

Operating Instructions

Diesel engine

12 V 4000 M23F

12 V 4000 M23S

16 V 4000 M23F

16 V 4000 M23S

MS150068/01E



Power. Passion. Partnership.

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This handbook is provided for use by maintenance and operating personnel in order to avoid malfunctions or damage during operation.

Subject to alterations and amendments.

Commissioning Note

Table of Contents

1 Safety		3.8 Fuel treatment system – Putting into operation	81
1.1 Important provisions for all products	7	3.9 Fuel treatment system – Switching on	84
1.2 Personnel and organizational requirements	8	3.10 Fuel treatment system – Shutdown	85
1.3 Transport	9	3.11 Stopping the engine	86
1.4 Safety regulations for maintenance and repair work	10	3.12 Emergency engine stop	87
1.5 Fire prevention and environmental protection, fluids and lubricants, auxiliary materials	13	3.13 After stopping the engine	88
1.6 Standards for safety notices in the text	15	3.14 Plant – Cleaning	89
2 Product Summary		4 Maintenance	
2.1 Engine Layout	16	4.1 Maintenance task reference table [QL1]	90
2.1.1 Product description	16	5 Troubleshooting	
2.1.2 Engine layout	28	5.1 Troubleshooting	92
2.1.3 Overview of sensors and actuators	32	5.2 Fuel treatment system – Troubleshooting	95
2.2 Engine Side and Cylinder Designations	52	5.3 Engine governor ADEC (ECU 7) fault messages for Series 4000 engines, marine application	96
2.2.1 Engine side and cylinder designations	52	5.4 Engine governor ADEC (ECU 7) – Fault codes	97
2.3 Main Engine Dimensions	53	6 Task Description	
2.3.1 Engine – Main dimensions	53	6.1 Engine	162
2.4 Firing Sequence	55	6.1.1 Engine – Barring manually	162
2.4.1 Firing order	55	6.1.2 Engine – Barring with starting system	164
2.5 Technical Data	56	6.2 Cylinder Liner	165
2.5.1 12V 4000 M23F engine data, RheinSchUO, stage II, IMO Tier II	56	6.2.1 Cylinder liner – Endoscopic examination	165
2.5.2 12V 4000 M23S engine data, RheinSchUO, stage II, IMO Tier II	59	6.2.2 Instructions and comments on endoscopic and visual examination of cylinder liners	167
2.5.3 12V 4000 M23S engine data, IMO Tier II, EPA Tier 2	62	6.3 Crankcase Breather	169
2.5.4 16V 4000 M23F engine data, RheinSchUO, stage II, IMO Tier II	65	6.3.1 Crankcase breather – Overview	169
2.5.5 16V 4000 M23S engine data, RheinSchUO, stage II, IMO Tier II	68	6.3.2 Crankcase breather – Oil mist fine separator replacement	171
2.5.6 16V 4000 M23S engine data, IMO Tier II, EPA Tier 2	71	6.4 Valve Drive	172
3 Operation		6.4.1 Valve gear – Lubrication	172
3.1 Controls	74	6.4.2 Valve clearance – Check and adjustment	173
3.2 Putting the engine into operation after extended out-of-service periods (>3 months)	75	6.4.3 Cylinder head cover – Removal and installation	176
3.3 Putting the engine into operation after scheduled out-of-service-period	76	6.5 Injection Pump / HP Pump	177
3.4 Starting the engine	77	6.5.1 HP pump – Filling with engine oil	177
3.5 Operational checks	78	6.5.2 HP pump – Relief bore check	178
3.6 Tasks after extended out-of-service periods (>3 weeks)	79	6.6 Injection Valve / Injector	179
3.7 Checks prior to start-up	80	6.6.1 Injector – Replacement	179
		6.6.2 Injector – Removal and installation	180
		6.7 Fuel Filter	185
		6.7.1 Supplementary fuel filter – Overview	185
		6.7.2 Additional fuel filter – Replacement	186

6.7.3	Fuel filter – Replacement	187	6.15.11	Preheater – Function and leak-tightness check	248
6.7.4	Fuel system – Venting	189	6.16	Raw Water Pump with Connections	249
6.7.5	Fuel prefilter – Differential pressure check and adjustment of gauge	190	6.16.1	Raw water pump – Relief bore check	249
6.7.6	Fuel prefilter – Draining	191	6.17	Engine Mounting / Support	250
6.7.7	Fuel prefilter – Flushing	193	6.17.1	Engine mounting – Check	250
6.7.8	Fuel prefilter with water separator – Filter element replacement	195	6.18	Battery-Charging Generator	251
6.7.9	Fuel prefilter with water separator – O-ring replacement in rotary slide valve	197	6.18.1	Battery-charging generator drive – Coupling condition check	251
6.8	Exhaust Turbocharger	198	6.19	Auxiliary PTO	252
6.8.1	Overview of turbocharger	198	6.19.1	Bilge pump – Relief bore check	252
6.8.2	Compressor wheel – Cleaning	205	6.20	Fuel Supply System	253
6.9	Charge-Air Cooling	213	6.20.1	Water drain valve – Check	253
6.9.1	Intercooler – Checking condensate drain for water discharge and obstruction	213	6.20.2	Differential pressure gauge – Check	254
6.10	Air Filter	214	6.20.3	Water level probe (3-in-1 rod electrode) – Check	255
6.10.1	Air filter – Replacement	214	6.20.4	Pump capacity – Check	256
6.10.2	Air filter – Removal and installation	215	6.20.5	Coalescer filter element – Replacement	257
6.11	Air Intake	216	6.21	Wiring (General) for Engine/Gearbox/Unit	259
6.11.1	Service indicator – Signal ring position check (optional)	216	6.21.1	Engine wiring harness – Overview	259
6.12	Starting Equipment	217	6.21.2	Engine wiring – Check	265
6.12.1	Starter – Condition check	217	6.22	Accessories for (Electronic) Engine Governor / Control System	266
6.13	Lube Oil System, Lube Oil Circuit	218	6.22.1	CDC parameters – Reset	266
6.13.1	Engine oil – Level check	218	6.22.2	Limit switch for start interlock – Check	267
6.13.2	Engine oil – Change	219	6.22.3	Engine Control Unit ECU 7 – Checking plug connections	268
6.13.3	Engine oil – Sample extraction and analysis	221	6.22.4	Engine Monitoring Unit EMU 7 – Plug connection check	269
6.14	Oil Filtration / Cooling	223	6.22.5	Interface module EIM plug connections – Check	270
6.14.1	Engine oil filter – Replacement	223	6.22.6	Engine Control Unit ECU 7 – Removal and installation	271
6.14.2	Oil indicator filter – Cleaning and check	225	6.22.7	EMU 7 – Removal and installation	272
6.14.3	Centrifugal oil filter – Cleaning and filter sleeve replacement	227	6.22.8	Engine Interface Module EIM – Removal and installation	273
6.15	Coolant Circuit, General, High-Temperature Circuit	230	6.22.9	Diagnostic features of EIM	274
6.15.1	Drain and vent points	230	7	Appendix A	
6.15.2	Engine coolant level – Check	234	7.1	Abbreviations	277
6.15.3	Engine coolant – Change	235	7.2	MTU contact persons/service partners	279
6.15.4	Engine coolant – Draining	236	8	Appendix B	
6.15.5	Engine coolant – Filling	239	8.1	Special Tools	280
6.15.6	HT coolant pump – Relief bore check	241	8.2	Index	285
6.15.7	Engine coolant – Sample extraction and analysis	242			
6.15.8	Engine coolant filter – Replacement	243			
6.15.9	Preheating unit	244			
6.15.10	Preheater – Overhaul	247			

1 Safety

1.1 Important provisions for all products

Nameplate

The product is identified by nameplate, model designation or serial number and must match with the information on the title page of this manual.

Nameplate, model designation or serial number can be found on the product.

General information

This product may pose a risk of injury or damage in the following cases:

- Incorrect use
- Operation, maintenance and repair by unqualified personnel
- Modifications or conversions
- Noncompliance with the safety instructions and warning notices

Correct use

The product is intended exclusively for the application specified in the contract or defined at the time of delivery.

This means that the equipment must be operated:

- Within the permissible operating parameters in accordance with the (→ Technical data)
- With fluids and lubricants approved by the manufacturer in accordance with the (→ Fluids and Lubricants Specifications of the manufacturer)
- With spare parts approved by the manufacturer in accordance with the (→ Spare Parts Catalog/MTU contact/Service partner)
- In the original as-delivered configuration or in a configuration approved by the manufacturer in writing (including engine control/parameters)
- In compliance with all safety regulations and in adherence with all warning notices in this manual
- In accordance with the maintenance requirements over the entire service life of the product (→ Maintenance Schedule)
- In compliance with the maintenance and repair instructions contained in this manual, in particular with regard to the specified tightening torques
- With the exclusive use of technical personnel trained in commissioning, operation, maintenance and repair
- By contracting only workshops authorized by the manufacturer to carry out repair and overhaul

Any other use is considered improper use and increases the risk of personnel injury or material damage in product operation. The manufacturer will accept no liability for such damage.

Modifications or conversions

Unauthorized modifications to the product compromise safety.

The manufacturer will accept no liability or warranty claims for any damage caused by unauthorized modifications or conversions.

Spare parts

Only genuine spare parts must be used to replace components or assemblies.

The manufacturer will accept no liability or warranty claims for any damage caused by the use of other spare parts.

1.2 Personnel and organizational requirements

Organizational measures of the operator

This manual must be issued to all personnel involved in operation, maintenance, repair or transportation.

Keep this manual handy in the vicinity of the product such that it is accessible to operating, maintenance, repair and transport personnel at all times.

Use this manual as a basis for instructing personnel on product operation and repair, whereby the safety-relevant instructions, in particular, must be read and understood.

This is particularly important in the case of personnel who only occasionally perform work on or around the product. This personnel must be instructed repeatedly.

Personnel requirements

All work on the product shall be carried out by trained and qualified personnel only.

- Training at the Training Center of the manufacturer
- Qualified personnel specialized in mechanical and plant engineering

The operator must define the responsibilities of the personnel involved in operation, maintenance, repair and transport.

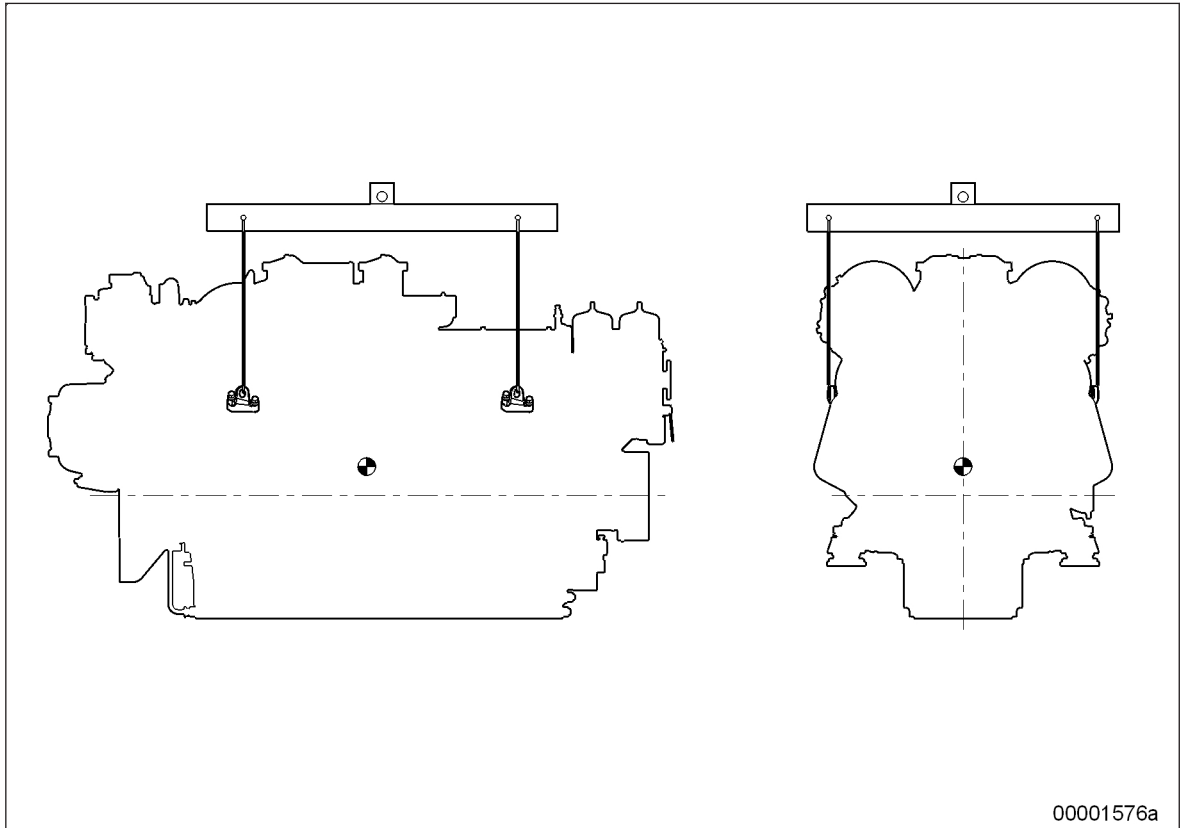
Working clothes and personal protective equipment

Wear proper protective clothing for all work.

When working, always wear the necessary personal protective equipment (e.g. ear protectors, protective gloves, goggles, breathing protection). Observe the information on personal protective equipment in the respective activity description.

1.3 Transport

Transport



Attach the engine at the lifting eyes provided only.

The lifting eyes are designed for engine transport only, not for the transport of propulsion units (engine and gearbox).

Use only the transport and lifting gear approved by MTU.

The engine must only be transported in installation position, max. permissible diagonal pull 10° .

Take note of the engine center of gravity.

In the case of special packaging with aluminum foil, suspend the engine on the lifting eyes of the transport pallet or transport with equipment for heavy loads (forklift truck).

Prior to transporting the engine, it is imperative to install transportation locking devices for crankshaft and engine mounts.

Secure the engine against tilting during transportation. The engine must be especially secured against slipping or tilting when going up or down inclines and ramps.

Setting the engine down after transport

Place the engine only on an even, firm surface.

Ensure appropriate consistency and load-bearing capacity of the ground or support surface.

Never place an engine on the oil pan, unless expressly authorized by MTU on a case-to-case basis to do so.

1.4 Safety regulations for maintenance and repair work

Safety regulations prior to maintenance and repair work

Have maintenance or repair work carried out by qualified and authorized personnel only.

Allow the product to cool down to below 50°C before starting maintenance work (risk of explosion of oil vapors, fluids and lubricants, risk of burning).

Before starting work, relieve pressure in systems and compressed-air lines which are to be opened. Use suitable containers of adequate capacity to catch fluids and lubricants.

When changing the oil or working on the fuel system, ensure that the service room is adequately ventilated.

Never carry out maintenance and repair work with the product in operation, unless:

- It is expressly permitted to do so following a written procedure.
- The product is running in the low load range and only for as long as absolutely necessary.

Secure the product against unintentional starting, e.g. with start interlock.

Attach "Do not operate" sign in the operating area or to control equipment.

Disconnect the battery. Lock contactors.

Close the main valve on the compressed-air system and vent the compressed-air line when pneumatic starters are fitted.

Disconnect the control equipment from the product.

The following applies to starters with copper-beryllium alloy pinions:

- Wear breathing protection of filter class P3 during maintenance work. Do not blow out the interior of the flywheel housing or the starter with compressed air. Clean the flywheel housing inside with a class H dust extraction device.
- Observe the safety data sheet.

Safety regulations during maintenance and repair work

Take special care when removing ventilation or plug screws from the product. Cover the screw or plug with a rag to prevent fluids escaping under pressure.

Take care when draining hot fluids and lubricants (risk of burning).

Use only proper and calibrated tools. Observe the specified tightening torques during assembly or disassembly.

Carry out work only on assemblies or plants which are properly secured.

Never use lines for climbing.

Keep fuel injection lines and connections clean.

Always seal connections with caps or covers if a line is removed or opened.

Take care not to damage lines, in particular fuel lines, during maintenance and repair work.

Ensure that all retainers and dampers are installed correctly.

Ensure that all fuel injection and pressurized oil lines are installed with enough clearance to prevent contact with other components. Do not place fuel or oil lines near hot components.

Do not touch elastomer seals if they have carbonized or resinous appearance unless hands are properly protected.

Note cooling time for components which are heated for installation or removal (risk of burning).

When working high on the equipment, always use suitable ladders and work platforms. Make sure components or assemblies are placed on stable surfaces.

Ensure particular cleanness during maintenance and repair work on the product. After completion of maintenance and repair work, make sure that no unattached parts are in/on the product (e.g. cloths and cable ties).

Safety regulations after completion of maintenance and repair work

Before barring, make sure that nobody is standing in the danger zone of the product.

After working on the product, check that all openings opened for work are closed again.

Check that all guards have been reinstalled and that all tools and loose parts have been removed after working on the product (in particular, the barring tool).

Welding work

Welding operations on the product or mounted units are not permitted. Cover the product when welding in its vicinity.

Before starting welding work:

- Switch off the power supply master switch.
- Disconnect the battery.
- Separate the electrical ground of electronic equipment from the ground of the unit.

No other maintenance or repair work must be carried out in the vicinity of the product while welding is going on. Risk of explosion or fire due to oil vapors and highly flammable fluids and lubricants.

Do not use product as ground terminal.

Never position the welding power supply cable adjacent to, or crossing wiring harnesses of the product. The welding current may otherwise induce an interference voltage in the wiring harnesses which could conceivably damage the electrical system.

Remove parts (e.g. exhaust pipes) which are to be welded from the product beforehand.

Hydraulic installation and removal

Check satisfactory function and safe operating condition of tools, jigs and fixtures to be used. Use only the specified jigs and fixtures for hydraulic removal/installation procedures.

Observe the max. permissible force-on pressure specified for the jig/fixture.

Do not attempt to bend or apply force to lines.

Before starting work, pay attention to the following:

- Vent the hydraulic installation/removal jig, the pumps and the lines at the relevant points for the equipment to be used (e.g. open vent plugs, pump until bubble-free air emerges, close vent plugs).
- For hydraulic installation, screw on the jig with the piston retracted.
- For hydraulic removal, screw on the jig with the piston extended.

For a hydraulic installation/removal jig with central expansion pressure supply, screw spindle into shaft end until correct sealing is established.

During hydraulic installation and removal, ensure that nobody is standing in the immediate vicinity of the component to be installed/removed.

Working with batteries

Observe the safety instructions of the battery manufacturer when working with batteries.

Gases emanating from the battery are explosive. Avoid sparks and naked flames.

Do not allow electrolyte to come in contact with skin or clothing.

Wear goggles and protective gloves.

Never place tools on the battery.

Before connecting the cable to the battery, check the battery polarity. Battery pole reversal may lead to injury through the sudden discharge of acid or bursting of the battery body.

Working on electrical and electronic assemblies

Always obtain the permission of the person in charge before commencing maintenance and repair work or switching off any part of the electronic system required to do so.

De-energize the appropriate areas prior to working on assemblies.

Do not damage cabling during removal work. When reinstalling ensure that wiring is not damaged during operation by contact with sharp objects, by rubbing against other components or by a hot surface.

Do not secure cables on lines carrying fluids.

Do not use cable straps to secure cables.

Always use connector pliers to tighten union nuts on connectors.

Subject the device as well as the product to a function check on completion of all repair work. In particular, check the function of the engine emergency stop feature.

Store spare parts properly prior to replacement, i.e. protect them against moisture in particular. Pack defective electronic components and assemblies in a suitable manner when dispatched for repair, i.e. protected, in particular, against moisture and impact and wrapped in anti-static foil if necessary.

Working with laser equipment

When working with laser equipment, always wear special laser-protection goggles (hazard due to heavily focused radiation).

Laser equipment must be equipped with the protective devices necessary for safe operation according to type and application.

For conducting light-beam procedures and measurement work, only the following laser devices must be used:

- Laser devices of classes 1, 2 or 3A.
- Laser devices of class 3B, which have maximum output in the visible wavelength range (400 to 700 nm), a maximum output of 5 mW, and in which the beam axis and surface are designed to prevent any risk to the eyes.

1.5 Fire prevention and environmental protection, fluids and lubricants, auxiliary materials

Fire prevention

Rectify any fuel or oil leaks immediately. Oil or fuel on hot components can cause fires – therefore always keep the product in a clean condition. Do not leave rags saturated with fluids and lubricants on the product. Do not store combustible materials near the product.

Do not carry out welding work on pipes and components carrying oil or fuel. Before welding, clean with a nonflammable fluid.

When starting the engine with an external power source, connect the ground lead last and remove it first. To avoid sparks in the vicinity of the battery, connect the ground lead from the external power source to the ground lead of the engine or to the ground terminal of the starter.

Always keep suitable firefighting equipment (fire extinguishers) at hand and familiarize yourself with their use.

Noise

Noise can lead to an increased risk of accidents if it makes it more difficult to hear audible signals, warning calls or noises indicating danger.

Wear ear protectors in workplaces with a sound pressure level in excess of 85dB (A).

Environmental protection and disposal

Modification or removal of any mechanical/electronic components or the installation of additional components including the execution of calibration processes that might affect the emission characteristics of the product are prohibited by emission regulations. Emission control units/systems may only be maintained, exchanged or repaired if the components used for this purpose are approved by the manufacturer. Noncompliance with these guidelines will invalidate the design type approval issued by the emissions regulation authorities. The manufacturer does not accept any liability for violations of the emission regulations. The maintenance schedules of the manufacturer must be observed over the entire life cycle of the product.

Dispose of used fluids, lubricants and filters in accordance with local regulations.

Within the EU, batteries can be returned free of charge to the manufacturer where they will be properly recycled.

Fluids and lubricants and auxiliary materials

The Fluids and Lubricants Specifications will be amended or supplemented as necessary. Prior to operation, make sure that the latest version is used. The latest version can be found on the website on the "Technical Info" or "Spare Parts and Service" tabs at <http://www.mtu-online.com>.

Consumable fluids and materials may also be hazardous or toxic. When using fluids, lubricants, consumables and other chemical substances, follow the safety regulations that apply to the product. Take special care when using hot, chilled or caustic substances. When using flammable materials, prevent them coming into contact with ignition sources and do not smoke.

Used oil

Used oil contains combustion residues that are harmful to health.

Rub barrier cream into hands.

Wash hands after contact with used oil.

Lead

- Adopt suitable measures to avoid the formation of lead dust.
- Switch on extraction system.
- When working with lead or pastes that contain lead, avoid direct contact with the skin. Do not inhale lead vapors.
- Wash hands after contact with lead or lead-containing substances.

Compressed air

Observe special safety precautions when working with compressed air:

- Unauthorized use of compressed air, e.g. forcing flammable liquids (hazard class A1, A2 and B) out of containers, risks causing an explosion.
- Wear goggles when blowing dirt off workpieces or blowing away swarf.
- Blowing compressed air into thin-walled containers (e.g. containers made of sheet metal, plastic or glass) for drying purposes or to check for leaks risks bursting them.
- Pay special attention to the pressure in the compressed air system or pressure vessel.
- Assemblies or products to be connected must either be designed for that pressure, or, if the permissible pressure is lower than the system pressure, a pressure reducing valve and safety valve (set to the permissible pressure) must be connected between the assemblies/products and the system.
- Hose couplings and connections must be securely attached.
- Provide the snout of the air nozzle with a protective disk (e.g. rubber disk).
- First shut off compressed air lines before compressed air device is disconnected from the supply line, or before device or tool is to be replaced.
- Carry out leak test in accordance with the specifications.

Paints and varnishes

- Observe the relevant safety data sheet for all materials.
- When painting in areas other than spray booths equipped with extractors, ensure good ventilation. Make sure that neighboring work areas are not adversely affected.
- There must be no naked flames in the vicinity.
- No smoking.
- Observe fire prevention regulations.
- Always wear a mask providing protection against paint and solvent vapors.

Liquid nitrogen

- Observe the relevant safety data sheet for all materials.
- Work with liquid nitrogen may be carried out only by qualified personnel.
- Store liquid nitrogen only in small quantities and always in regulation containers (without gas-tight caps).
- Avoid body contact (eyes, hands).
- Wear protective clothing, protective gloves, closed shoes and safety goggles.
- Make sure that working area is well ventilated.
- Avoid knocking or jolting the containers, valves and fittings or workpieces in any way.

Acids/alkaline solutions/urea (AdBlue[®], DEF)

- Observe the relevant safety data sheet for all materials.
- When working with acids and alkaline solutions, wear goggles or face mask, gloves and protective clothing.
- Do not inhale vapors.
- If urea solution is swallowed, rinse out mouth and drink plenty of water.
- If spilled onto clothing, remove the affected clothing immediately.
- After contact with skin, rinse affected parts of the body with plenty of water.
- Rinse eyes immediately with eye drops or clean tap water. Seek medical attention as soon as possible.

