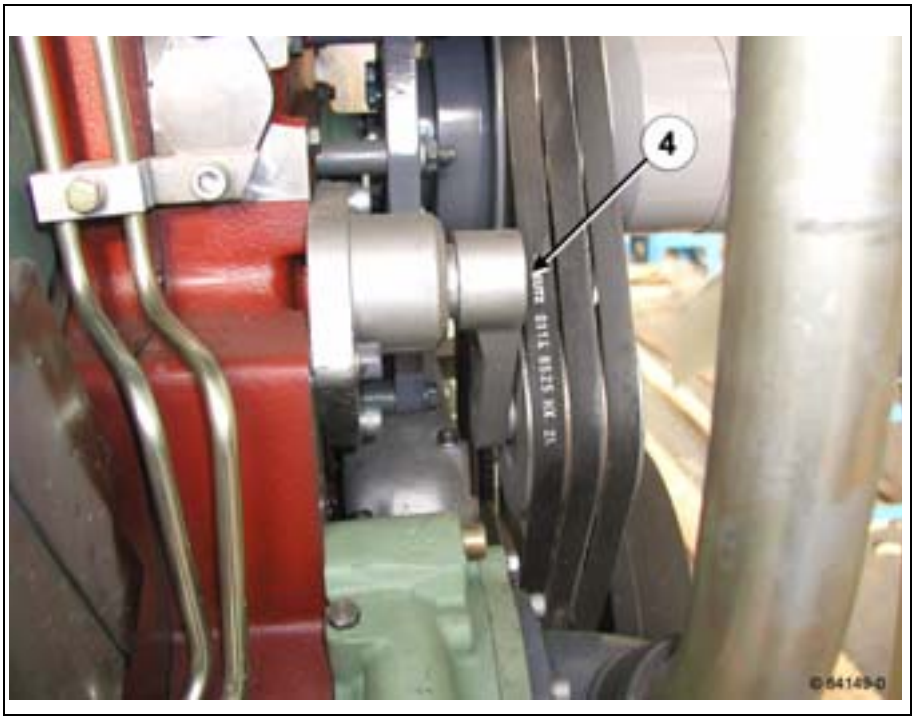

Figure 5 V-belt tension arm

- Remove the V-belts.
- Fit new V-belts.

All V-belts must always be renewed. Exchanging individual V-belts is not permitted.

- Press the tension arm until the right V-belt tension is reached and tighten fastening screw 4 with 110 + 10 Nm. Check the V-belt tension with the V-belt tension measuring instrument.

Figure 6 V-belt tension measuring instrument

- Install the fan and tighten the fastening screws 3 diagonally 45 Nm.

Tighten carefully because the fan flange is made of aluminum. Make sure that the fan is level on the fan flange.

- Install the V-belt of the three-phase current generator, see above.
- After a trial run, check the V-belt tension again and correct it if necessary.

Renew the V-belt of the fan drive (V16 engine)

- Remove the V-belt of the three-phase current generator, see above.
- Remove the fastening screws of the fan 3 and remove the fan.

Place the fan on a soft base. The fan may never be placed on its blades.