1.6 Standards for safety notices in the text

DANGER 	In the event of immediate danger. Consequences: Death, serious or permanent injury! • Remedial action.
WARNING 	In the event of a situation involving potential danger. Consequences: Death, serious or permanent injury! • Remedial action.
CAUTION 	In the event of a situation involving potential danger. Consequences: Minor or moderate injuries! • Remedial action.
NOTICE 	In the event of a situation involving potentially adverse effects on the product. Consequences: Material damage! • Remedial action. • Additional product information.

Safety notices

- This manual with all safety instructions and safety notices must be issued to all personnel involved in operation, maintenance, repair or transportation.

2 Product Summary

2.1 Engine Layout

2.1.1 Product description

Description of the engine

Engine

The engine is a liquid-cooled four-stroke diesel engine, rotating counterclockwise (seen from driving end), with direct injection, sequential turbocharging and charge air cooling.

The engine is monitored by an engine control and monitoring system (ADEC).

Fuel system

Electronically controlled common-rail-injection system with HP pump, pressure accumulator (rail) and single injectors with integrated individual store.

The electronic control unit controls

- Injection start
- Injection quantity
- Injection pressure

Exhaust system

The exhaust system is equipped with triple-walled, water-cooled exhaust lines.

The triple-walled design permits

- low surface temperature,
- reduced amount of heat to be dissipated by the coolant,
- absolute gas-tightness.

Turbocharging

Sequential turbocharging with internal, engine-coolant-controlled charge air cooling. The right-hand exhaust turbocharger is cut-in and cut-out on 12V and 16V engines with electronically-controlled, hydraulically-actuated flaps.

Cooling system

Split-circuit engine cooling system with remote or engine-mounted heat exchanger.

Heating of the charge air in idle and low-load operation prevents white smoke formation.

Seawater flows only through engine coolant cooler and fuel cooler as well as the raw water pump (if fitted).

Service block

The service components are mounted at the auxiliary PTO end.

The layout permits easy access for maintenance.

Service-components:

- Raw water pump (if fitted), coolant pump
- Centrifugal lube oil filter
- Coolant expansion tank (only on engines with engine-mounted heat exchanger)
- Coolant filter

Intermittent oil priming for marine genset engines (M23-M43)

The standard configuration of these engines comprises intermittent oil priming.

Oil priming is activated every 30 minutes. The oil priming process ends as soon as oil pressure in the main oil gallery reaches 0.4 bar or after 180 seconds, at the latest.

If a pressure of at least 0.2 bar is not attained after 180 seconds, an alarm is output.

To avoid engine damage from a hydraulic lock due to excessive oil supply to the combustion chambers, the engine must be started at least once a month.

Electronic system

Electronic control and monitoring system with integrated safety and test system with interfaces to Remote Control System (RCS) and to Monitoring and Control System (MCS).

Engine Interface Module (EIM)

The Engine Interface Module (EIM) is the central connection box on the engine. It covers the complete minimum scope of a marine engine. It does not comprise controls of components requiring maintenance.

Functions:

- Starter control (start repetition, tooth alignment, starter protection)
- Monitoring of the battery-charging generator
- Open bus interface to the plant (SAE J1939)
- Emergency stop function with line break monitoring
- Redundant supply voltage input
- Emergency air-shutoff flap control (option)
- Key switch logic
- Interface to ECU and EMU
- MCS5 dialog interface
- Control of an MTU lube-oil priming pump (power components in separate MTU PPC Box)
- Connection facility for an MTU Local Operating Station (LOS)

Serial RS422 interface for diagnosis

The engine interface comprises two parts. The first part of signals is integrated in the engine wiring harness with a 62-pole Tyco connector X52. The second part refers to signals associated with higher currents. These signals are led out via M threaded pins and also integrated in the engine wiring harness.

Functions

- ECU supply
- EMU supply
- Plant signals (ECU7 connector X1)
- Bus interface (2x MCS5 CAN)
- CAN dialog output (1xMCS5 CAN)
- Emergency stop from EMU and ECU
- Electric starter
- Terminal 45 starter A/B (engaged)
- Pneumatic starter
- Starting-air pressure valve
- Start-air pressure sensor
- Barring gear (1 and 2)
- Battery-charging generator (with exciter control)
- Optional emergency-air shutoff flaps
- Activation signal to air shut-off flaps 1+2
- Feedback signal from air shut-off flaps 1+2

Electronic engine governor (ECU)

Functions:

- Engine speed control with fuel and speed limitation dependent on engine status and operating conditions
- Control of sequential turbocharging, cylinder bank cut-out and air recirculation function
- Data processing logistics for analog and binary signals
- Interface for data transfer to CAN field bus for remote control and ship-side monitoring

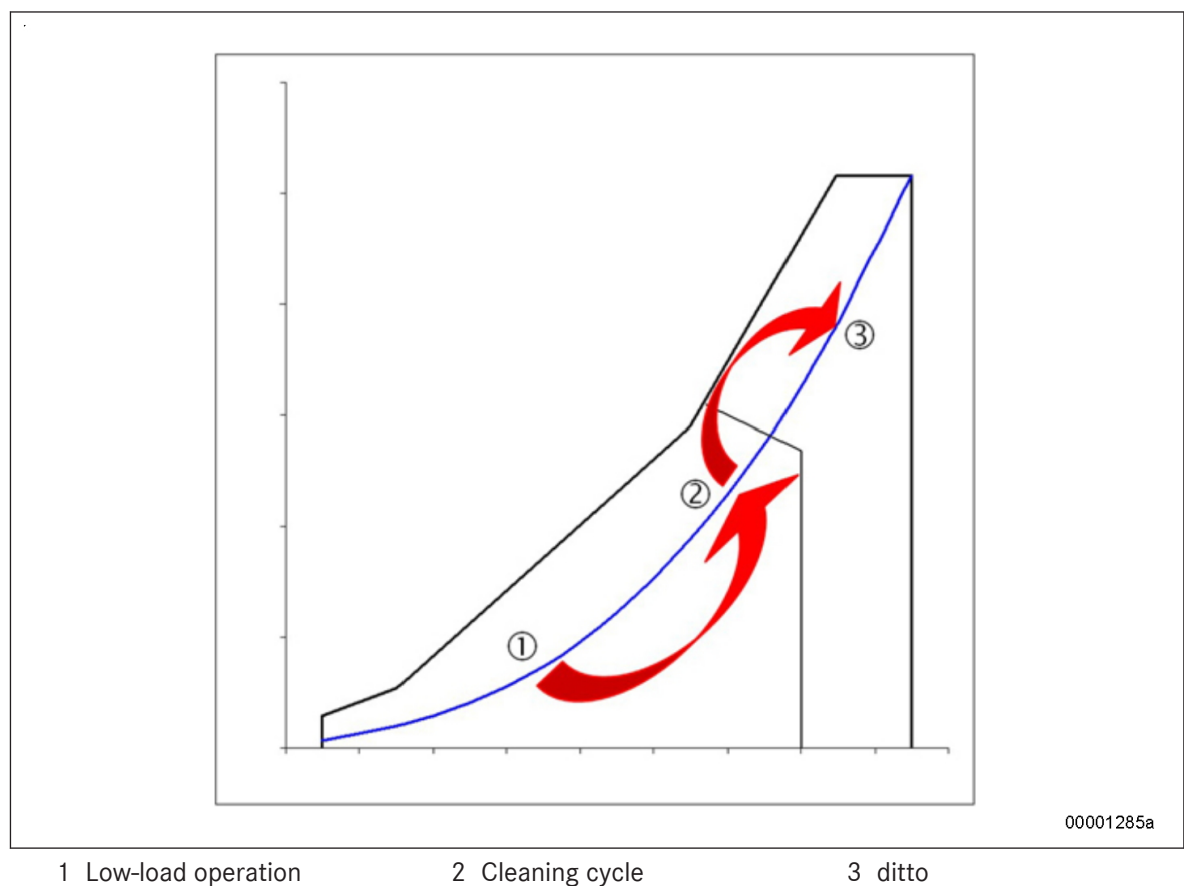
Electronic Engine Monitoring Unit (EMU)

Functions:

- Data processing logistics for analog and binary signals
- Interface for data transfer to CAN field bus for remote control and ship-side monitoring

Low-load operation

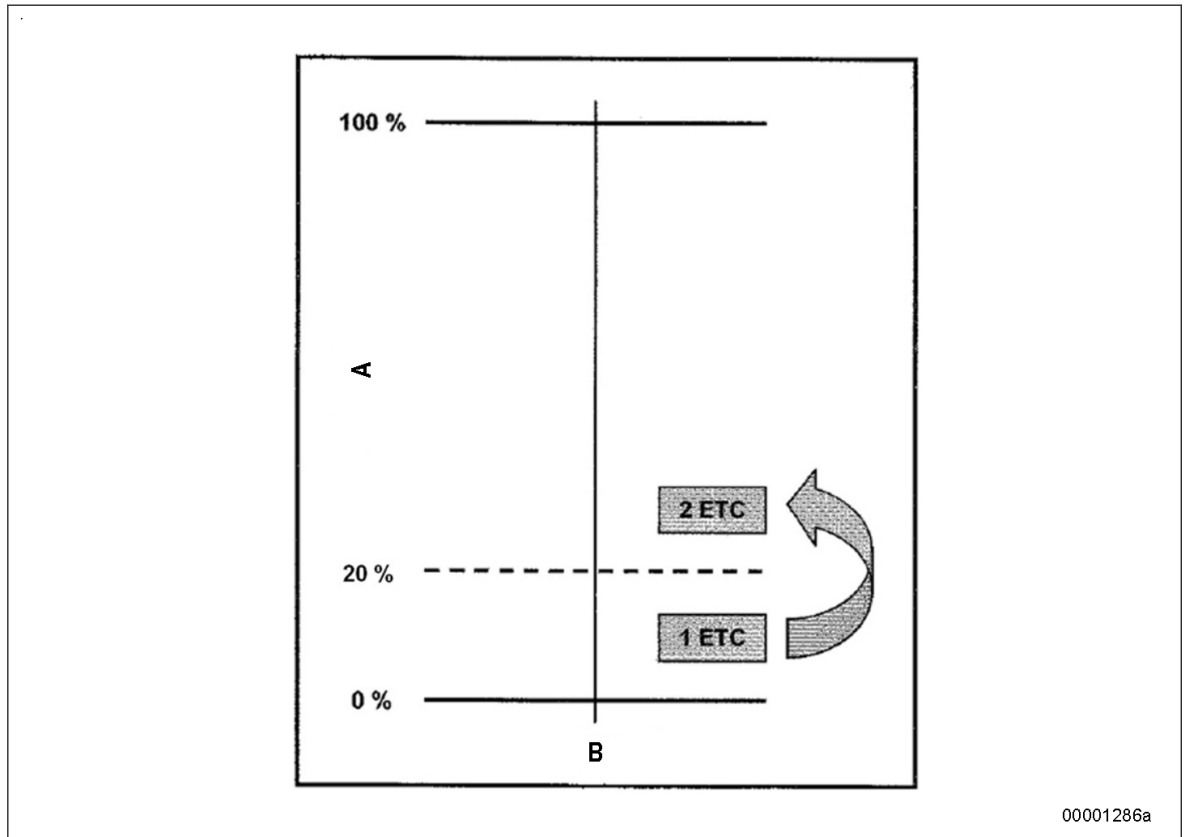
12/16V4000M53R/M53/M63R/M63/M63L engines



MTU marine engine Series 4000M53R to ...M93L may be operated in low-load operation. State-of-the-art design and equipment features, e.g. TE coolant circuit, sequential turbocharging, jacketed, coolant-cooled exhaust lines, Common Rail fuel injection and cylinder cutout allow engine operation at low load.

Nevertheless, low-load operation at engine load below 15% of the nominal rating is permitted for max. 100 hours. In order to avoid inadmissible oil carbon and/or carbon particle deposits in the engine, it is recommended to carry out a cleaning cycle for at least 20 minutes after extended low-load operation periods. During the cleaning cycle, engine speed (power) must be increased step by step until all exhaust turbochargers are running. The figure shows the basic speed/power run-up procedure for the cleaning cycle to be carried out.

12/16V4000M23S/M23F/M33S/M33F/M43S engines



A Engine power

B Engine speed

ETC Exhaust turbocharger

MTU marine genset engine Series 4000M23/M33/M43 may be operated in low-load operation. State-of-the-art design and equipment features e.g. TE coolant circuit, jacketed, coolant-cooled exhaust lines, Common Rail fuel injection and cylinder cutout allow engine operation at low load.

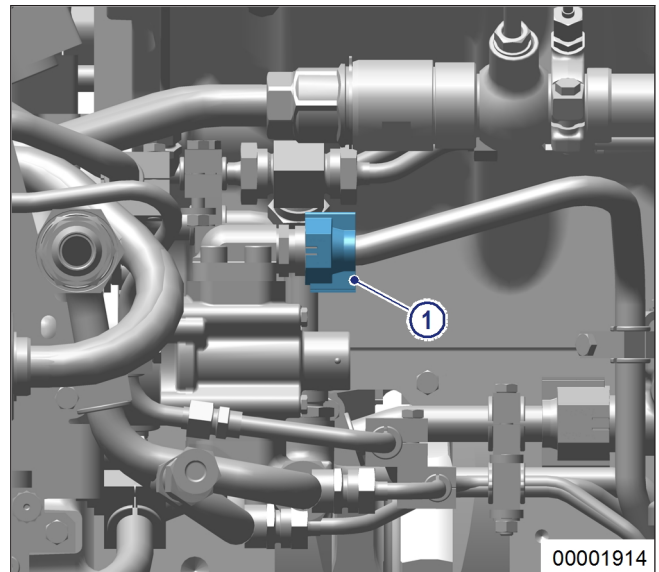
Low-load operation (engine power up to approx. 20% of rated power) takes place in single-ETC mode (with only one exhaust turbocharger running). To ensure the functionality of the control mechanism and of the exhaust flap of the turbocharger which does not run in low-load operation, it is recommended to operate the engine with both exhaust turbochargers running after 100 operating hours in low-load operation, at the latest.

SOLAS – Fire protection specifications

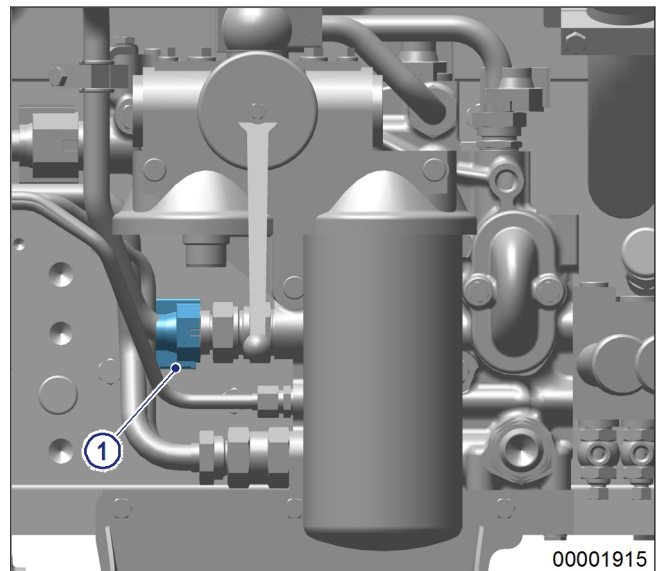
Fuel system, fuel lines with fuel pressure >1.8 bar

All lines with SOLAS-compliant covers for pipe connections, according to MTU standard MTN5233, are shown.

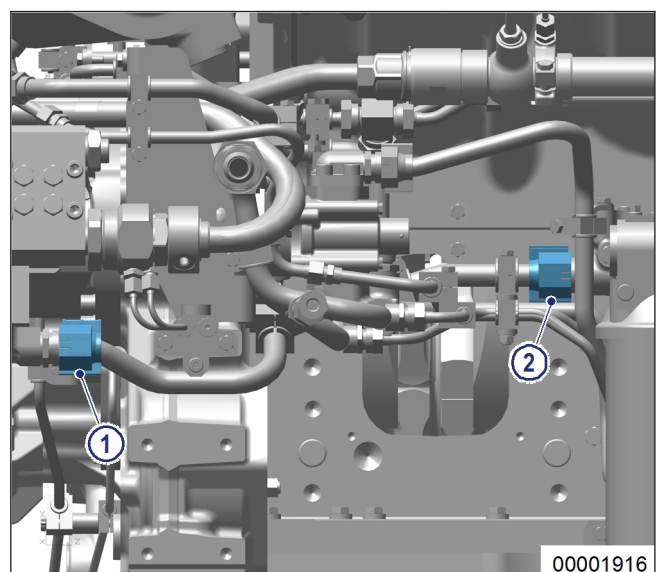
- 1 SOLAS clip on the fuel line: after LP pump



- 1 SOLAS clip on the fuel line: on fuel filter head retainer

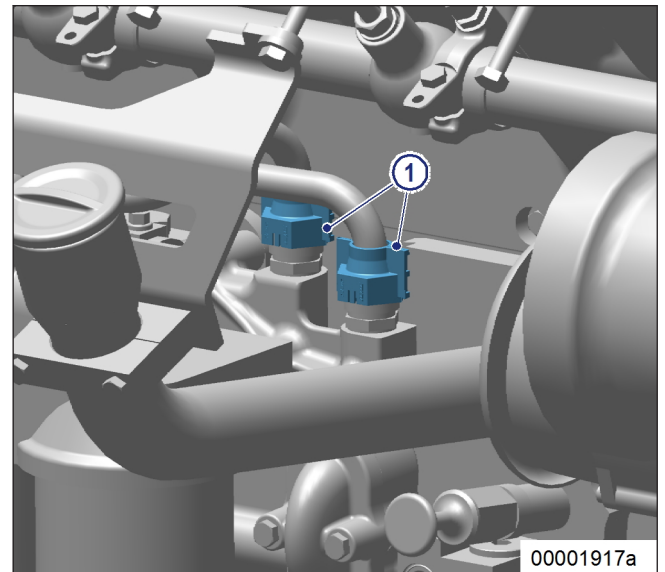


- 1 SOLAS clip on the fuel line: on HP pump
- 2 SOLAS clip on the fuel line: after fuel filter head

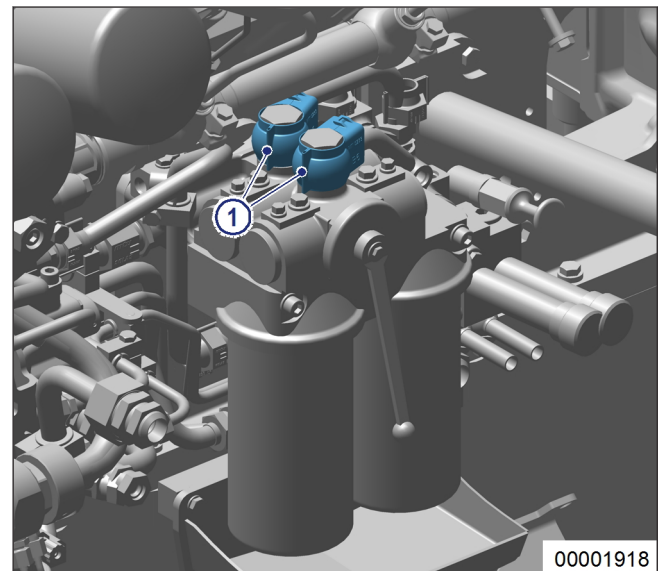


TIM-ID: 0000010054 - 009

- 1 SOLAS clips on the fuel line: on fuel filter head retainer



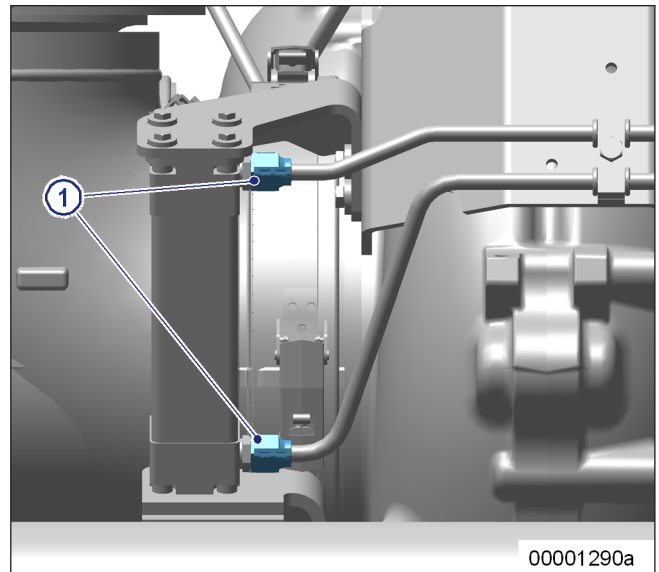
- 1 SOLAS clips on the fuel line: on fuel filter head



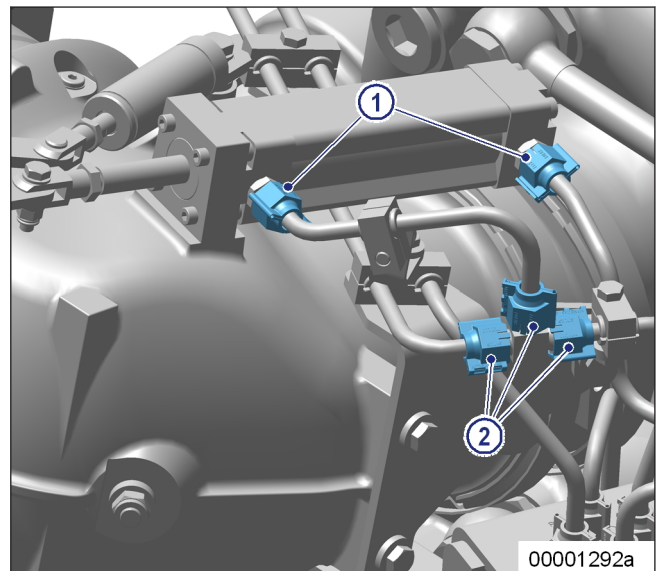
Lube oil system, oil lines with oil pressure >1.8 bar

All lines with SOLAS-compliant covers for pipe connections, according to MTU standard MTN5233, are shown.

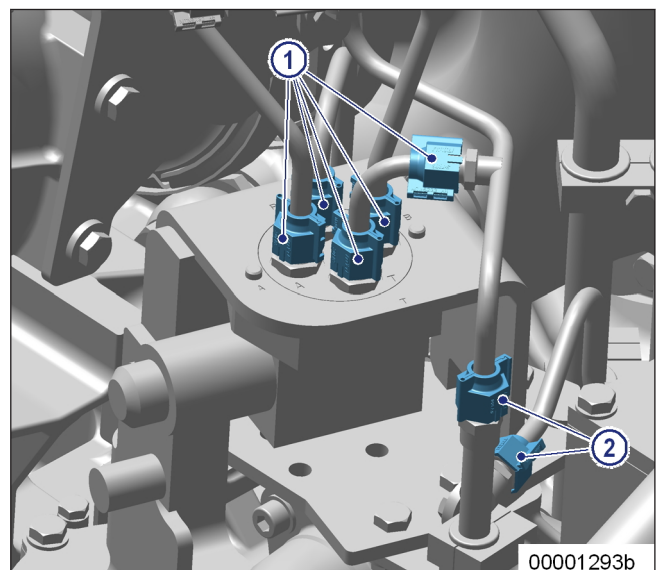
- 1 SOLAS clips on exhaust flap switching cylinder ETC B1



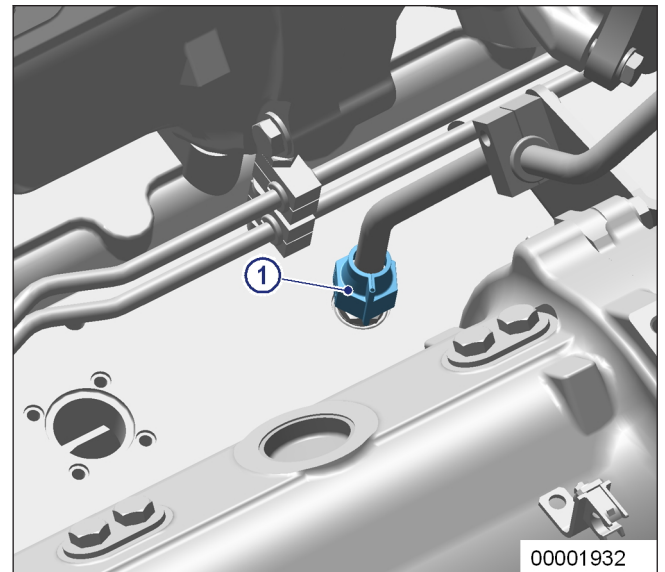
- 1 SOLAS clips on air flap switching cylinder ETC B1
- 2 SOLAS clips on flap control T adapter ETC B1



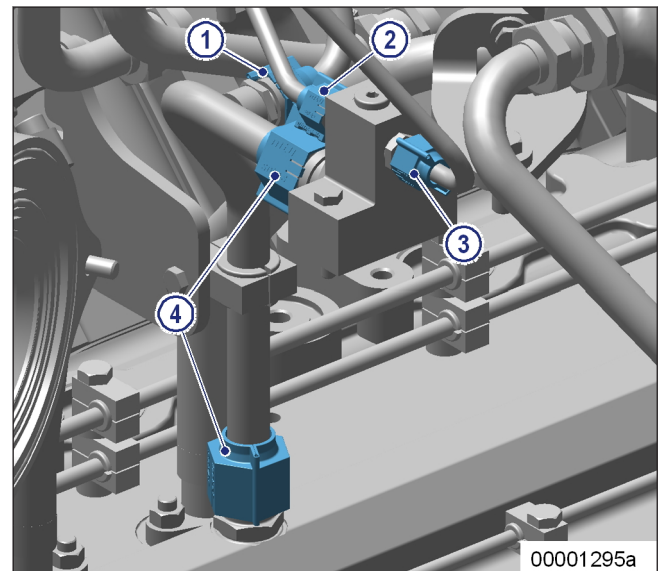
- 1 SOLAS clips on distributor element
- 2 SOLAS clips on oil return



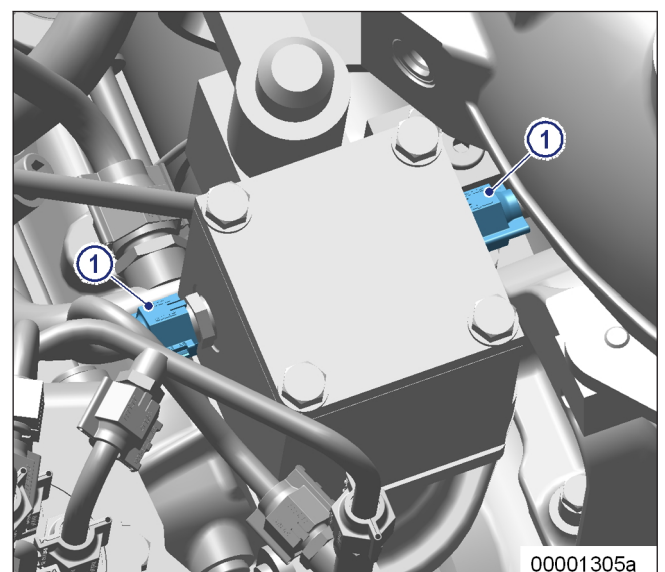
- 1 SOLAS clip on oil return



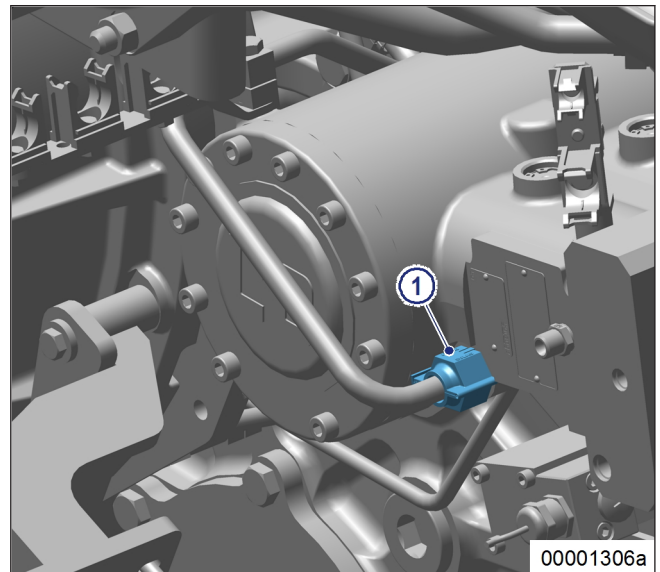
- 1 SOLAS clip on oil line to ETC
- 2 SOLAS clip on oil line to flap control
- 3 SOLAS clip on oil line to recirculation valve
- 4 SOLAS clips on oil line from main gallery



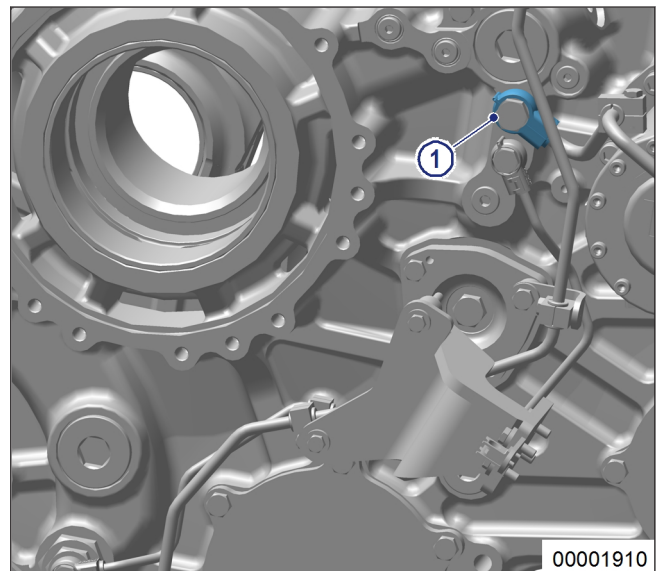
- 1 SOLAS clips on recirculation valve



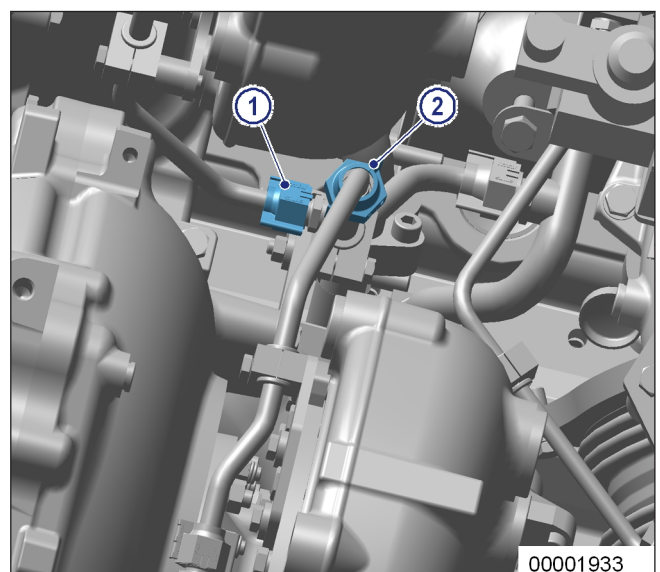
- 1 SOLAS clip on HP pump oil supply:
on HP pump



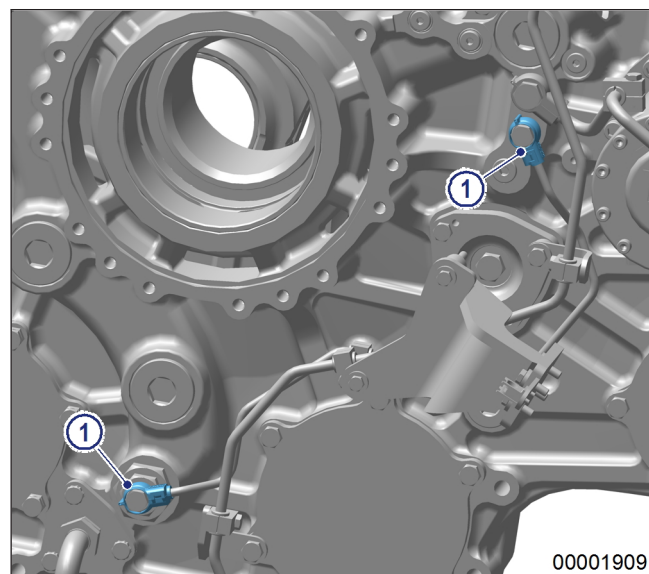
- 1 SOLAS clip on HP pump oil supply:
on equipment carrier



- 1 SOLAS clip on ETC oil supply
- 2 SOLAS clip on ETC oil supply



- 1 SOLAS clips of oil line on equipment carrier

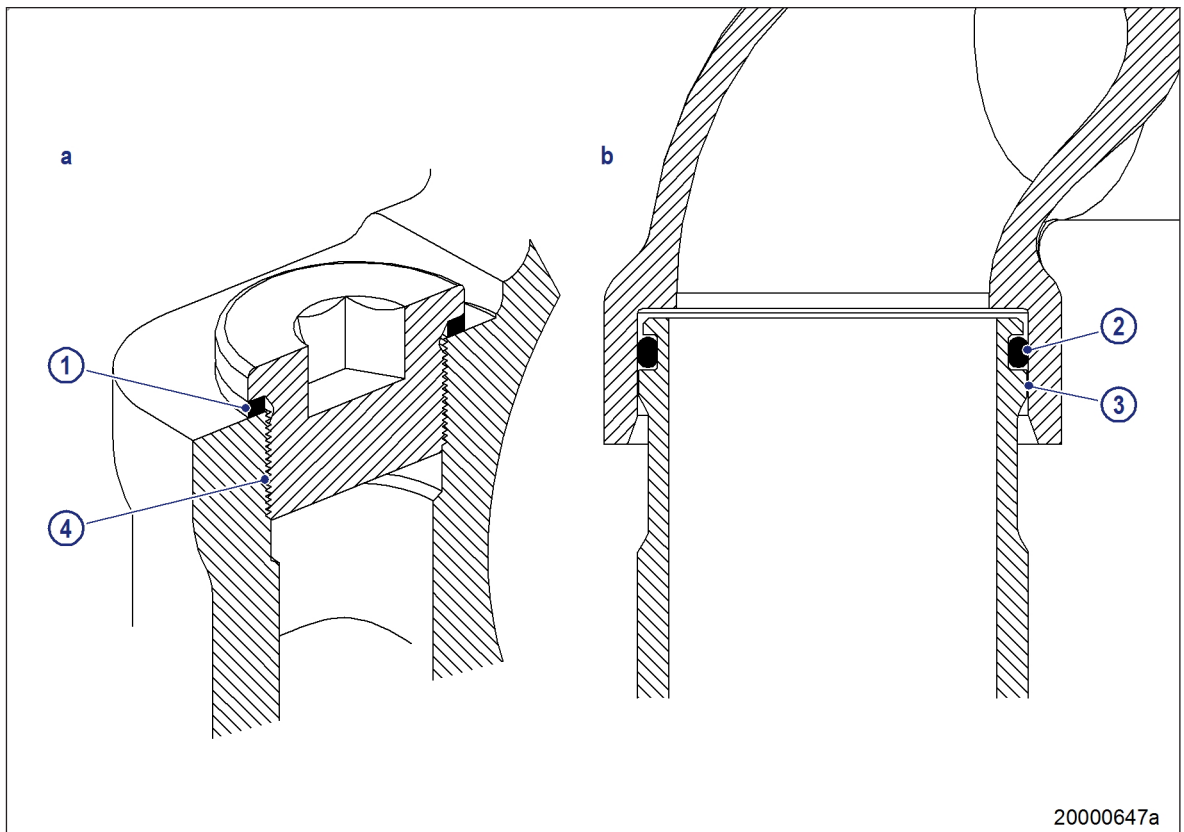


- 1 Cover on oil filter cartridge



Special connections

The following types of union are spray-proof in case of leakage even without covers and have been confirmed as being SOLAS-compliant by GL and DNV.



Plugs and sensors (a)

Screw-in plugs (4) are sealed toward the outside either with a copper sealing ring (1), according to DIN, or an O-ring (ISO).

In case of a loose thread or a defective sealing ring (1), the liquid first has to pass the thread.

The pressure is so greatly reduced by this and the faulty sealing ring (1) that any leakage is not under pressure.

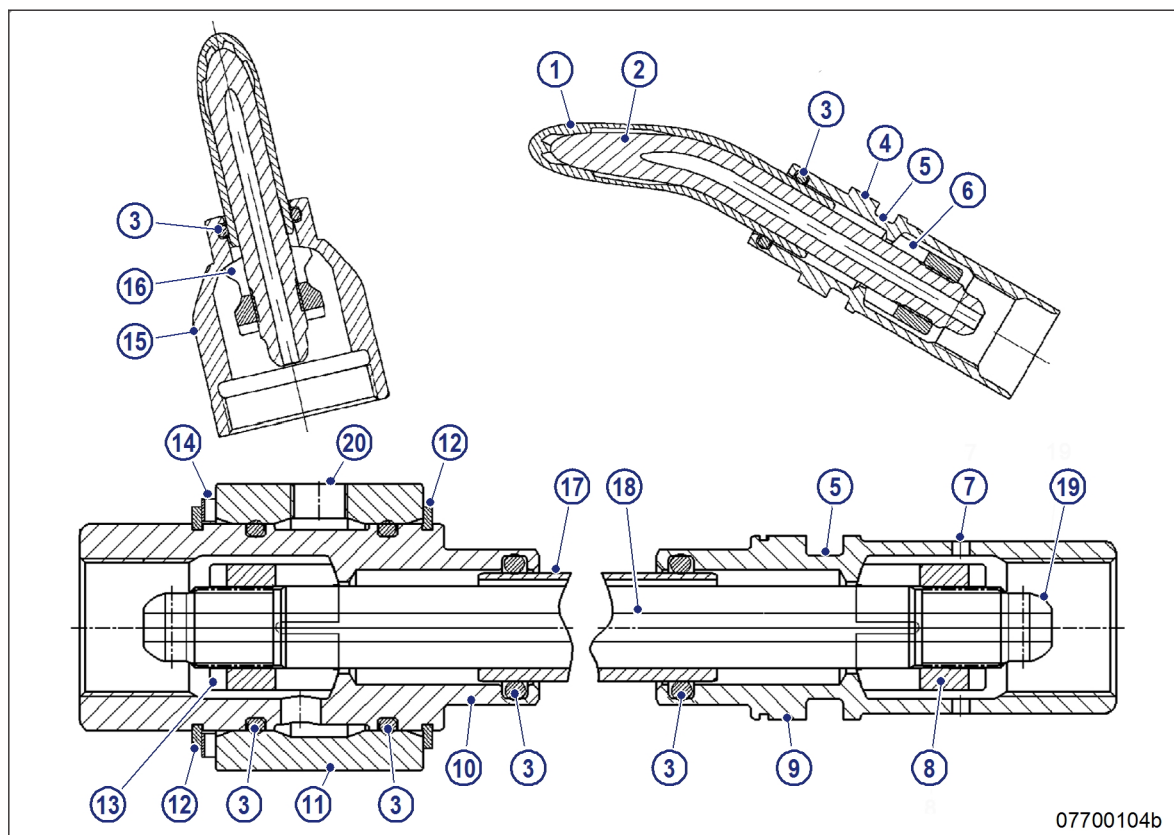
Plug-in pipe union (b)

The sleeve (3) covers the joint to prevent lateral spray.

Only leak-off along the line is possible, the pressure is decreases significantly if an O-ring (2) defect occurs.

The union is confirmed as being SOLAS-compliant by DNV and GL.

HP connections



07700104b

- | | | |
|-------------------------|---------------------|-----------------------------|
| 1 Jacket pipe | 8 Thrust ring | 15 Union nut |
| 2 HP fuel line | 9 Union nut | 16 Thrust ring |
| 3 O-ring | 10 Union nut | 17 HP line outer pipe |
| 4 Union nut | 11 Connecting piece | 18 Internal pipe of HP line |
| 5 Recess for O-ring | 12 Snap ring | 19 Ball-type seal area |
| 6 Thrust ring | 13 Thrust ring | 20 Leak-fuel connection |
| 7 Leakage overflow bore | 14 Shim washers | |

The HP fuel line is sealed by the thrust ring (8).

If leakage in the area of the thrust ring (8) or the HP line (2) occurs, the emerging fuel is routed to the leakage chamber.

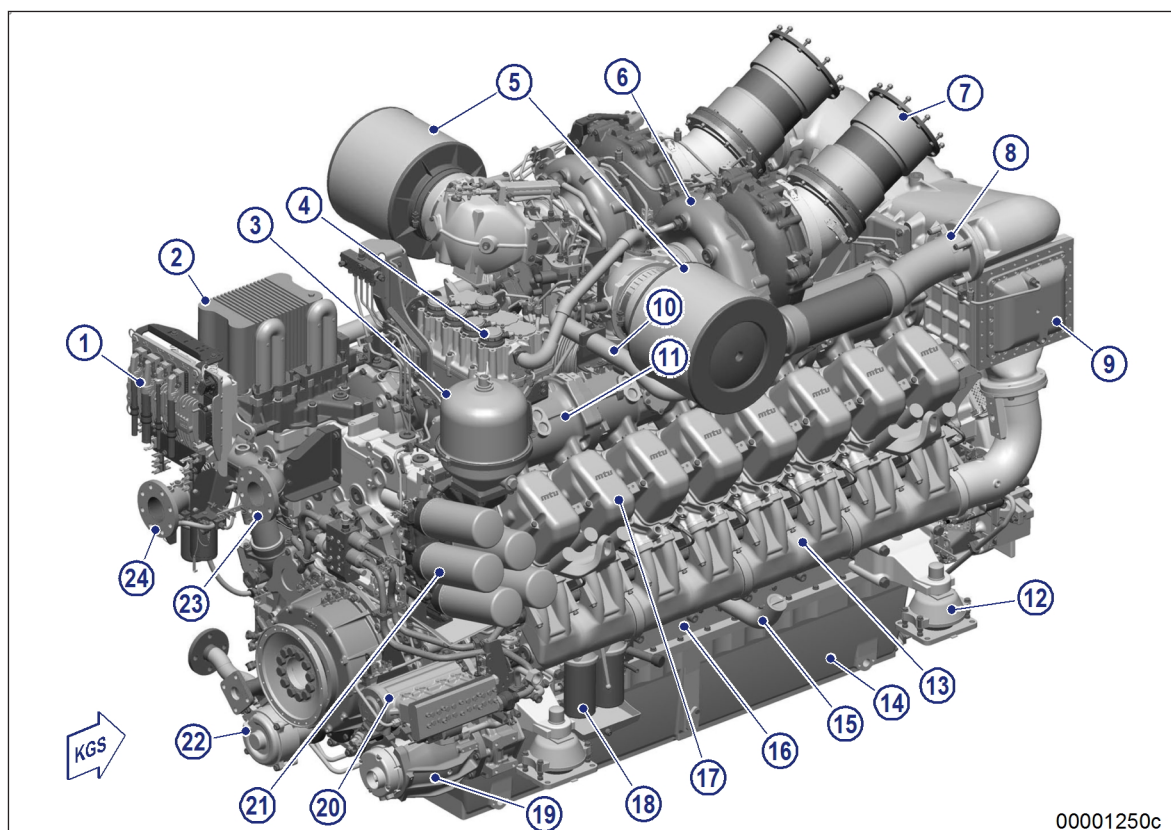
The leaking fuel is drained off without pressure via the leakage overflow-bore (7). The leakage chamber is sealed toward the outside by the O-rings (3).

This prevents leakage egress.

The union is confirmed as being SOLAS-compliant by DNV and GL.

2.1.2 Engine layout

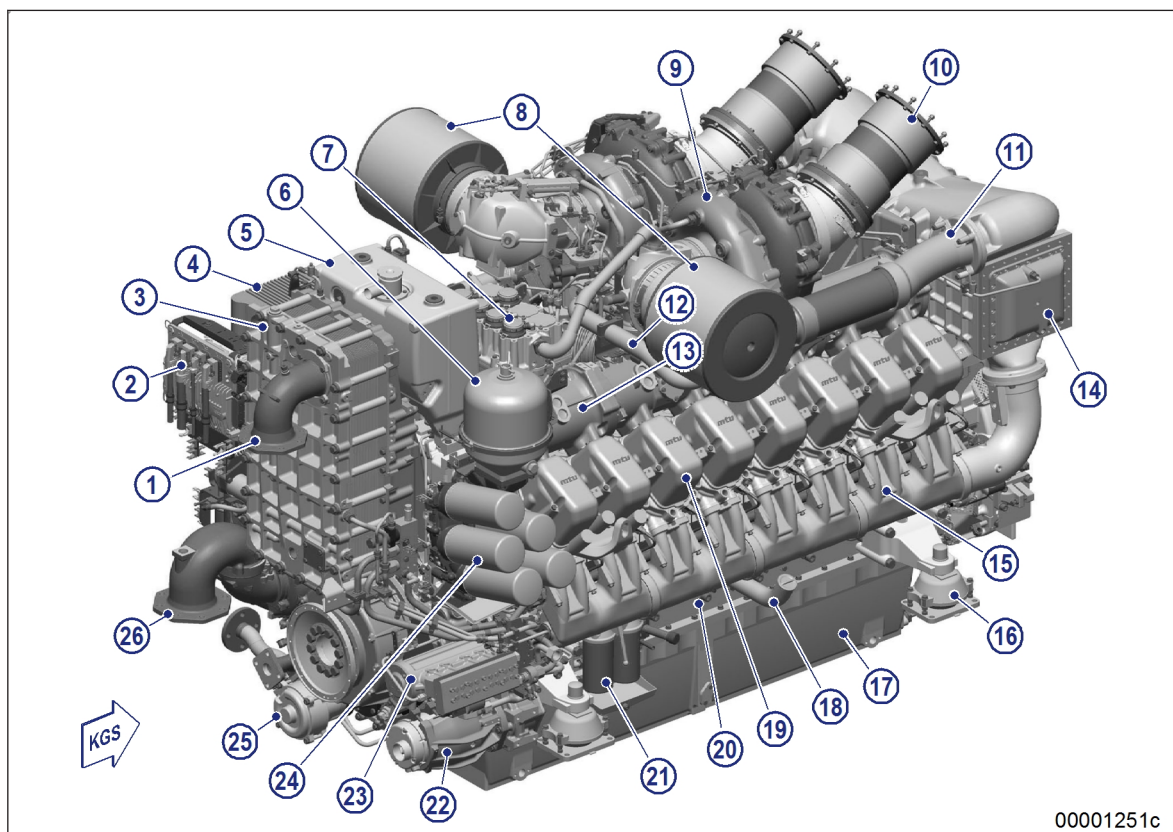
Engines with remote heat exchanger and horizontal air intake



00001250c

- | | | |
|------------------------------------|-----------------------|---|
| 1 Engine management and monitoring | 10 Recirculation line | 19 Battery-charging generator |
| 2 Oil cooler | 11 Exhaust manifold | 20 HP fuel pump |
| 3 Centrifugal oil filter | 12 Engine mounts | 21 Oil filter |
| 4 Crankcase breather | 13 Charge-air line | 22 Bilge pump (option) |
| 5 Dry-type air filter | 14 Oil pan | 23 Coolant outlet to remote cooling system |
| 6 Exhaust turbocharger | 15 Oil filler neck | 24 Coolant inlet from remote cooling system |
| 7 Exhaust outlet | 16 Crankcase | |
| 8 Air pipe to intercooler | 17 Cylinder head | |
| 9 Intercooler | 18 Fuel filter | KGS Free end |

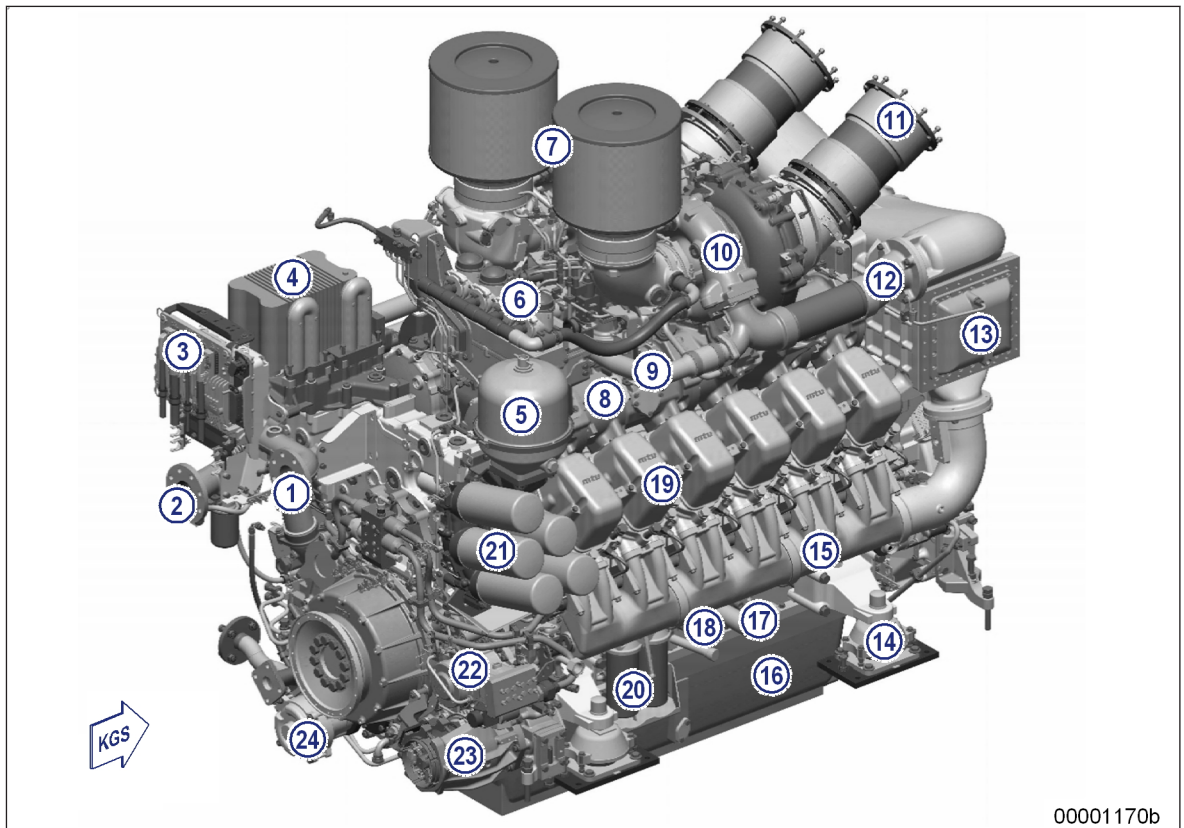
Engines with engine-mounted heat exchanger and horizontal air intake