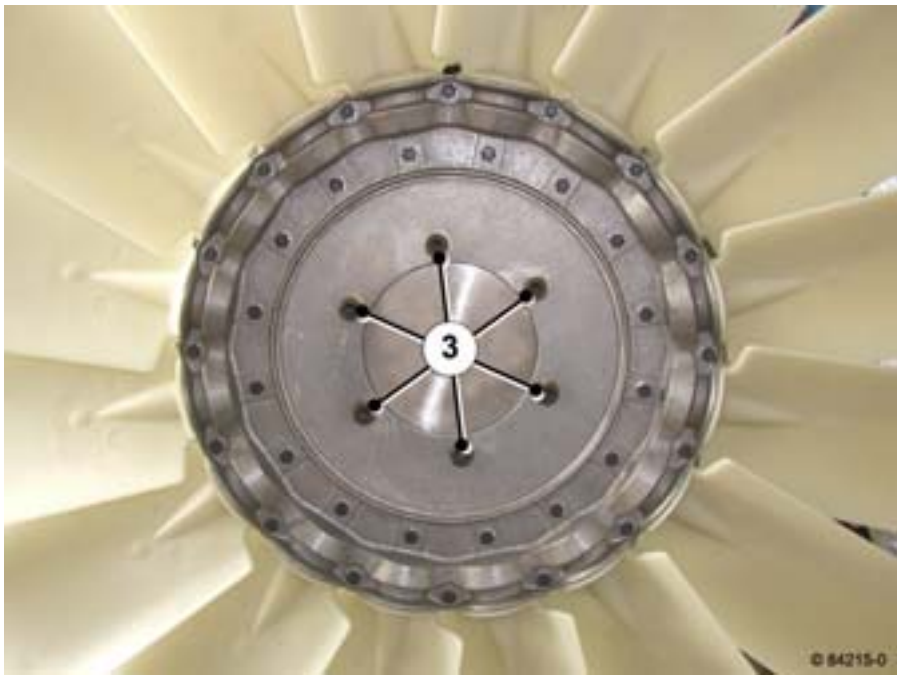

Figure 7 Fan

- Loosen the fastening screws 10 of the V-belt clamping device.

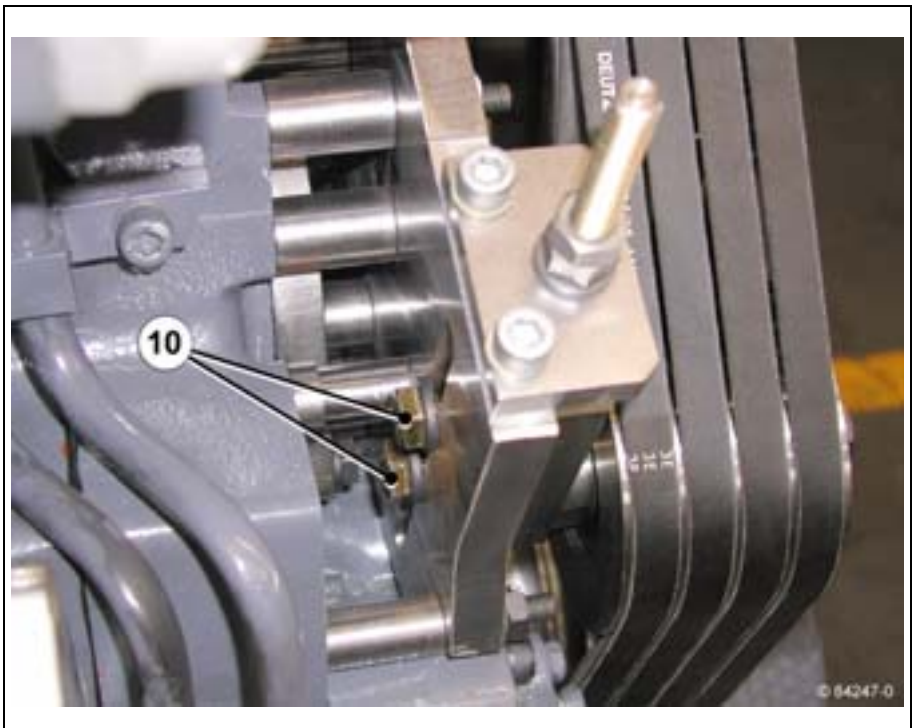

Figure 8 V-belt clamping device

- Loosen the lock nut 11 and turn up. Press spindle down until the V-belts can be removed.

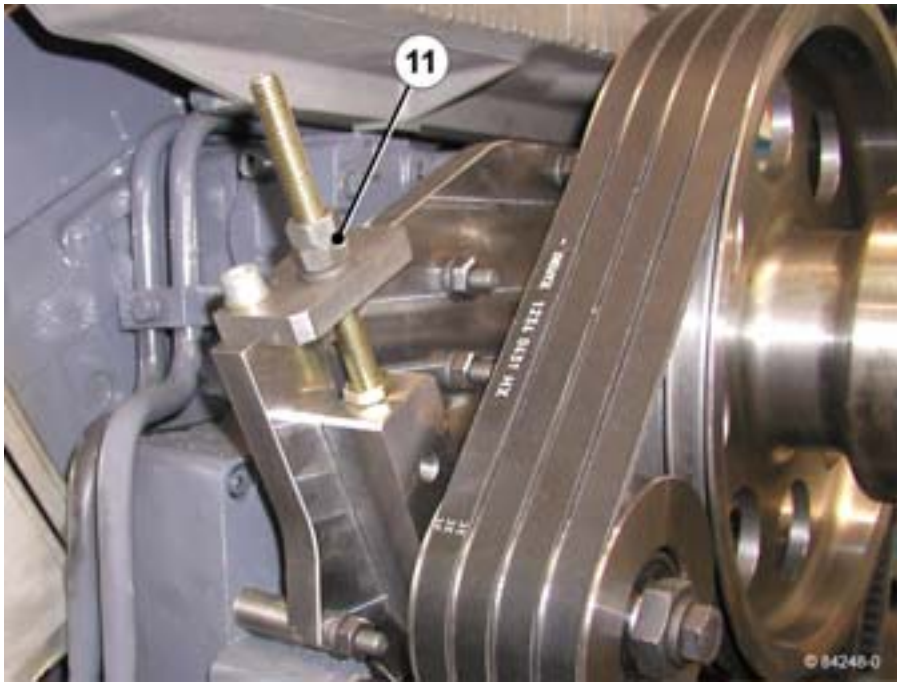

Figure 9 Lock nut on the spindle of the V-belt clamping device

- Remove the V-belt.
- Fit new V-belts.

All V-belts must always be renewed. Exchanging individual V-belts is not permitted.

- Pull spindle up and tighten lock nut. Pull the spindle up with the lock nut until the desired V-belt tension is reached. Check the V-belt tension with the V-belt tension measuring instrument.

Figure 10 V-belt tension measuring instrument

- Tighten the fastening screws 10 of the V-belt clamping device.
- Counter lock nuts 11 and tighten.
- Install the fan and tighten the fastening screws 3 diagonally 45 Nm.

Tighten carefully because the fan flange is made of aluminum. Make sure that the fan is level on the fan flange.

- Install the V-belt of the three-phase current generator, see above.
- After a trial run, check the V-belt tension again and correct it if necessary.

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Maintaining the battery

Tools

- Standard tools
- Acid tester order no. 12157944

Equipment

- Distilled water
- Acid protection grease
- Cloths

Carry out this work only when the engine has been shut down.

The gases emitted by the battery are explosive.

- **Avoid sparks and open flames in the vicinity of the battery.**
- **Do not allow any acid to get on your skin or clothing.**
- **Wear protective goggles.**
- **Do not place any tools on the battery.**

Check battery and cable connectors

- Keep battery clean and dry.
- Undo dirty clamps.
- Clean terminal posts (+ and -) and clamps of battery, and grease with acid-free and acid-resistant grease.
- When reassembling, ensure that clamps make good contact. Tighten clamp bolts hand-tight.