00001251c

- | | | |
|------------------------------------|----------------------------|-------------------------------|
| 1 Raw-water outlet | 10 Exhaust outlet | 19 Cylinder head |
| 2 Engine management and monitoring | 11 Air pipe to intercooler | 20 Crankcase |
| 3 Plate-core heat exchanger | 12 Recirculation line | 21 Fuel filter |
| 4 Oil cooler | 13 Exhaust manifold | 22 Battery-charging generator |
| 5 Coolant expansion tank | 14 Intercooler | 23 HP fuel pump |
| 6 Centrifugal oil filter | 15 Charge-air line | 24 Oil filter |
| 7 Crankcase breather | 16 Engine mounts | 25 Bilge pump (option) |
| 8 Dry-type air filter | 17 Oil pan | 26 Raw-water inlet |
| 9 Exhaust turbocharger | 18 Oil filler neck | KGS Free end |

Engines with remote heat exchanger and vertical air intake

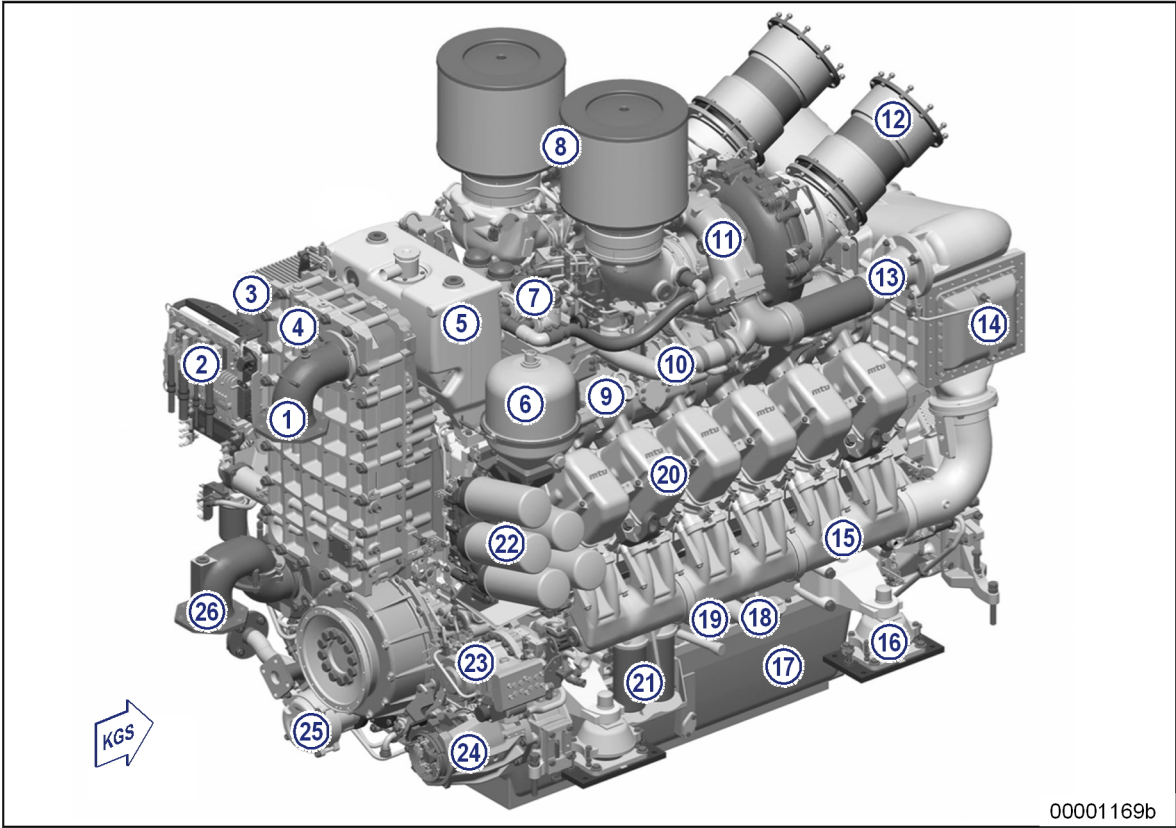


00001170b

- | | | |
|--|----------------------------|-------------------------------|
| 1 Coolant outlet to remote cooling system | 10 Exhaust turbocharger | 19 Cylinder head |
| 2 Coolant inlet from remote cooling system | 11 Exhaust outlet | 20 Fuel filter |
| 3 Engine management and monitoring | 12 Air pipe to intercooler | 21 Oil filter |
| 4 Oil cooler | 13 Intercooler | 22 HP fuel pump |
| 5 Centrifugal oil filter | 14 Engine mounts | 23 Battery-charging generator |
| 6 Crankcase breather | 15 Charge-air line | 24 Bilge pump (option) |
| 7 Dry-type air filter | 16 Oil pan | KGS Free end |
| 8 Exhaust manifold | 17 Oil filler neck | |
| 9 Recirculation line | 18 Crankcase | |

Overview drawing is also valid for 16V engines.

Engines with engine-mounted heat exchanger and vertical air intake



00001169b

- | | | |
|------------------------------------|----------------------------|-------------------------------|
| 1 Raw-water outlet | 10 Recirculation line | 19 Crankcase |
| 2 Engine management and monitoring | 11 Exhaust turbocharger | 20 Cylinder head |
| 3 Oil cooler | 12 Exhaust outlet | 21 Fuel filter |
| 4 Plate-core heat exchanger | 13 Air pipe to intercooler | 22 Oil filter |
| 5 Coolant expansion tank | 14 Intercooler | 23 HP fuel pump |
| 6 Centrifugal oil filter | 15 Charge-air line | 24 Battery-charging generator |
| 7 Crankcase breather | 16 Engine mounts | 25 Bilge pump (option) |
| 8 Dry-type air filter | 17 Oil pan | 26 Raw-water inlet |
| 9 Exhaust manifold | 18 Oil filler neck | KGS Free end |

Overview drawing is also valid for 16V engines.

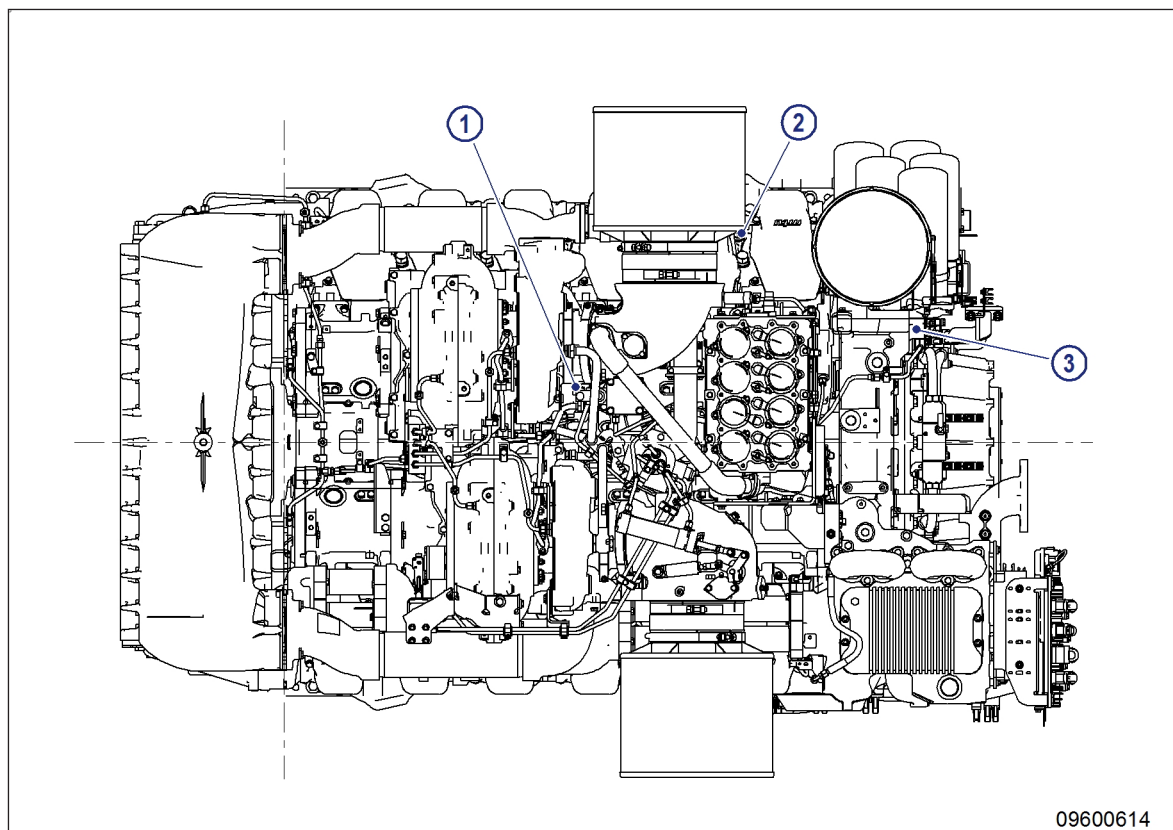
Engine model designation

Key to the engine model designations 12/16V 4000 Mxy z	
12, 16	Number of cylinders
V	Cylinder arrangement: V-engine
4000	Series
M	Application (M= Marine)
x	Application load profile (0, 1, 2, 3...9)
y	Design index (0, 1, 2, 3...9)
z	R (power / speed reduction) L (enhanced power / speed) S (60 Hz) F (50 Hz)

TIM-ID: 0000009990 - 007

2.1.3 Overview of sensors and actuators

Top view of 12V 4000 M with external cooling

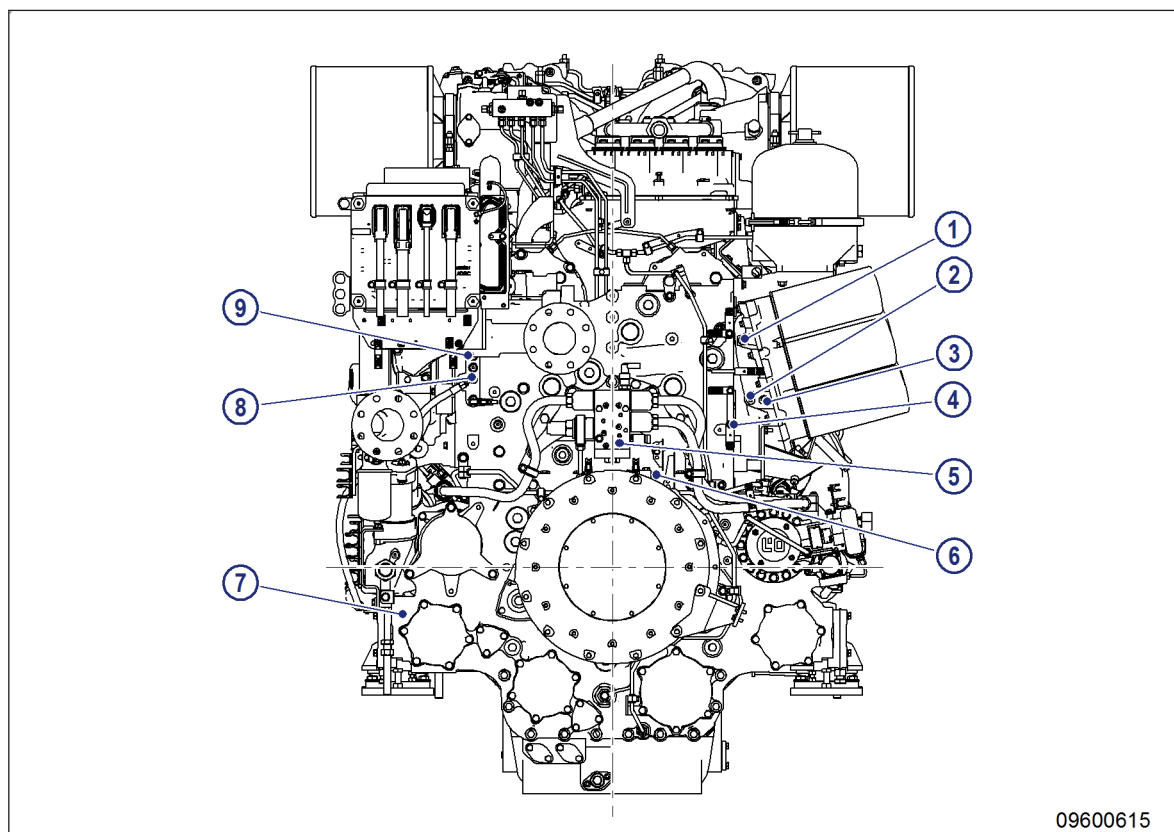


1 B49 (charge-air temp., air recirculation valve)
Y26 (air recirculation valve A)

2 B4.A1-B4.B6 (single exhaust temp., A1-A6, B1-B6)

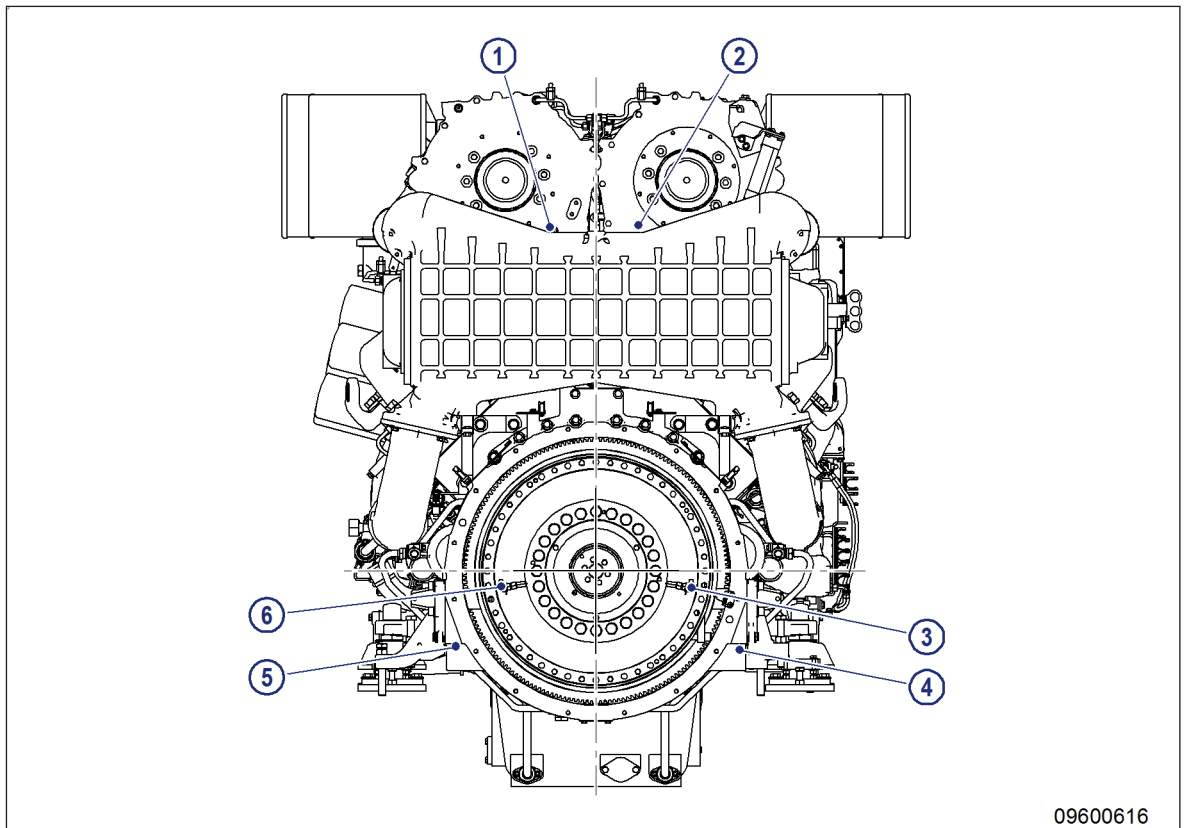
3 B33 (fuel temperature in common rail)

Aux. PTO end, 12V 4000 M, external cooling



- | | | |
|--|---|----------------------------------|
| 1 B7 (engine oil temp.) | 4 B33 (fuel temperature in common rail) | 7 B54 (oil refill pump pressure) |
| 2 B5.3 (oil pressure upstream of filter) | 5 B48 (fuel pressure in common rail) | 8 B6.2 (coolant temperature) |
| 3 B5.1 (oil pressure downstream of filter) | 6 B1 (camshaft speed) | 9 B6 (coolant temperature) |

Main PTO end, 12V 4000 M, external cooling

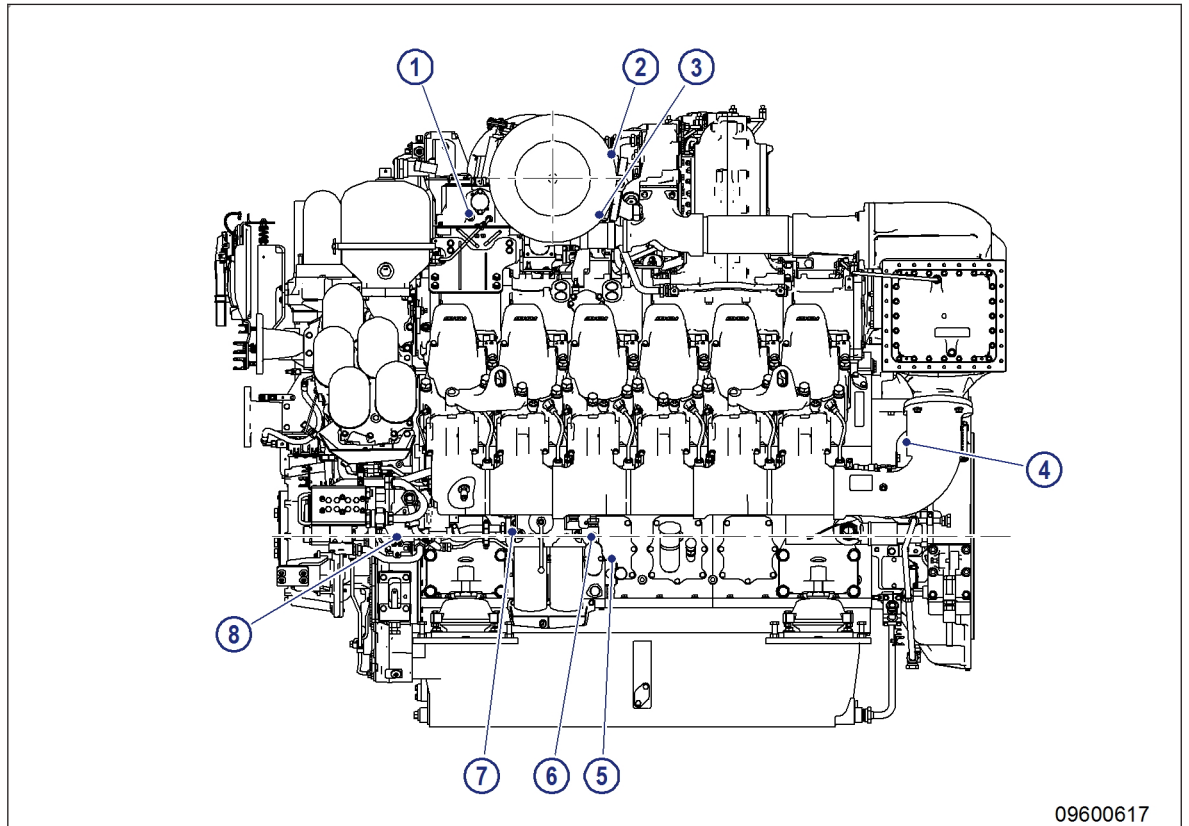


- 1 B4.21 (exhaust temperature, A bank)
- 2 B4.22 (exhaust temperature, B bank)

- 3 B13 (crankshaft speed)
- 4 S37.2 (safety switch)

- 5 S37.1 (safety switch)
- 6 B13.2 (crankshaft speed)

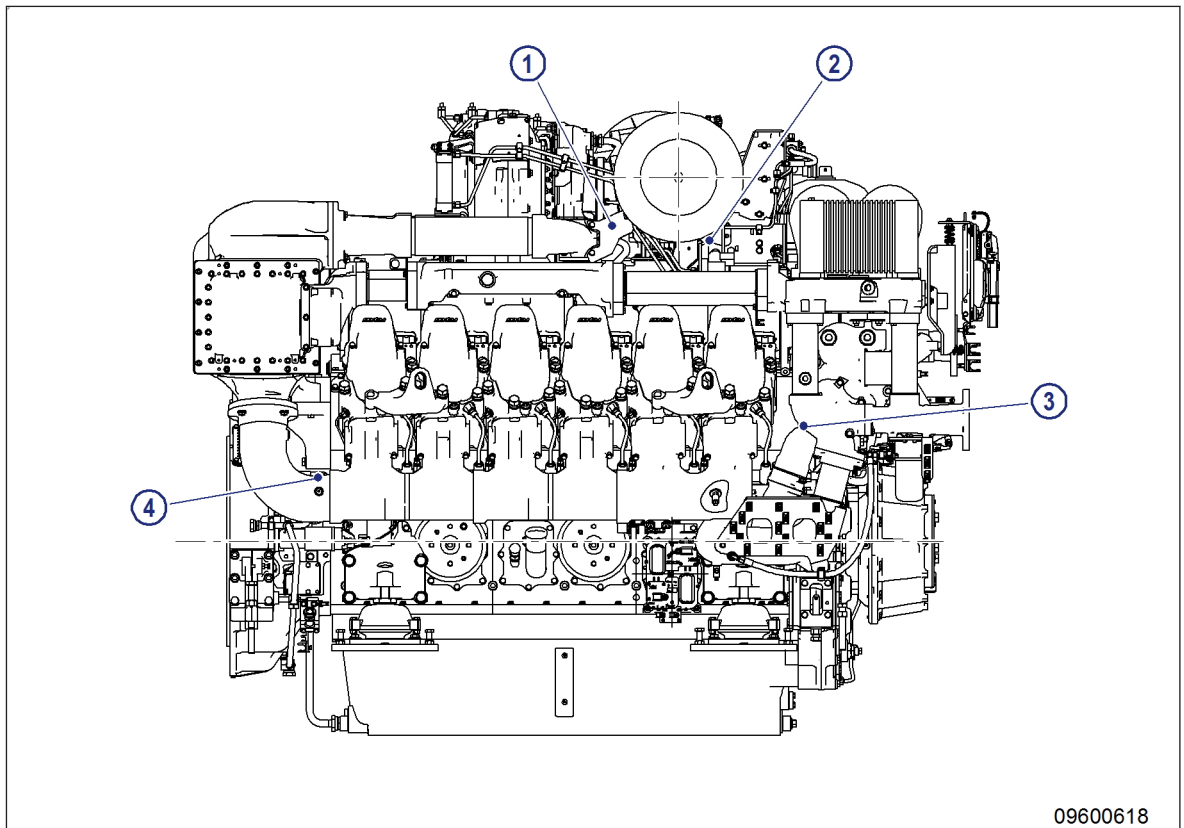
Left side of engine, 12V 4000 M, external cooling



09600617

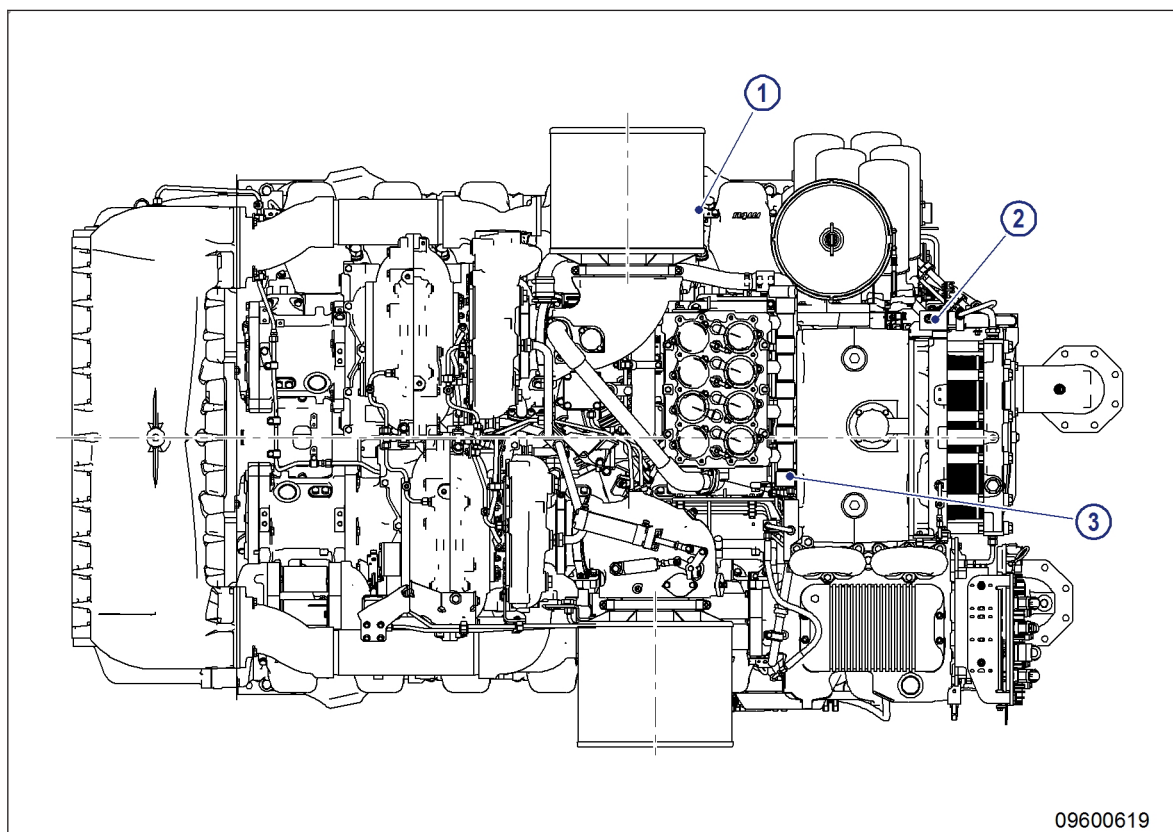
- | | | |
|-----------------------------------|---|---|
| 1 B50 (crankcase pressure) | 4 B10 (charge-air pressure) | 7 B34.1 (fuel pressure down-
stream of filter) |
| 2 B3 (intake air temperature) | 5 B34.3 (fuel pressure up-
stream of filter) | 8 F46 (fuel overflow level) |
| 3 B44.1 (turbocharger A
speed) | 6 B34.2 (fuel pressure up-
stream of filter) | |

Right side of engine, 12V 4000 M, external cooling



- | | |
|------------------------------------|-------------------------------|
| 1 B44.2 (turbocharger B speed) | 3 B16 (coolant pressure) |
| 2 Y27 (turbocharger control valve) | 4 B9 (charge-air temperature) |

Top view, 12V 4000 M, integral cooling

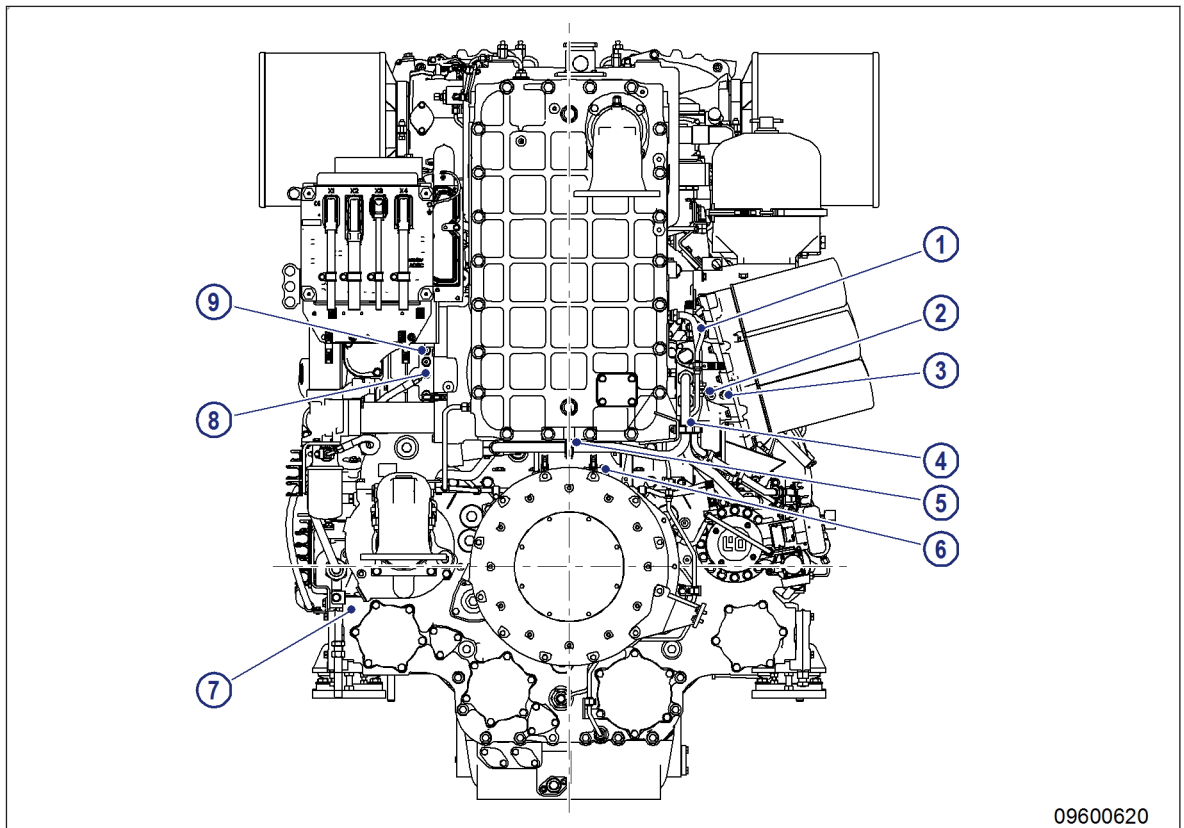


1 B4.A1-B4.B6 (single exhaust temp., A1-A6, B1-B6)

2 B33 (fuel temperature in common rail)

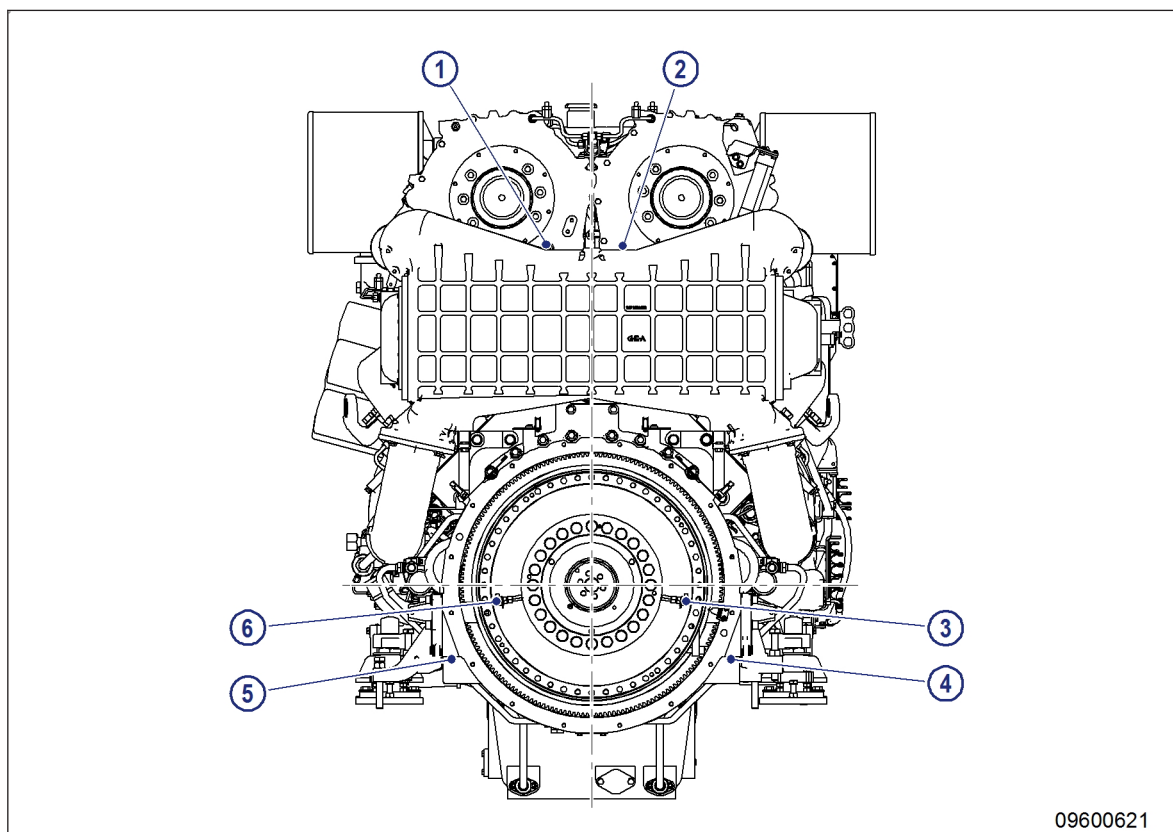
3 F33 (coolant level)

Aux. PTO end, 12V 4000 M, integral cooling



- | | | |
|--|---|----------------------------------|
| 1 B7 (engine oil temp.) | 4 B33 (fuel temperature in common rail) | 7 B54 (oil refill pump pressure) |
| 2 B5.3 (oil pressure upstream of filter) | 5 B48 (fuel pressure in common rail) | 8 B6.2 (coolant temperature) |
| 3 B5.1 (oil pressure downstream of filter) | 6 B1 (camshaft speed) | 9 B6 (coolant temperature) |

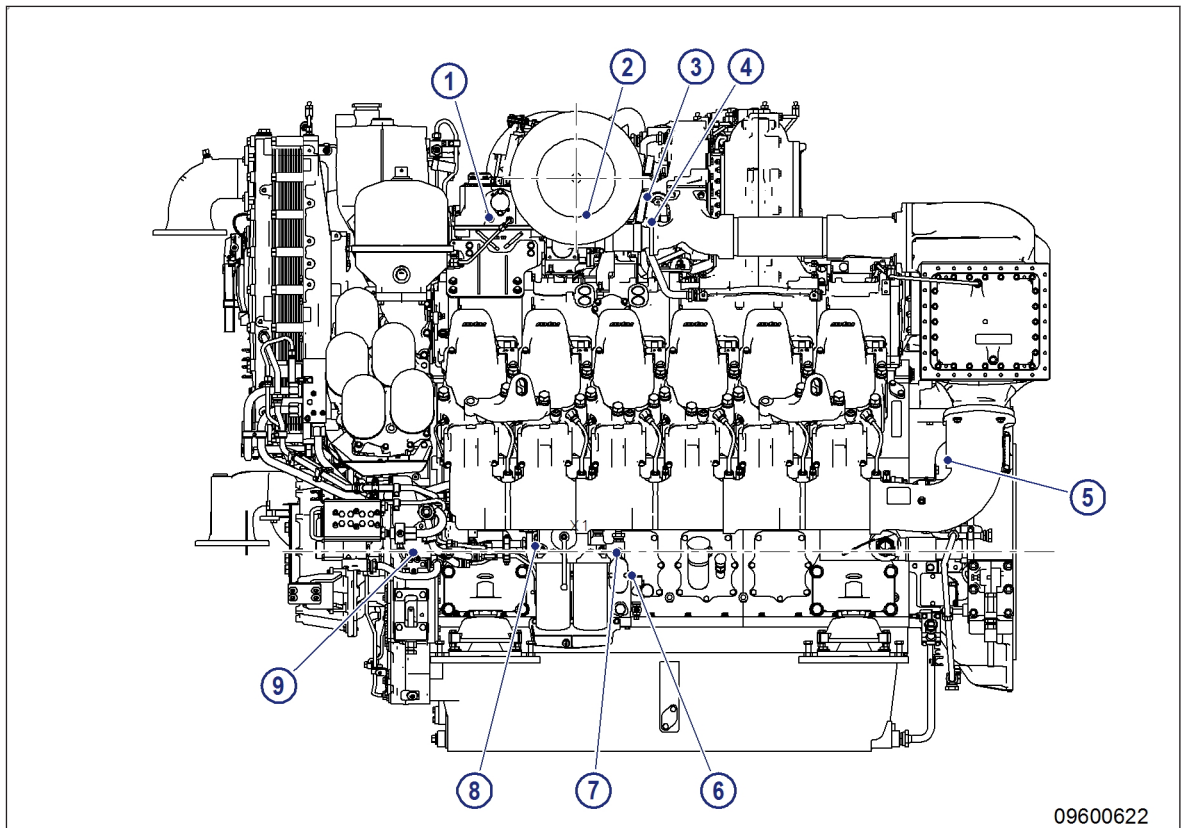
Main PTO end, 12V 4000 M, integral cooling



09600621

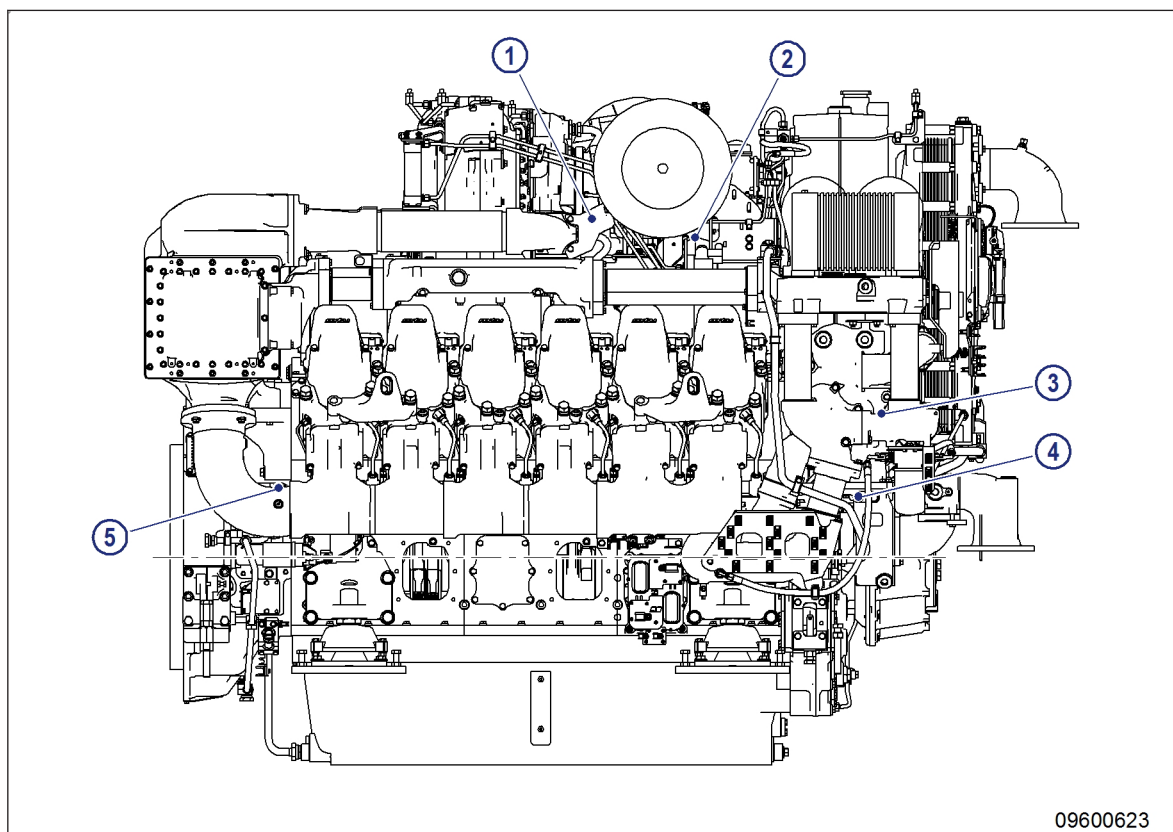
- | | | |
|---------------------------------------|--------------------------|----------------------------|
| 1 B4.21 (exhaust temperature, A bank) | 3 B13 (crankshaft speed) | 5 S37.1 (safety switch) |
| 2 B4.22 (exhaust temperature, B bank) | 4 S37.2 (safety switch) | 6 B13.2 (crankshaft speed) |

Left side of engine, 12V 4000 M, integral cooling



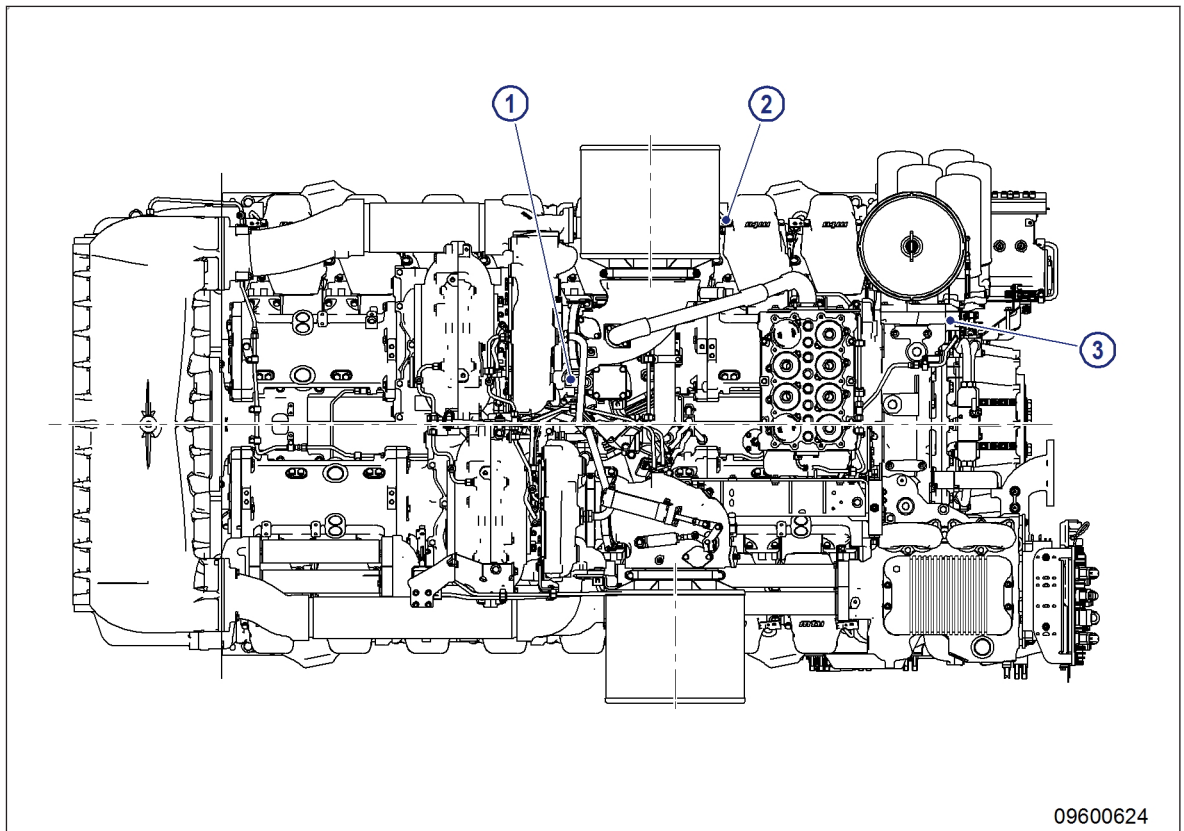
- | | | |
|---|--|--|
| 1 B50 (crankcase pressure) | 4 B44.1 (turbocharger A speed) | 7 B34.2 (fuel pressure upstream of filter) |
| 2 B49 (charge-air temp., air recirculation valve) | 5 B10 (charge-air pressure) | 8 B34.1 (fuel pressure downstream of filter) |
| Y26 (air recirculation valve A) | 6 B34.3 (fuel pressure upstream of filter) | 9 F46 (fuel overflow level) |
| 3 B3 (intake air temperature) | | |

Right side of engine, 12V 4000 M, integral cooling



- | | | |
|------------------------------------|----------------------------|-------------------------------|
| 1 B44.2 (turbocharger B speed) | 3 B16 (coolant pressure) | 5 B9 (charge-air temperature) |
| 2 Y27 (turbocharger control valve) | 4 B21 (raw water pressure) | |

Top view of 16V 4000 M with external cooling

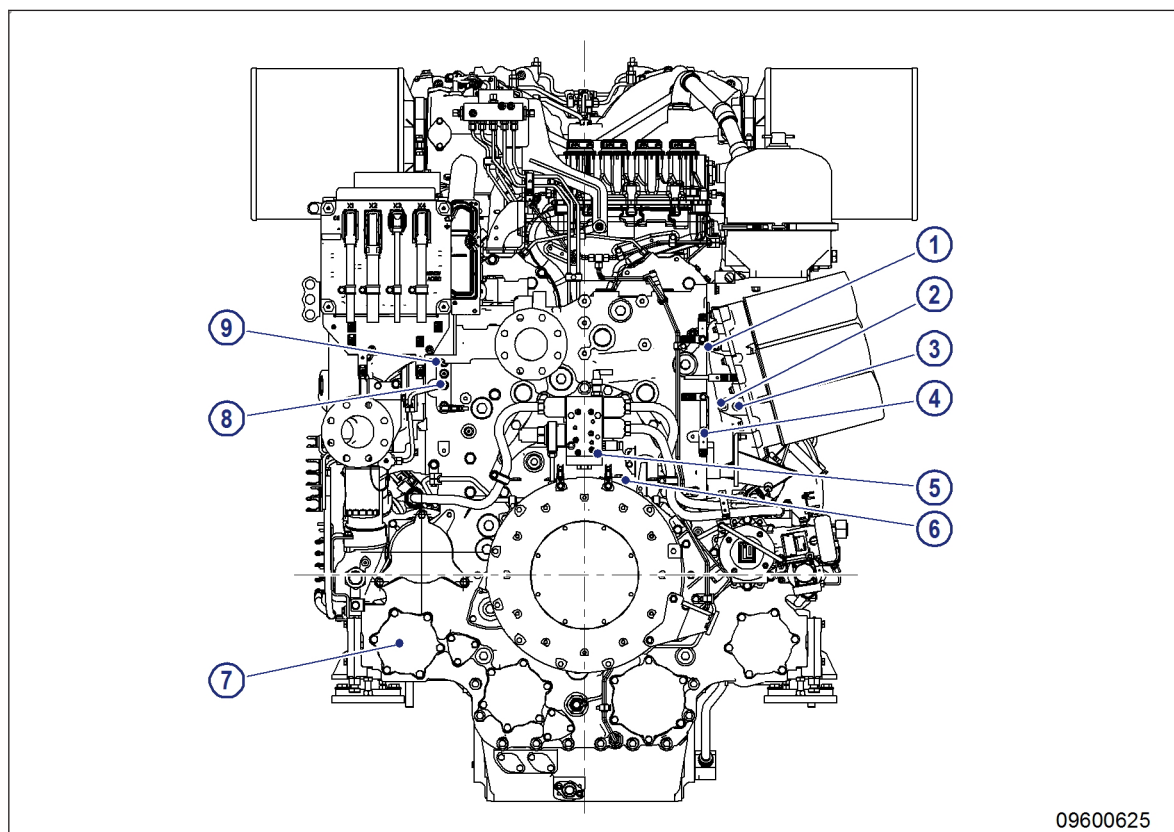


1 B49 (charge-air temp., air recirculation valve)
Y26 (air recirculation valve A)

2 B4.A1-B4.B8 (single exhaust temp., A1-A8, B1-B8)

3 B33 (fuel temperature in common rail)

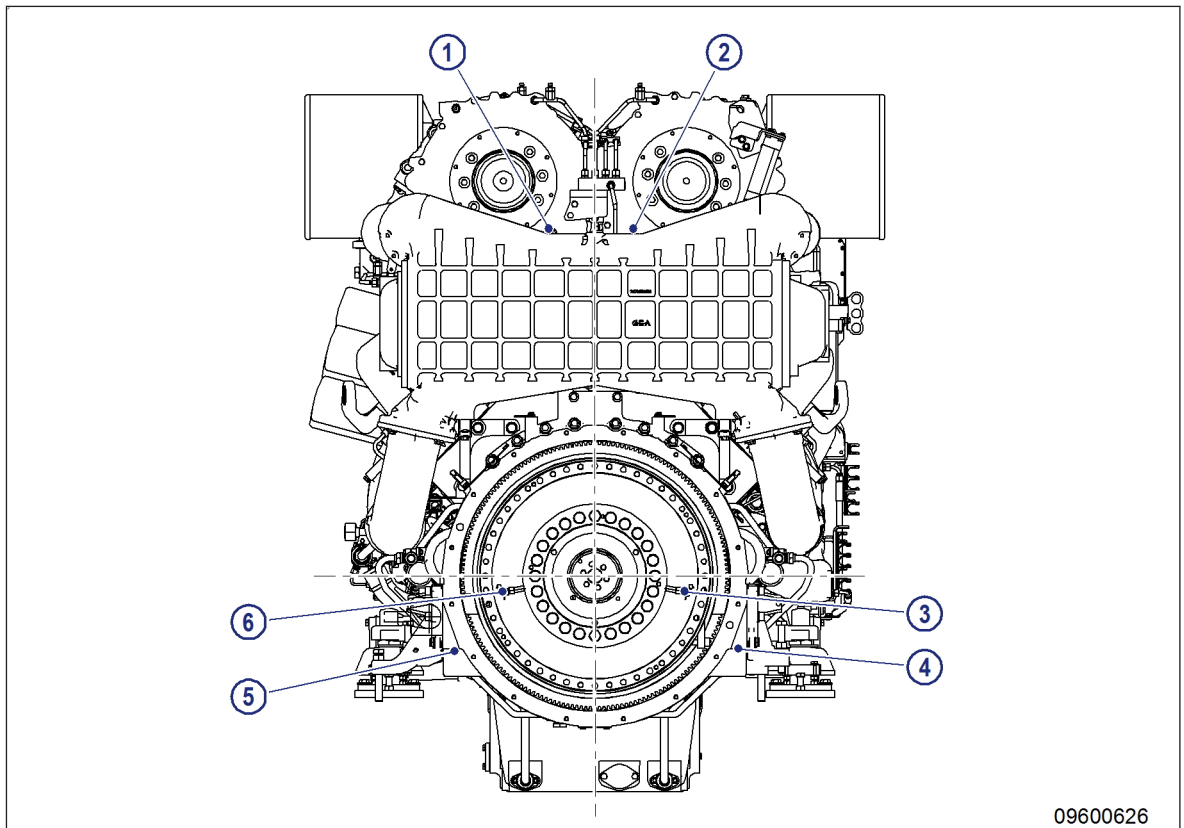
Aux. PTO end, 16V 4000 M, external cooling