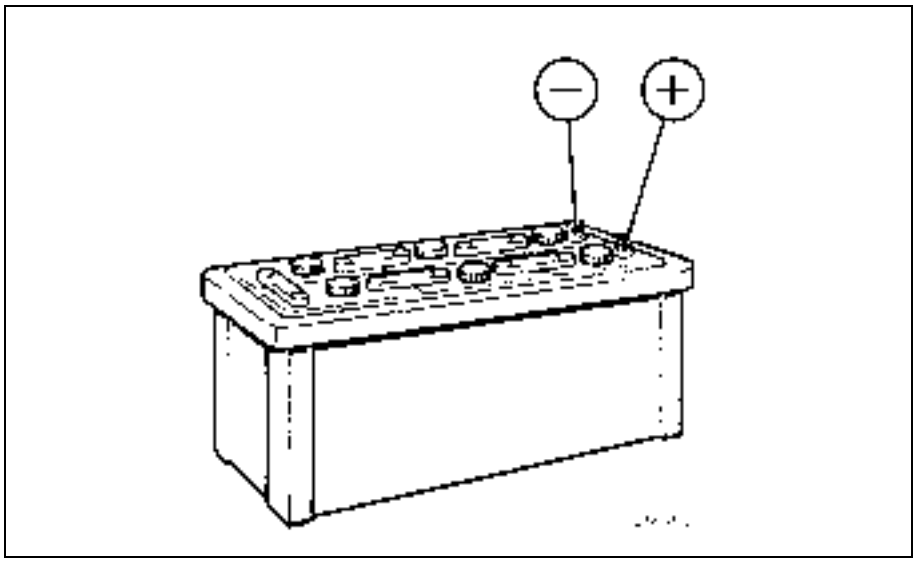

Figure 1 Battery poles

Check acid level

- Remove sealing caps 1.
- If testers 2 are present:
  Electrolyte level should reach the base of these.
- Without testers:
  Electrolyte level should reach 10 - 15 mm above top edge of plate.
- If necessary, top up with distilled water.
- Screw sealing caps back in.

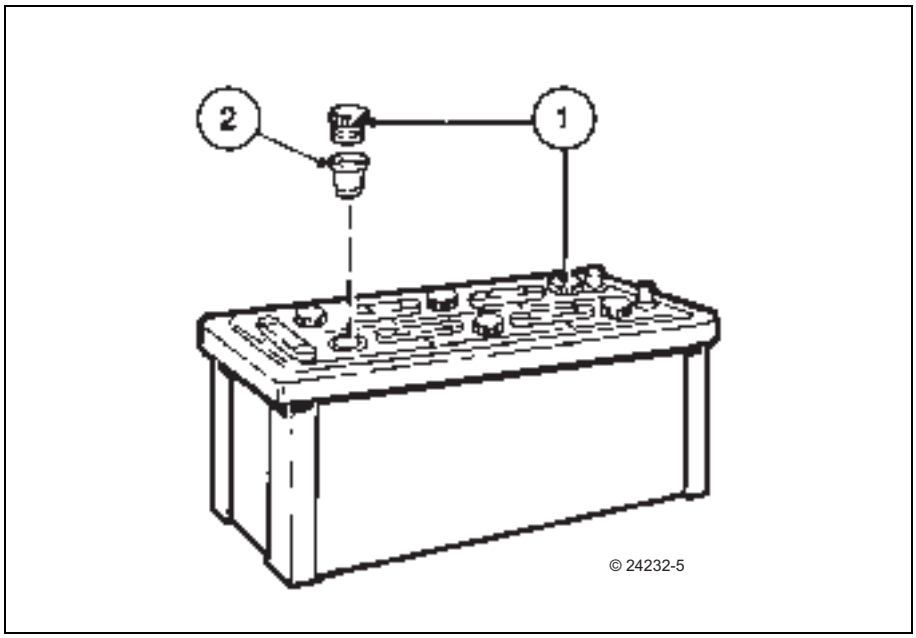

Figure 2 Battery sealing caps

Check acid density

- Measure the electrolyte density of individual cells with a commercial hydrometer.