09600625

- | | | |
|--|---|----------------------------------|
| 1 B7 (engine oil temp.) | 4 B33 (fuel temperature in common rail) | 7 B54 (oil refill pump pressure) |
| 2 B5.3 (oil pressure upstream of filter) | 5 B48 (fuel pressure in common rail) | 8 B6.2 (coolant temperature) |
| 3 B5.1 (oil pressure downstream of filter) | 6 B1 (camshaft speed) | 9 B6 (coolant temperature) |

Main PTO end, 16V 4000 M, external cooling

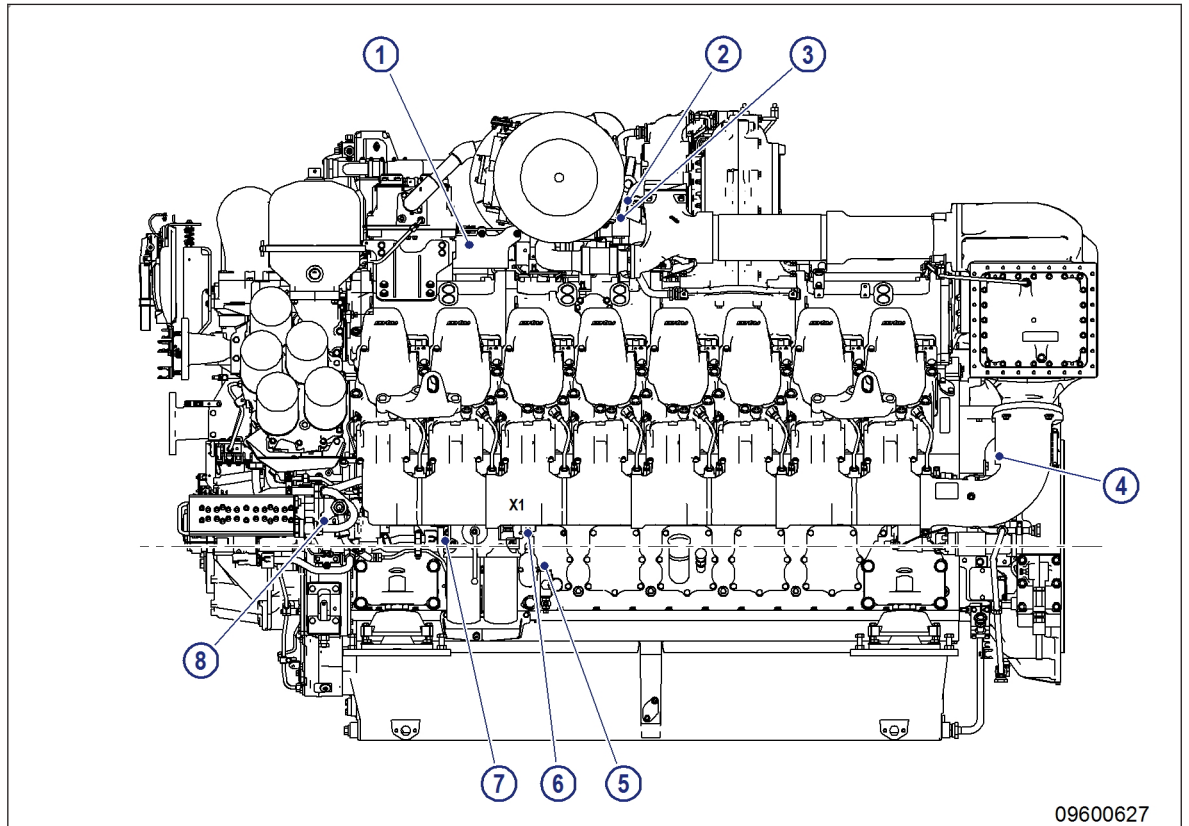


- 1 B4.21 (exhaust temperature, A bank)
- 2 B4.22 (exhaust temperature, B bank)

- 3 B13 (crankshaft speed)
- 4 S37.2 (safety switch)

- 5 S37.1 (safety switch)
- 6 B13.2 (crankshaft speed)

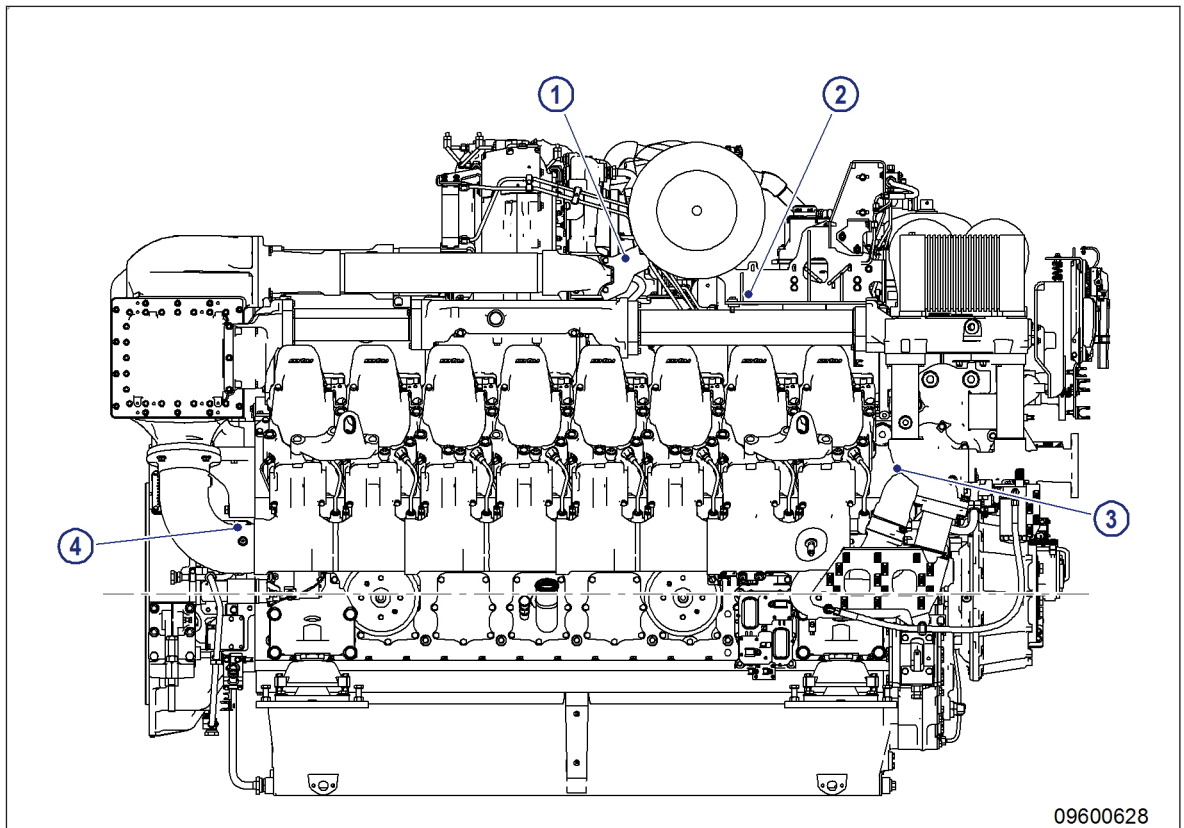
Left side of engine, 16V 4000 M, external cooling



09600627

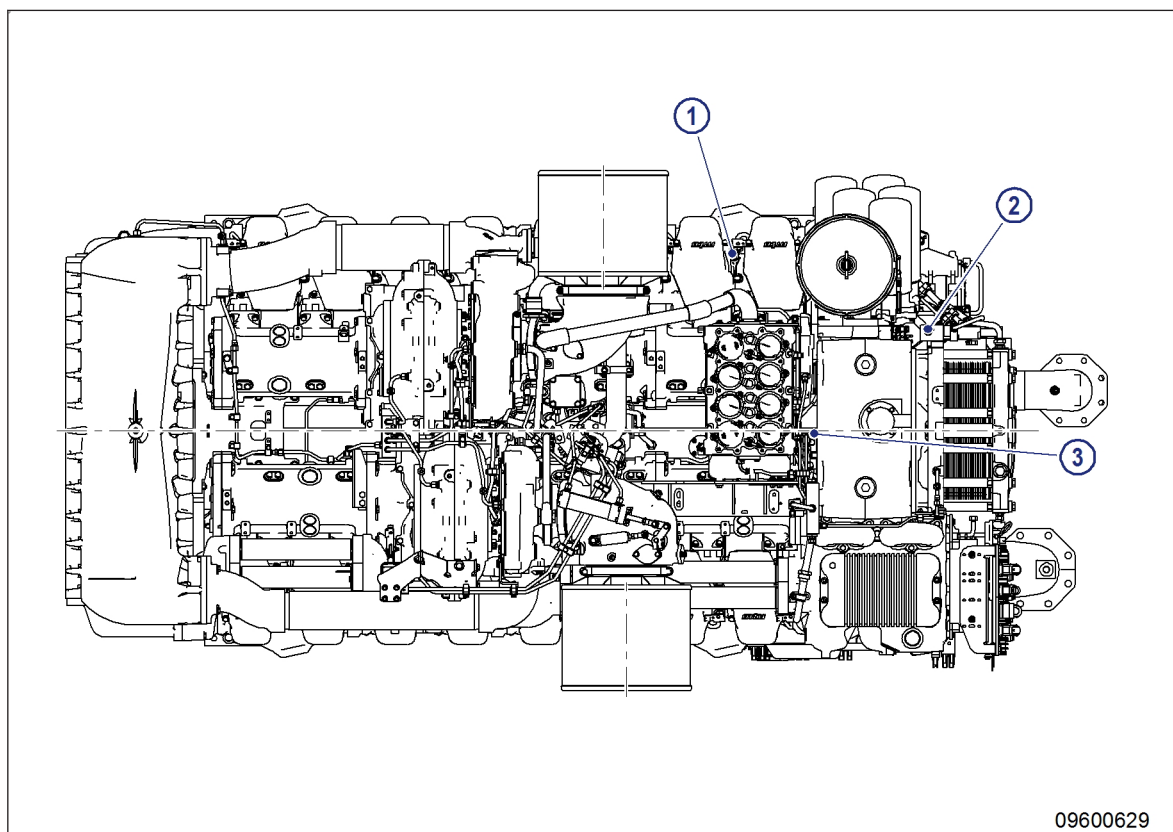
- | | | |
|-----------------------------------|---|---|
| 1 B50 (crankcase pressure) | 4 B10 (charge-air pressure) | 7 B34.1 (fuel pressure down-
stream of filter) |
| 2 B3 (intake air temperature) | 5 B34.3 (fuel pressure up-
stream of filter) | 8 F46 (fuel overflow level) |
| 3 B44.1 (turbocharger A
speed) | 6 B34.2 (fuel pressure up-
stream of filter) | |

Right side of engine, 16V 4000 M, external cooling



- | | |
|------------------------------------|-------------------------------|
| 1 B44.2 (turbocharger B speed) | 3 B16 (coolant pressure) |
| 2 Y27 (turbocharger control valve) | 4 B9 (charge-air temperature) |

Top view, 16V 4000 M, integral cooling

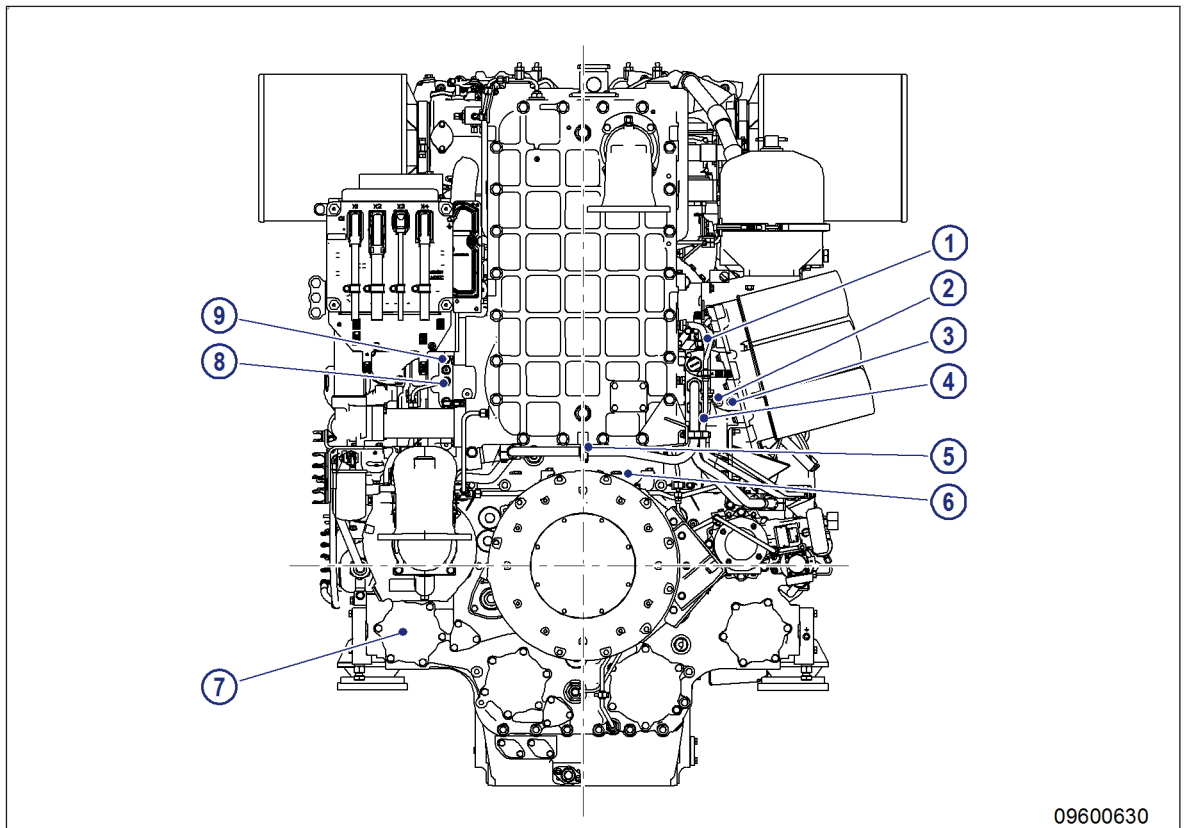


1 B4.A1-B4.B8 (single exhaust temp., A1-A8, B1-B8)

2 B33 (fuel temperature in common rail)

3 F33 (coolant level)

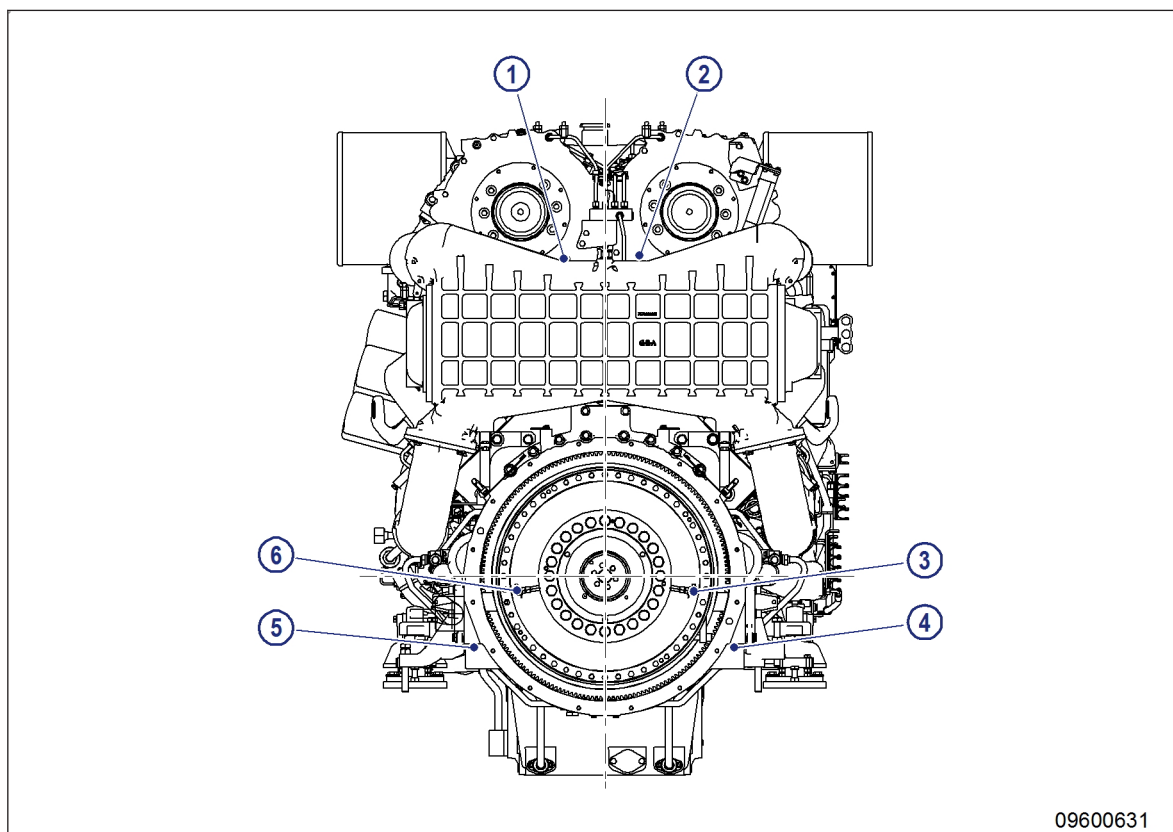
Aux. PTO end, 16V 4000 M, integral cooling



09600630

- | | | |
|--|---|----------------------------------|
| 1 B7 (engine oil temp.) | 4 B33 (fuel temperature in common rail) | 7 B54 (oil refill pump pressure) |
| 2 B5.3 (oil pressure upstream of filter) | 5 B48 (fuel pressure in common rail) | 8 B6.2 (coolant temperature) |
| 3 B5.1 (oil pressure downstream of filter) | 6 B1 (camshaft speed) | 9 B6 (coolant temperature) |

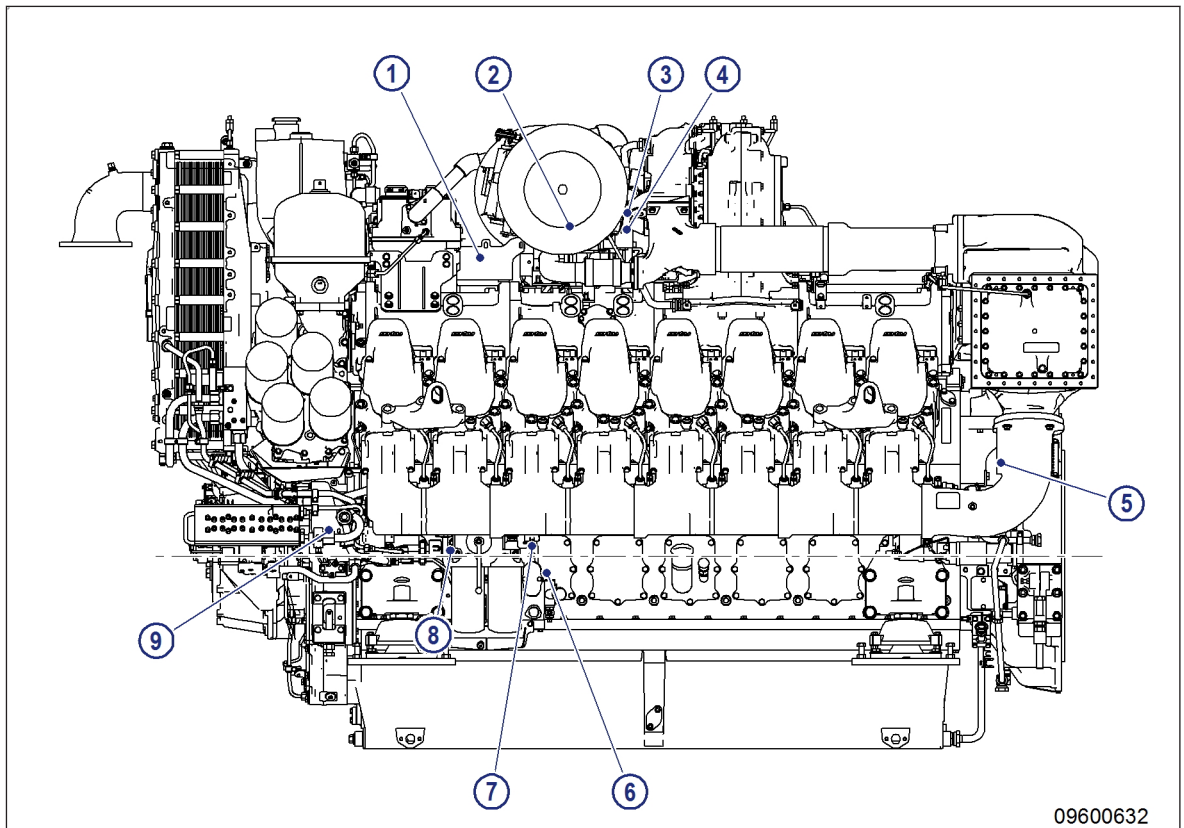
Main PTO end, 16V 4000 M, integral cooling



09600631

- | | | |
|---------------------------------------|--------------------------|----------------------------|
| 1 B4.21 (exhaust temperature, A bank) | 3 B13 (crankshaft speed) | 5 S37.1 (safety switch) |
| 2 B4.22 (exhaust temperature, B bank) | 4 S37.2 (safety switch) | 6 B13.2 (crankshaft speed) |

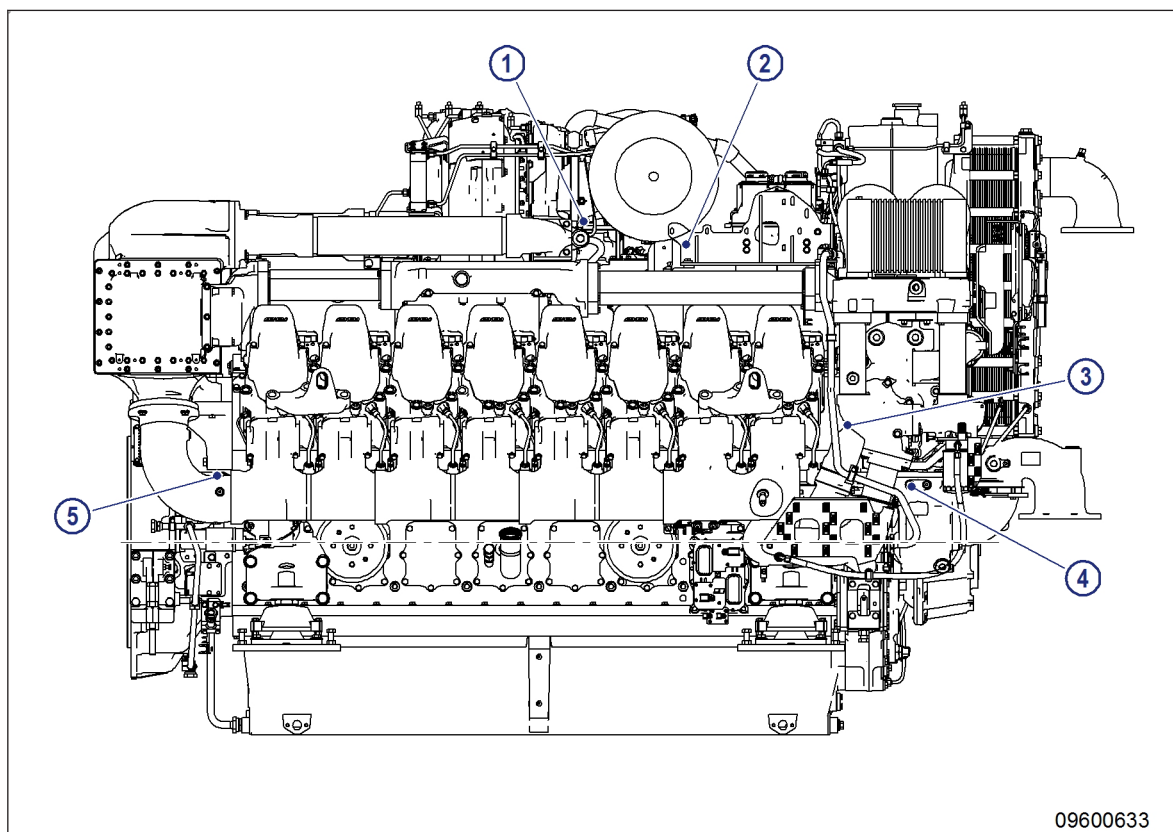
Left side of engine, 16V 4000 M, integral cooling



09600632

- | | | |
|---|--|--|
| 1 B50 (crankcase pressure) | 4 B44.1 (turbocharger A speed) | 7 B34.2 (fuel pressure upstream of filter) |
| 2 B49 (charge-air temp., air recirculation valve) | 5 B10 (charge-air pressure) | 8 B34.1 (fuel pressure downstream of filter) |
| Y26 (air recirculation valve A) | 6 B34.3 (fuel pressure upstream of filter) | 9 F46 (fuel overflow level) |
| 3 B3 (intake air temperature) | | |

Right side of engine, 16V 4000 M, integral cooling



09600633

- | | | |
|------------------------------------|----------------------------|-------------------------------|
| 1 B44.2 (turbocharger B speed) | 3 B16 (coolant pressure) | 5 B9 (charge-air temperature) |
| 2 Y27 (turbocharger control valve) | 4 B21 (raw water pressure) | |

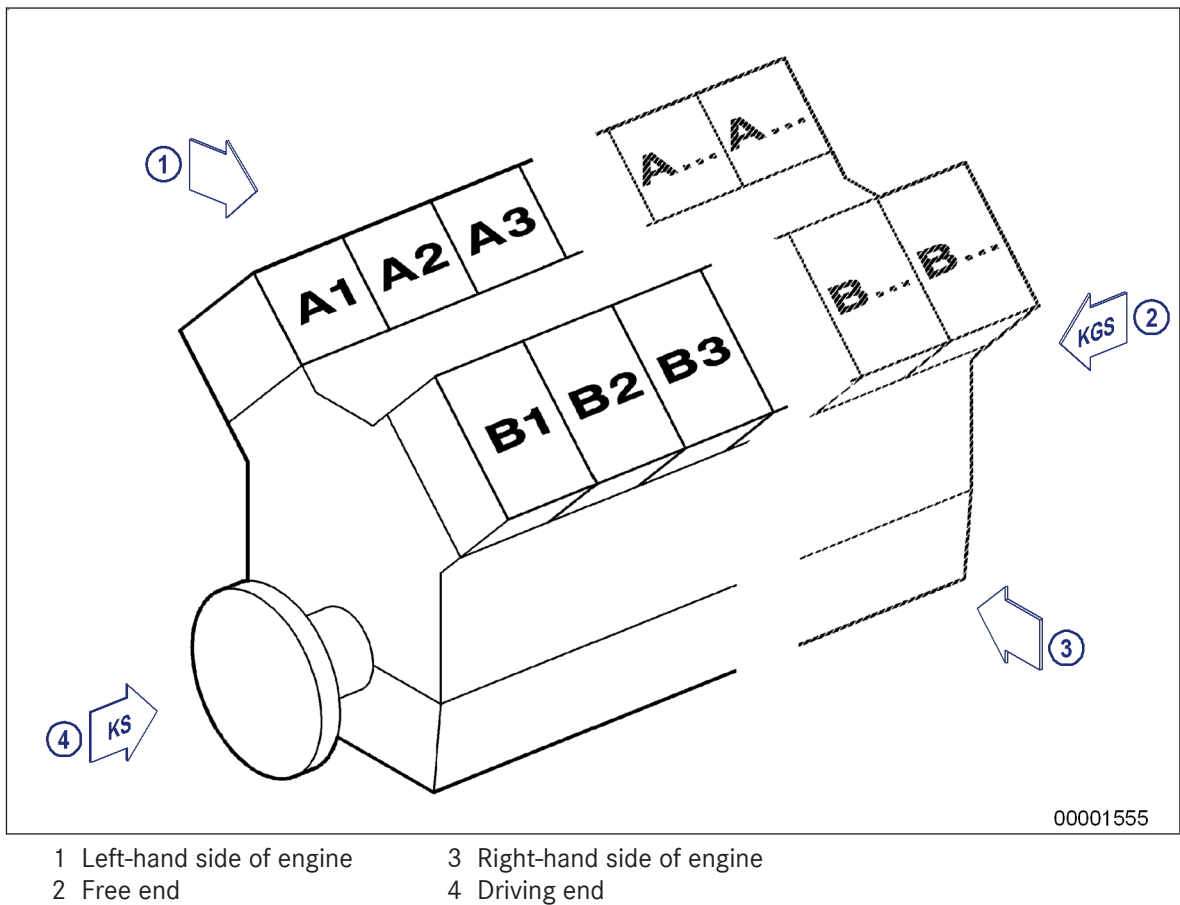
2.2 Engine Side and Cylinder Designations

2.2.1 Engine side and cylinder designations

Engine sides are always designated as viewed from the driving end (KS) (4).

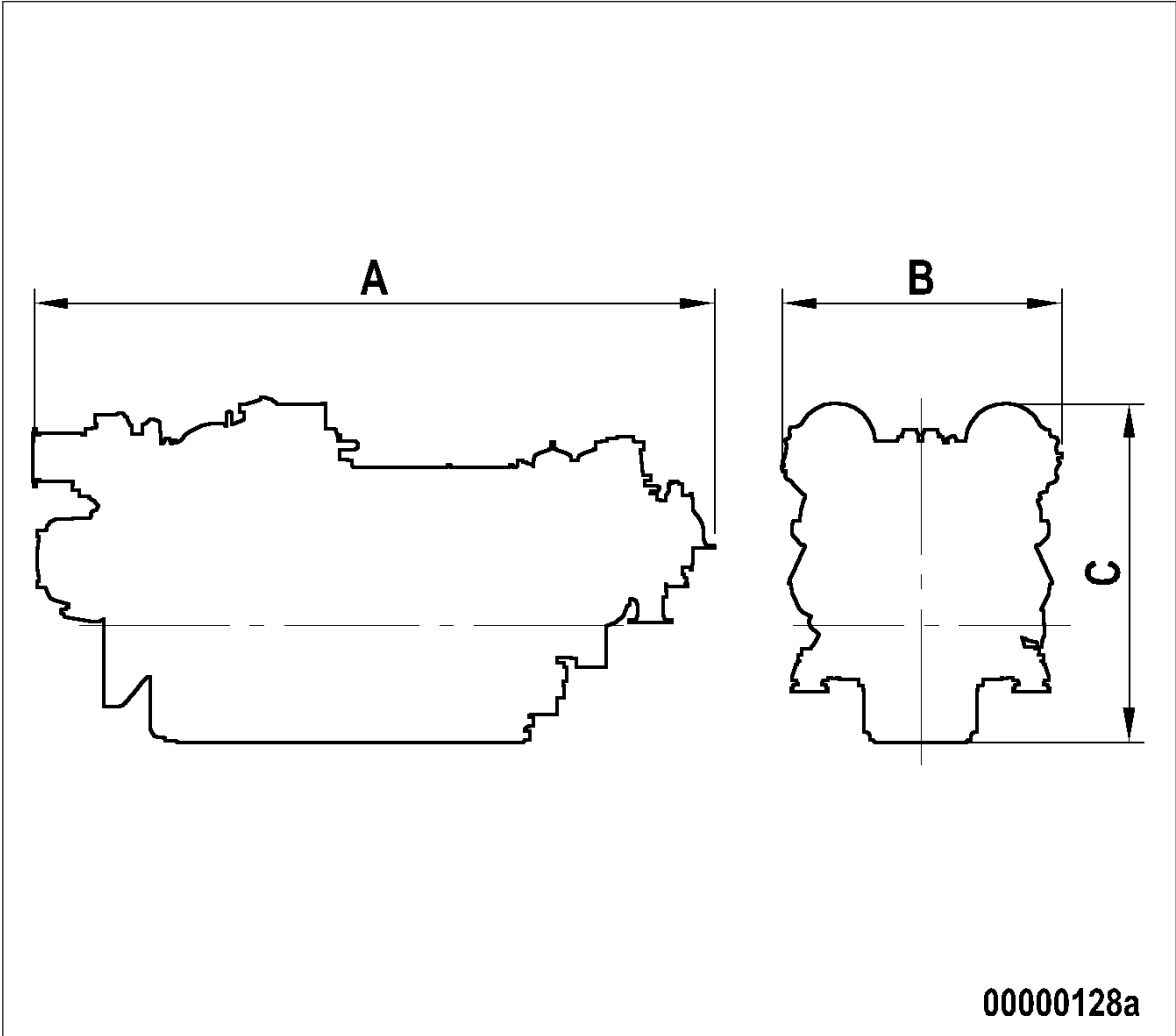
For designation of the cylinders (to DIN ISO 1204) the letter "A" (1) is used to refer to the cylinders on the left-hand side of the engine and the letter "B" (3) to refer to the cylinders on the right-hand side. The cylinders of each bank are numbered consecutively, starting with No. 1 at the driving end.

The numbering of other engine components also starts with no. 1 at the driving end.



2.3 Main Engine Dimensions

2.3.1 Engine - Main dimensions



Engines with horizontal air intake

With remote heat exchanger

Engine model	Length (A)	Width (B) without silencer	Width (B) with silencer	Height (C)
16V 4000 M23S/23F/33S/33F/ 43S 16V 4000 M53R/ 53/63R/63/63L	approx. 3108 mm	approx. 1690 mm	approx. 1850 mm	approx. 2064 mm

With engine-mounted heat exchanger

Engine model	Length (A)	Width (B) without silencer	Width (B) with silencer	Height (C)
16V 4000 M23S/23F/33S/33F/ 43S	approx. 3388 mm	approx. 1690 mm	approx. 1850 mm	approx. 2064 mm

Engine model	Length (A)	Width (B) without silencer	Width (B) with silencer	Height (C)
16V 4000 M53R/53/63R/63/63L				

Engines with vertical air intake

With remote heat exchanger

Engine model	Length (A)	Width (B)	Height (C) without silencer	Height (C) with silencer
12V 4000 M23S/23F/33S/33F 12V 4000 M53R/53/63	approx. 2628 mm	approx. 1602 mm	approx. 2368 mm	approx. 2448 mm
16V 4000 M23S/23F/33S/33F/43S 16V 4000 M53R/53/63R/63/63L	approx. 3108 mm	approx. 1602 mm	approx. 2361 mm	approx. 2441 mm

With engine-mounted heat exchanger

Engine model	Length (A)	Width (B)	Height (C) without silencer	Height (C) with silencer
12V 4000 M23S/23F/33S/33F 12V 4000 M53R/53/63	approx. 2857 mm	approx. 1602 mm	approx. 2368 mm	approx. 2448 mm
16V 4000 M23S/23F/33S/33F/43S 16V 4000 M53R/53/63R/63/63L	approx. 3388 mm	approx. 1602 mm	approx. 2361 mm	approx. 2441 mm

2.4 Firing Sequence

2.4.1 Firing order

Cylinders	Firing order
12 V	A1-B5-A5-B3-A3-B6-A6-B2-A2-B4-A4-B1
16 V	A1-A7-B4-B6-A4-B8-A2-A8-B3-B5-A3-A5-B2-A6-B1-B7

2.5 Technical Data

2.5.1 12V 4000 M23F engine data, RheinSchUO, stage II, IMO Tier II

Explanation:

- DL Ref. value: Continuous power
- BL Ref. value: Fuel stop power
- A Design value
- G Guaranteed value
- R Guideline value
- L Limit value, up to which the engine can be operated, without change (e.g. of power settings).
- N Not yet defined value
- Not applicable
- X Applicable

			Heat exchanger mounted		Heat exchanger separate	
Application group			3A	3A	3A	3A
Intake-air temperature		°C	25	32	25	32
Charge-air coolant temperature		°C	-	-	-	-
Raw-water inlet temperature		°C	25	45	25	45
Barometric pressure		mbar	1000	1000	1000	1000
Site altitude above sea level		m	100	100	100	100

POWER DATA (power ratings are net brake power as per ISO 3046)

			Heat exchanger mounted		Heat exchanger separate	
Rated engine speed	A	rpm	1500	1500	1500	1500
Continuous power ISO 3046 (10% overload capability, design power DIN 6280, ISO 8528)	A	kW	1140	1140	1140	1140

GENERAL CONDITIONS (for maximum power)

			Heat exchanger mounted		Heat exchanger separate	
Intake depression (new filter)	A	mbar	15	15	15	15
Intake depression, max.	L	mbar	30	30	30	30

MODEL-RELATED DATA (basic design)

			Heat exchanger mounted		Heat exchanger separate	
Cylinder arrangement: V-angle		Degrees (°)	90	90	90	90
Bore		mm	170	170	170	170
Stroke		mm	210	210	210	210
Cylinder displacement		Liters	4.77	4.77	4.77	4.77
Total displacement		Liters	57.2	57.2	57.2	57.2

TIM-ID: 000002715 - 001

			Heat exchanger mounted		Heat exchanger separate	
Number of inlet valves per cylinder			2	2	2	2
Number of exhaust valves per cylinder			2	2	2	2

RAW-WATER CIRCUIT (open circuit)

			Heat exchanger mounted		Heat exchanger separate	
Raw-water pump: Inlet pressure, min.	L	bar	-0.4	-0.4	–	–
Raw-water pump: Inlet pressure, max.	L	bar	1.0	1.0	–	–
Pressure loss in engine-external raw-water system, max.	L	bar	N	N	–	–

LUBE-OIL SYSTEM

			Heat exchanger mounted		Heat exchanger separate	
Lube-oil operating temperature before engine, from	R	°C	81	81	81	81
Lube-oil operating temperature before engine, to	R	°C	89	89	89	89
Lube-oil operating pressure before engine, from	R	bar	5.0	5.0	5.0	5.0
Lube-oil operating pressure before engine, to	R	bar	6.0	6.0	6.0	6.0
Lube-oil operating pressure (low idle) (meas. point: before engine)	R	bar				

FUEL SYSTEM

			Heat exchanger mounted		Heat exchanger separate	
Fuel pressure at supply connection to engine, min. (when engine is starting)	L	bar	-0.1	-0.1	-0.1	-0.1
Fuel pressure at supply connection to engine, min. (when engine is running)	L	bar	-0.3	-0.3	-0.3	-0.3
Fuel pressure at supply connection to engine, max. (when engine is starting)	L	bar	1.5	1.5	1.5	1.5
Fuel supply flow, max.	A	Liters/min				

GENERAL OPERATING DATA

			Heat exchanger mounted		Heat exchanger separate	
Firing speed, from	R	rpm	80	80	80	80
Firing speed, to	R	rpm	120	120	120	120

STARTING SYSTEM (electric)

			Heat exchanger mounted		Heat exchanger separate	
Rated starter voltage (standard design)	R	V=	24	24	24	24

STARTING (with compressed air/hydraulic starter)

			Heat exchanger mounted		Heat exchanger separate	
Starting-air pressure before starter, min.	R	bar	8	8	8	8
Starting-air pressure before starter, max.	R	bar	10	10	10	10

CAPACITIES

			Heat exchanger mounted		Heat exchanger separate	
Engine coolant, engine-side (with cooling system)	R	Liters	305	305	—	—
Engine oil, total, for initial filling (standard oil system) (option: max. operating inclinations)	R	Liters	N	N	N	N
Oil change quantity, max. (standard oil system) (option: max. operating inclinations)	R	Liters	265	265	265	265
Oil pan capacity at dipstick mark "min." (standard oil system) (option: max. operating inclinations)	L	Liters	195	195	195	195
Oil pan capacity at dipstick mark "max." (standard oil system) (option: max. operating inclinations)	L	Liters	235	235	235	235

WEIGHTS / MAIN DIMENSIONS

			Heat exchanger mounted		Heat exchanger separate	
Engine dry weight (with attached standard accessories, without coupling)	R	kg	7640	7640	7240	7240

ACOUSTICS

			Heat exchanger mounted		Heat exchanger separate	
Exhaust noise, unsilenced - DL (free-field sound pressure level L_p , 1m distance, ISO 6798, +3dB(A) tolerance)	R	dB(A)	105	105	105	105

TIM-ID: 000002715 - 001

2.5.2 12V 4000 M23S engine data, RheinSchUO, stage II, IMO Tier II

Explanation:

DL Ref. value: Continuous power

BL Ref. value: Fuel stop power

A Design value

G Guaranteed value

R Guideline value

L Limit value, up to which the engine can be operated, without change (e.g. of power settings).

N Not yet defined value

- Not applicable

X Applicable

			Heat exchanger mounted		Heat exchanger separate	
Application group			3A	3A	3A	3A
Intake-air temperature		°C	25	45	25	45
Charge-air coolant temperature		°C	-	-	-	-
Raw-water inlet temperature		°C	25	32	25	32
Barometric pressure		mbar	1000	1000	1000	1000
Site altitude above sea level		m	100	100	100	100

POWER DATA (power ratings are net brake power as per ISO 3046)

			Heat exchanger mounted		Heat exchanger separate	
Rated engine speed	A	rpm	1800	1800	1800	1800
Continuous power ISO 3046 (10% overload capability, design power DIN 6280, ISO 8528)	A	kW	1380	1380	1380	1380

GENERAL CONDITIONS (for maximum power)

			Heat exchanger mounted		Heat exchanger separate	
Intake depression (new filter)	A	mbar	15	15	15	15
Intake depression, max.	L	mbar	30	30	30	30

MODEL-RELATED DATA (basic design)

			Heat exchanger mounted		Heat exchanger separate	
Cylinder arrangement: V-angle		Degrees (°)	90	90	90	90
Bore		mm	170	170	170	170
Stroke		mm	210	210	210	210
Cylinder displacement		Liters	4.77	4.77	4.77	4.77
Total displacement		Liters	57.2	57.2	57.2	57.2
Number of inlet valves per cylinder			2	2	2	2
Number of exhaust valves per cylinder			2	2	2	2

RAW-WATER CIRCUIT (open circuit)

			Heat exchanger mounted		Heat exchanger separate	
Raw-water pump: Inlet pressure, min.	L	bar	-0.4	-0.4	—	—
Raw-water pump: Inlet pressure, max.	L	bar	1.0	1.0	—	—
Pressure loss in engine-external raw-water system, max.	L	bar	N	N	—	—

LUBE-OIL SYSTEM

			Heat exchanger mounted		Heat exchanger separate	
Lube-oil operating temperature before engine, from	R	°C	84	85	84	85
Lube-oil operating temperature before engine, to	R	°C	92	93	92	93
Lube-oil operating pressure before engine, from	R	bar	5.5	5.5	5.5	5.5
Lube-oil operating pressure before engine, to	R	bar	6.5	6.5	6.5	6.5
Lube-oil operating pressure (low idle) (meas. point: before engine)	R	bar				

FUEL SYSTEM

			Heat exchanger mounted		Heat exchanger separate	
Fuel pressure at supply connection to engine, min. (when engine is starting)	L	bar	-0.1	-0.1	-0.1	-0.1
Fuel pressure at supply connection to engine, min. (when engine is running)	L	bar	-0.3	-0.3	-0.3	-0.3
Fuel pressure at supply connection to engine, max. (when engine is starting)	L	bar	1.5	1.5	1.5	1.5
Fuel supply flow, max.	A	Liters/min				

GENERAL OPERATING DATA

			Heat exchanger mounted		Heat exchanger separate	
Firing speed, from	R	rpm	80	80	80	80
Firing speed, to	R	rpm	120	120	120	120

STARTING SYSTEM (electric)

			Heat exchanger mounted		Heat exchanger separate	
Rated starter voltage (standard design)	R	V=	24	24	24	24

TIM-ID: 000002718 - 001

STARTING (with compressed air/hydraulic starter)

			Heat exchanger mounted		Heat exchanger separate	
Starting-air pressure before starter, min.	R	bar	8	8	8	8
Starting-air pressure before starter, max.	R	bar	10	10	10	10

CAPACITIES

			Heat exchanger mounted		Heat exchanger separate	
Engine coolant, engine-side (with cooling system)	R	Liters	305	305	–	–
Engine oil, total, for initial filling (standard oil system) (option: max. operating inclinations)	R	Liters	N	N	N	N
Oil change quantity, max. (standard oil system) (option: max. operating inclinations)	R	Liters	265	265	265	265
Oil pan capacity at dipstick mark "min." (standard oil system) (option: max. operating inclinations)	L	Liters	195	195	195	195
Oil pan capacity at dipstick mark "max." (standard oil system) (option: max. operating inclinations)	L	Liters	235	235	235	235

WEIGHTS / MAIN DIMENSIONS

			Heat exchanger mounted		Heat exchanger separate	
Engine dry weight (with attached standard accessories, without coupling)	R	kg	7640	7640	7240	7240

ACOUSTICS

			Heat exchanger mounted		Heat exchanger separate	
Exhaust noise, unsilenced - DL (free-field sound pressure level Lp, 1m distance, ISO 6798, +3dB(A) tolerance)	R	dB(A)	106	106	106	106

2.5.3 12V 4000 M23S engine data, IMO Tier II, EPA Tier 2

Explanation:

DL Ref. value: Continuous power

BL Ref. value: Fuel stop power

A Design value

G Guaranteed value

R Guideline value

L Limit value, up to which the engine can be operated, without change (e.g. of power settings).