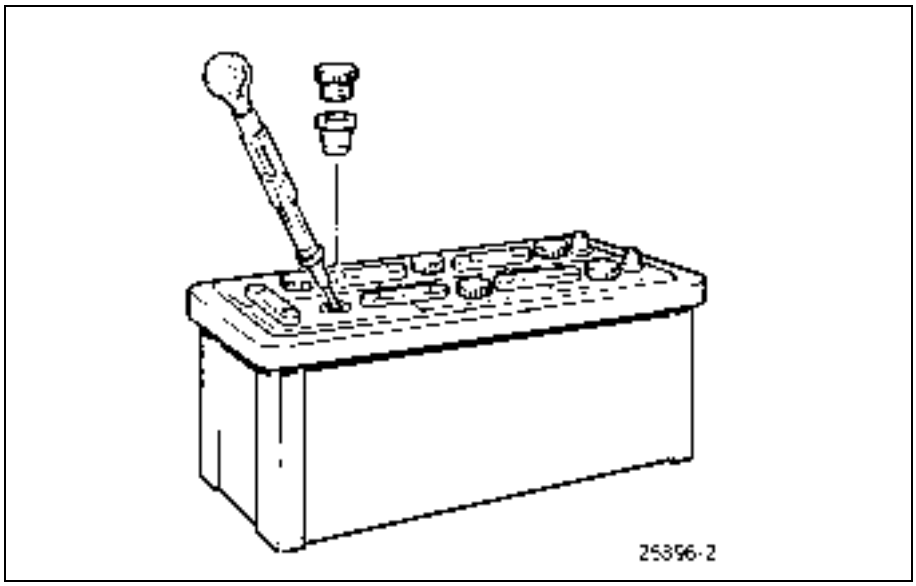

Figure 3 Check acid density

Hydrometer reading (see table below) indicates battery's state of charge.
During measurement, temperature of electrolyte should preferably be 20 °C.

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Acid density		
in [kg/l]		Charge status
Normal	Tropical	
1.28	1.23	well charged
1.20	1.12	semi-charged, re-charge
1.12	1.08	discharged, charge immediately

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10 Other instructions

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Service

We move your world

DEUTZ has always stood for excellence in engine construction, pioneering many developments in the industry. As an independent engine manufacturer we offer a full range of diesel and gas engines in the performance range from 4 to 7,400 kW. Our products are tailor-made to meet our customers' requirements.

More than 1.4 million DEUTZ engines are in service worldwide. We are determined to preserve the high standard of performance and dependability of our engines, thus keeping our customers satisfied at all times. For this reason we are represented worldwide through a network of highly competent service partners who will meet the needs of our customers, wherever they are.

This is why DEUTZ is not only the name for engines which pack a lot of inventiveness. DEUTZ also means reliable service and comprehensive support to enhance your engine's performance.

DEUTZ AG - at your service.

Sales & Service Index

This Sales & Service Index offers you an overview of the DEUTZ partners in your vicinity, including the products for which they are responsible and the range of services provided. But even when no direct product responsibility is mentioned, your DEUTZ partner will be happy to help you with expert advice. The Index is constantly updated. Please ask your DEUTZ service partner for the latest edition.

Order no.: 0312 0806 (Printed version)

Order no.: 0312 0807 (CD-ROM)

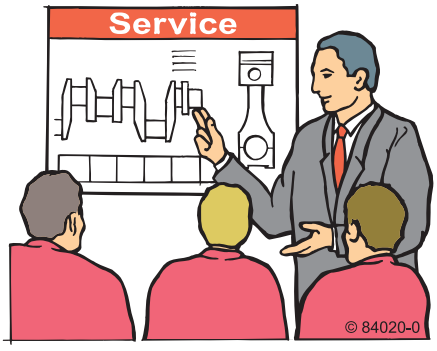
DEPIC

The **DE**utz **P**arts **I**dentification for **C**ustomers (DEPIC) offers you spare parts identification individually adapted to your systems. DEPIC enables you to generate an order list almost automatically and to make your spare parts procurement more efficient.

Order no.: on request (CD-ROM)

Seminar program

Degree of availability, reliability and service life of equipment and drive assemblies are determined to a great extent by professional operation and service by qualified and experienced operators and service technicians.



The DEUTZ AG offers service-related seminars for DEUTZ products to customers and operators staff for this.

Apart from the seminars which are held in our Training Centers in Cologne and Mannheim it is also possible to hold special seminars in the Training Centers or at another location requested by the customer by agreement.

Information about the seminar program will be distributed in a mailing.
Please ask your DEUTZ Service representative.