N Not yet defined value

- Not applicable

X Applicable

			Heat exchanger mounted		Heat exchanger separate	
Application group			3A	3A	3A	3A
Intake-air temperature		°C	25	45	25	45
Charge-air coolant temperature		°C	-	-	-	-
Raw-water inlet temperature		°C	25	32	25	32
Barometric pressure		mbar	1000	1000	1000	1000
Site altitude above sea level		m	100	100	100	100

POWER DATA (power ratings are net brake power as per ISO 3046)

			Heat exchanger mounted		Heat exchanger separate	
Rated engine speed	A	rpm	1800	1800	1800	1800
Continuous power ISO 3046 (10% overload capability, design power DIN 6280, ISO 8528)	A	kW	1380	1380	1380	1380

GENERAL CONDITIONS (for maximum power)

			Heat exchanger mounted		Heat exchanger separate	
Intake depression (new filter)	A	mbar	15	15	15	15
Intake depression, max.	L	mbar	30	30	30	30

MODEL-RELATED DATA (basic design)

			Heat exchanger mounted		Heat exchanger separate	
Cylinder arrangement: V-angle		Degrees (°)	90	90	90	90
Bore		mm	170	170	170	170
Stroke		mm	210	210	210	210
Cylinder displacement		Liters	4.77	4.77	4.77	4.77
Total displacement		Liters	57.2	57.2	57.2	57.2
Number of inlet valves per cylinder			2	2	2	2
Number of exhaust valves per cylinder			2	2	2	2

TIM-ID: 000002719 - 001

RAW-WATER CIRCUIT (open circuit)

			Heat exchanger mounted		Heat exchanger separate	
Raw-water pump: Inlet pressure, min.	L	bar	-0.4	-0.4	–	–
Raw-water pump: Inlet pressure, max.	L	bar	1.0	1.0	–	–
Pressure loss in engine-external raw-water system, max.	L	bar	N	N	–	–

LUBE-OIL SYSTEM

			Heat exchanger mounted		Heat exchanger separate	
Lube-oil operating temperature before engine, from	R	°C	85	85	85	85
Lube-oil operating temperature before engine, to	R	°C	93	93	93	93
Lube-oil operating pressure before engine, from	R	bar	5.5	5.5	5.5	5.5
Lube-oil operating pressure before engine, to	R	bar	6.5	6.5	6.5	6.5
Lube-oil operating pressure (low idle) (meas. point: before engine)	R	bar				

FUEL SYSTEM

			Heat exchanger mounted		Heat exchanger separate	
Fuel pressure at supply connection to engine, min. (when engine is starting)	L	bar	-0.1	-0.1	-0.1	-0.1
Fuel pressure at supply connection to engine, min. (when engine is running)	L	bar	-0.3	-0.3	-0.3	-0.3
Fuel pressure at supply connection to engine, max. (when engine is starting)	L	bar	1.5	1.5	1.5	1.5
Fuel supply flow, max.	A	Liters/min				

GENERAL OPERATING DATA

			Heat exchanger mounted		Heat exchanger separate	
Firing speed, from	R	rpm	80	80	80	80
Firing speed, to	R	rpm	120	120	120	120

STARTING SYSTEM (electric)

			Heat exchanger mounted		Heat exchanger separate	
Rated starter voltage (standard design)	R	V=	24	24	24	24

STARTING (with compressed air/hydraulic starter)

			Heat exchanger mounted		Heat exchanger separate	
Starting-air pressure before starter, min.	R	bar	8	8	8	8
Starting-air pressure before starter, max.	R	bar	10	10	10	10

CAPACITIES

			Heat exchanger mounted		Heat exchanger separate	
Engine coolant, engine-side (with cooling system)	R	Liters	305	305	—	—
Engine oil, total, for initial filling (standard oil system) (option: max. operating inclinations)	R	Liters	N	N	N	N
Oil change quantity, max. (standard oil system) (option: max. operating inclinations)	R	Liters	265	265	265	265
Oil pan capacity at dipstick mark "min." (standard oil system) (option: max. operating inclinations)	L	Liters	195	195	195	195
Oil pan capacity at dipstick mark "max." (standard oil system) (option: max. operating inclinations)	L	Liters	235	235	235	235

WEIGHTS / MAIN DIMENSIONS

			Heat exchanger mounted		Heat exchanger separate	
Engine dry weight (with attached standard accessories, without coupling)	R	kg	7640	7640	7240	7240

ACOUSTICS

			Heat exchanger mounted		Heat exchanger separate	
Exhaust noise, unsilenced - DL (free-field sound pressure level Lp, 1m distance, ISO 6798, +3dB(A) tolerance)	R	dB(A)	106	106	106	106

2.5.4 16V 4000 M23F engine data, RheinSchUO, stage II, IMO Tier II

Explanation:

DL Ref. value: Continuous power

BL Ref. value: Fuel stop power

A Design value

G Guaranteed value

R Guideline value

L Limit value, up to which the engine can be operated, without change (e.g. of power settings).

N Not yet defined value

- Not applicable

X Applicable

			Heat exchanger mounted		Heat exchanger separate	
Application group			3A	3A	3A	3A
Intake-air temperature		°C	25	45	25	45
Charge-air coolant temperature		°C	–	–	–	–
Raw-water inlet temperature		°C	25	32	25	32
Barometric pressure		mbar	1000	1000	1000	1000
Site altitude above sea level		m	100	100	100	100

POWER DATA (power ratings are net brake power as per ISO 3046)

			Heat exchanger mounted		Heat exchanger separate	
Rated engine speed	A	rpm	1500	1500	1500	1500
Continuous power ISO 3046 (10% overload capability, design power DIN 6280, ISO 8528)	A	kW	1520	1520	1520	1520

GENERAL CONDITIONS (for maximum power)

			Heat exchanger mounted		Heat exchanger separate	
Intake depression (new filter)	A	mbar	15	15	15	15
Intake depression, max.	L	mbar	30	30	30	30

MODEL-RELATED DATA (basic design)

			Heat exchanger mounted		Heat exchanger separate	
Cylinder arrangement: V-angle		Degrees (°)	90	90	90	90
Bore		mm	170	170	170	170
Stroke		mm	210	210	210	210
Cylinder displacement		Liters	4.77	4.77	4.77	4.77
Total displacement		Liters	76.3	76.3	76.3	76.3
Number of inlet valves per cylinder			2	2	2	2
Number of exhaust valves per cylinder			2	2	2	2

RAW-WATER CIRCUIT (open circuit)

			Heat exchanger mounted		Heat exchanger separate	
Raw-water pump: Inlet pressure, min.	L	bar	-0.4	-0.4	—	—
Raw-water pump: Inlet pressure, max.	L	bar	1.0	1.0	—	—
Pressure loss in engine-external raw-water system, max.	L	bar	1.0	1.0	—	—

LUBE-OIL SYSTEM

			Heat exchanger mounted		Heat exchanger separate	
Lube-oil operating temperature before engine, from	R	°C	80	80	80	80
Lube-oil operating temperature before engine, to	R	°C	88	88	88	88
Lube-oil operating pressure before engine, from	R	bar	5.0	5.0	5.0	5.0
Lube-oil operating pressure before engine, to	R	bar	6.0	6.0	6.0	6.0
Lube-oil operating pressure (low idle) (meas. point: before engine)	R	bar	—	—	—	—

FUEL SYSTEM

			Heat exchanger mounted		Heat exchanger separate	
Fuel pressure at supply connection to engine, min. (when engine is starting)	L	bar	-0.1	-0.1	-0.1	-0.1
Fuel pressure at supply connection to engine, min. (when engine is running)	L	bar	-0.3	-0.3	-0.3	-0.3
Fuel pressure at supply connection to engine, max. (when engine is starting)	L	bar	1.5	1.5	1.5	1.5
Fuel supply flow, max.	A	Liters/min				

GENERAL OPERATING DATA

			Heat exchanger mounted		Heat exchanger separate	
Firing speed, from	R	rpm	80	80	80	80
Firing speed, to	R	rpm	120	120	120	120

STARTING SYSTEM (electric)

			Heat exchanger mounted		Heat exchanger separate	
Rated starter voltage (standard design)	R	V=	24	24	24	24

TIM-ID: 0000022717 - 001

STARTING (with compressed air/hydraulic starter)

			Heat exchanger mounted		Heat exchanger separate	
Starting-air pressure before starter, min.	R	bar	8	8	8	8
Starting-air pressure before starter, max.	R	bar	9	9	9	9

CAPACITIES

			Heat exchanger mounted		Heat exchanger separate	
Engine coolant, engine-side (with cooling system)	R	Liters	350	350	–	–
Engine oil, total, for initial filling (standard oil system) (option: max. operating inclinations)	R	Liters	N	N	N	N
Oil change quantity, max. (standard oil system) (option: max. operating inclinations)	R	Liters	280	280	280	280
Oil pan capacity at dipstick mark "min." (standard oil system) (option: max. operating inclinations)	L	Liters	210	210	210	210
Oil pan capacity at dipstick mark "max." (standard oil system) (option: max. operating inclinations)	L	Liters	250	250	250	250

WEIGHTS / MAIN DIMENSIONS

			Heat exchanger mounted		Heat exchanger separate	
Engine dry weight (with attached standard accessories, without coupling)	R	kg	9020	9020	8590	8590

ACOUSTICS

			Heat exchanger mounted		Heat exchanger separate	
Exhaust noise, unsilenced - DL (free-field sound pressure level Lp, 1m distance, ISO 6798, +3dB(A) tolerance)	R	dB(A)	108	108	108	108

2.5.5 16V 4000 M23S engine data, RheinSchUO, stage II, IMO Tier II

Explanation:

DL Ref. value: Continuous power

BL Ref. value: Fuel stop power

A Design value

G Guaranteed value

R Guideline value

L Limit value, up to which the engine can be operated, without change (e.g. of power settings).

N Not yet defined value

- Not applicable

X Applicable

			Heat exchanger mounted		Heat exchanger separate	
Application group			3A	3A	3A	3A
Intake-air temperature		°C	25	45	25	45
Charge-air coolant temperature		°C	–	–	–	–
Raw-water inlet temperature		°C	25	32	25	32
Barometric pressure		mbar	1000	1000	1000	1000
Site altitude above sea level		m	100	100	100	100

POWER DATA (power ratings are net brake power as per ISO 3046)

			Heat exchanger mounted		Heat exchanger separate	
Rated engine speed	A	rpm	1800	1800	1800	1800
Continuous power ISO 3046 (10% overload capability, design power DIN 6280, ISO 8528)	A	kW	1840	1840	1840	1840

GENERAL CONDITIONS (for maximum power)

			Heat exchanger mounted		Heat exchanger separate	
Intake depression (new filter)	A	mbar	15	15	15	15
Intake depression, max.	L	mbar	30	30	30	30

MODEL-RELATED DATA (basic design)

			Heat exchanger mounted		Heat exchanger separate	
Cylinder arrangement: V-angle		Degrees (°)	90	90	90	90
Bore		mm	170	170	170	170
Stroke		mm	210	210	210	210
Cylinder displacement		Liters	4.77	4.77	4.77	4.77
Total displacement		Liters	76.3	76.3	76.3	76.3
Number of inlet valves per cylinder			2	2	2	2
Number of exhaust valves per cylinder			2	2	2	2

TIM-ID: 0000022720 - 001

RAW-WATER CIRCUIT (open circuit)

			Heat exchanger mounted		Heat exchanger separate	
Raw-water pump: Inlet pressure, min.	L	bar	-0.4	-0.4	–	–
Raw-water pump: Inlet pressure, max.	L	bar	1.0	1.0	–	–
Pressure loss in engine-external raw-water system, max.	L	bar	1.0	1.0	–	–

LUBE-OIL SYSTEM

			Heat exchanger mounted		Heat exchanger separate	
Lube-oil operating temperature before engine, from	R	°C	84	87	84	87
Lube-oil operating temperature before engine, to	R	°C	92	95	92	95
Lube-oil operating pressure before engine, from	R	bar	5.3	5.3	5.3	5.3
Lube-oil operating pressure before engine, to	R	bar	6.3	6.3	6.3	6.3
Lube-oil operating pressure (low idle) (meas. point: before engine)	R	bar	–	–	–	–

FUEL SYSTEM

			Heat exchanger mounted		Heat exchanger separate	
Fuel pressure at supply connection to engine, min. (when engine is starting)	L	bar	-0.1	-0.1	-0.1	-0.1
Fuel pressure at supply connection to engine, min. (when engine is running)	L	bar	-0.3	-0.3	-0.3	-0.3
Fuel pressure at supply connection to engine, max. (when engine is starting)	L	bar	1.5	1.5	1.5	1.5
Fuel supply flow, max.	A	Liters/min				

GENERAL OPERATING DATA

			Heat exchanger mounted		Heat exchanger separate	
Firing speed, from	R	rpm	80	80	80	80
Firing speed, to	R	rpm	120	120	120	120

STARTING SYSTEM (electric)

			Heat exchanger mounted		Heat exchanger separate	
Rated starter voltage (standard design)	R	V=	24	24	24	24

STARTING (with compressed air/hydraulic starter)

			Heat exchanger mounted		Heat exchanger separate	
Starting-air pressure before starter, min.	R	bar	8	8	8	8
Starting-air pressure before starter, max.	R	bar	9	9	9	9

CAPACITIES

			Heat exchanger mounted		Heat exchanger separate	
Engine coolant, engine-side (with cooling system)	R	Liters	350	350	—	—
Engine oil, total, for initial filling (standard oil system) (option: max. operating inclinations)	R	Liters	N	N	N	N
Oil change quantity, max. (standard oil system) (option: max. operating inclinations)	R	Liters	280	280	280	280
Oil pan capacity at dipstick mark "min." (standard oil system) (option: max. operating inclinations)	L	Liters	210	210	210	210
Oil pan capacity at dipstick mark "max." (standard oil system) (option: max. operating inclinations)	L	Liters	250	250	250	250

WEIGHTS / MAIN DIMENSIONS

			Heat exchanger mounted		Heat exchanger separate	
Engine dry weight (with attached standard accessories, without coupling)	R	kg	9020	9020	8590	8590

ACOUSTICS

			Heat exchanger mounted		Heat exchanger separate	
Exhaust noise, unsilenced - DL (free-field sound pressure level Lp, 1m distance, ISO 6798, +3dB(A) tolerance)	R	dB(A)	109	109	109	109

2.5.6 16V 4000 M23S engine data, IMO Tier II, EPA Tier 2

Explanation:

DL Ref. value: Continuous power

BL Ref. value: Fuel stop power

A Design value

G Guaranteed value

R Guideline value

L Limit value, up to which the engine can be operated, without change (e.g. of power settings).

N Not yet defined value

- Not applicable

X Applicable

			Heat exchanger mounted		Heat exchanger separate	
Application group			3A	3A	3A	3A
Intake-air temperature		°C	25	45	25	45
Charge-air coolant temperature		°C	–	–	–	–
Raw-water inlet temperature		°C	25	32	25	32
Barometric pressure		mbar	1000	1000	1000	1000
Site altitude above sea level		m	100	100	100	100

POWER DATA (power ratings are net brake power as per ISO 3046)

			Heat exchanger mounted		Heat exchanger separate	
Rated engine speed	A	rpm	1800	1800	1800	1800
Continuous power ISO 3046 (10% overload capability, design power DIN 6280, ISO 8528)	A	kW	1840	1840	1840	1840

GENERAL CONDITIONS (for maximum power)

			Heat exchanger mounted		Heat exchanger separate	
Intake depression (new filter)	A	mbar	15	15	15	15
Intake depression, max.	L	mbar	30	30	30	30

MODEL-RELATED DATA (basic design)

			Heat exchanger mounted		Heat exchanger separate	
Cylinder arrangement: V-angle		Degrees (°)	90	90	90	90
Bore		mm	170	170	170	170
Stroke		mm	210	210	210	210
Cylinder displacement		Liters	4.77	4.77	4.77	4.77
Total displacement		Liters	76.3	76.3	76.3	76.3
Number of inlet valves per cylinder			2	2	2	2
Number of exhaust valves per cylinder			2	2	2	2

RAW-WATER CIRCUIT (open circuit)

			Heat exchanger mounted		Heat exchanger separate	
Raw-water pump: Inlet pressure, min.	L	bar	-0.4	-0.4	—	—
Raw-water pump: Inlet pressure, max.	L	bar	1.0	1.0	—	—
Pressure loss in engine-external raw-water system, max.	L	bar	1.0	1.0	—	—

LUBE-OIL SYSTEM

			Heat exchanger mounted		Heat exchanger separate	
Lube-oil operating temperature before engine, from	R	°C	84	83	84	83
Lube-oil operating temperature before engine, to	R	°C	92	91	92	91
Lube-oil operating pressure before engine, from	R	bar	5.3	5.3	5.3	5.3
Lube-oil operating pressure before engine, to	R	bar	6.3	6.3	6.3	6.3
Lube-oil operating pressure (low idle) (meas. point: before engine)	R	bar	—	—	—	—

FUEL SYSTEM

			Heat exchanger mounted		Heat exchanger separate	
Fuel pressure at supply connection to engine, min. (when engine is starting)	L	bar	-0.1	-0.1	-0.1	-0.1
Fuel pressure at supply connection to engine, min. (when engine is running)	L	bar	-0.3	-0.3	-0.3	-0.3
Fuel pressure at supply connection to engine, max. (when engine is starting)	L	bar	1.5	1.5	1.5	1.5
Fuel supply flow, max.	A	Liters/min				

GENERAL OPERATING DATA

			Heat exchanger mounted		Heat exchanger separate	
Firing speed, from	R	rpm	80	80	80	80
Firing speed, to	R	rpm	120	120	120	120

STARTING SYSTEM (electric)

			Heat exchanger mounted		Heat exchanger separate	
Rated starter voltage (standard design)	R	V=	24	24	24	24

TIM-ID: 000002721 - 001

STARTING (with compressed air/hydraulic starter)

			Heat exchanger mounted		Heat exchanger separate	
Starting-air pressure before starter, min.	R	bar	8	8	8	8
Starting-air pressure before starter, max.	R	bar	9	9	9	9

CAPACITIES

			Heat exchanger mounted		Heat exchanger separate	
Engine coolant, engine-side (with cooling system)	R	Liters	350	350	–	–
Engine oil, total, for initial filling (standard oil system) (option: max. operating inclinations)	R	Liters	N	N	N	N
Oil change quantity, max. (standard oil system) (option: max. operating inclinations)	R	Liters	280	280	280	280
Oil pan capacity at dipstick mark "min." (standard oil system) (option: max. operating inclinations)	L	Liters	210	210	210	210
Oil pan capacity at dipstick mark "max." (standard oil system) (option: max. operating inclinations)	L	Liters	250	250	250	250

WEIGHTS / MAIN DIMENSIONS

			Heat exchanger mounted		Heat exchanger separate	
Engine dry weight (with attached standard accessories, without coupling)	R	kg	9020	9020	8590	8590

ACOUSTICS

			Heat exchanger mounted		Heat exchanger separate	
Exhaust noise, unsilenced - DL (free-field sound pressure level Lp, 1m distance, ISO 6798, +3dB(A) tolerance)	R	dB(A)	109	109	109	109

3 Operation

3.1 Controls

Automation system controls

Refer to automation system operating instructions

3.2 Putting the engine into operation after extended out-of-service periods (>3 months)

Preconditions

- ☑ Engine is stopped and starting disabled.
- ☑ MTU Preservation and Represervation Specifications (A001070/..) are available.

Putting the engine into operation after extended out-of-service-periods (>3 months)

Item	Task
Engine	Depreserve (→ Preservation and Represervation Specifications A001070/..).
Lube oil system	Check engine oil level (→ Page 218); Preheat engine oil if required.
Fuel prefilter	Prime with fuel (→ Page 195)
Fuel prefilter, pressure gauge	Align adjustable pointer with position of pressure indicator (→ Page 190).
HP fuel pump	Only for engines without oil priming pump: Fill HP fuel pump with new engine oil (→ Page 177).
Raw-water pump (if located above waterline (only applicable to engines with engine-mounted heat exchanger or with optional remote heat exchanger))	Prime with water (approx. 3 – 4 l).
Coolant circuit	If engine is out of service for more than one year, change engine coolant (→ Page 235).
Coolant circuit	Check coolant level (→ Page 234).
Coolant circuit	Preheat coolant with preheating unit.
Engine control system	Refer to automation system operating instructions.
ECU	Check plug connections (→ Page 268).
EMU	Check plug connections (→ Page 269)
EIM	Check plug connections (→ Page 270).

3.3 Putting the engine into operation after scheduled out-of-service-period

Preconditions

☑ Engine is stopped and starting disabled.

Putting into operation

Item	Task
Lube oil system	Check engine oil level (→ Page 218); Preheat engine oil if required.
Coolant system	Check coolant level (→ Page 234).
Coolant system	Preheat coolant with preheating unit.
Fuel prefilter	Drain (→ Page 191); Check that suction-side pressure indicated at the fuel prefilter pressure gauge is within the limit (→ Page 190).
Engine control system	Refer to automation system operating instructions.
ECU	Check plug connections (→ Page 268).
EIM	Check plug connections (→ Page 270).
EMU	Check plug connections (→ Page 269).

3.4 Starting the engine

Start the engine via the automation system

Refer to automation system operating instructions

3.5 Operational checks

DANGER



Rotating and moving engine parts.

Risk of crushing, danger of parts of the body being caught or pulled in!

- Only run the engine at low power. Keep away from the engine's danger zone.

WARNING



High level of engine noise when the engine is running.

Risk of damage to hearing!

- Wear ear protectors.

Operational checks

Item	Measure
Engine under load Engine at nominal speed	Check engine visually for leaks and general condition; Check air pipework between air filter and exhaust turbocharger for leaks and damage. Check for abnormal running noise, vibration, and exhaust color (→ Page 92).
Charge-air cooler	Check condensate drain (→ Page 213).
Air filter	Check signal ring position of service indicator (→ Page 216). Replace air filter (→ Page 214), if the signal ring is completely visible in the service indicator control window.
HP fuel pump	Check relief bores for fuel discharge (→ Page 178).
HT coolant pump	Check relief bore for oil and coolant discharge and obstructions (→ Page 241).
Fuel prefilter (optional)	Check reading on differential pressure gauge (→ Page 216); Drain water and contaminants (→ Page 193).
Raw water pump (only on engines with engine-mounted or optional remote heat exchanger)	Check relief bore for oil and coolant discharge and obstructions (→ Page 249).
Bilge pump (optional)	Check relief bore for oil and coolant discharge and obstructions (→ Page 252).

3.6 Tasks after extended out-of-service periods (>3 weeks)

Tasks after extended out-of-service periods (>3 weeks)

Note: Operate fuel treatment system for at least 5 minutes.

1. Start up fuel treatment system (→ Page 81).
2. Shut down fuel treatment system (→ Page 85).

3.7 Checks prior to start-up

Checks prior to start-up

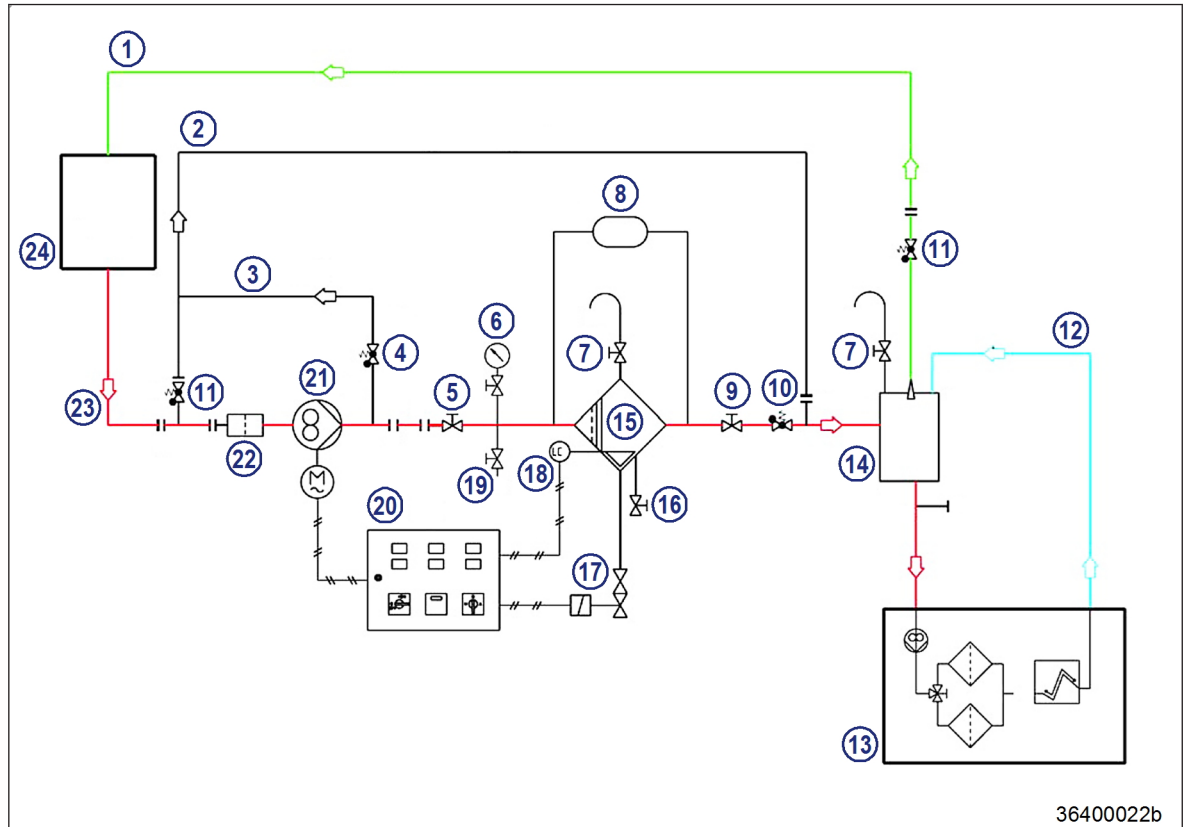
1. Check tank and the entire pipework for cleanness. If microorganisms are detected:
 - a) Clean affected components.
 - b) Disinfect affected components with biocides (→ MTU Fluids and Lubricants Specifications A001061/..).
 2. Close drain valves on housing.
 3. Open all supply and discharge valves.
 4. Switch on fuel treatment system (→ Page 84).
 5. Check direction of rotation of pump.
 6. Vent bypass and fuel lines of the system.
 - a) Open ball valve for pressure tank.
 - b) Open ball valve for overflow tank.
 - c) Close ball valve at the inlet to the fuel treatment system.
- Result: Bypass line is vented via the overflow tank.
- d) Open ball valve at the inlet to the fuel treatment system.

7. Check the fuel treatment system for leaks.

Result: The fuel treatment system is ready for operation.

3.8 Fuel treatment system – Putting into operation

Overview of fuel treatment system



- | | | |
|----------------------------------|---------------------------------|---|
| 1 Pressure-free overflow | 9 Ball valve, outlet | 17 Automatic water drain |
| 2 Bypass 1 | 10 Check valve 700 mbar | 18 Water level electrode |
| 3 Bypass 2 | 11 Check valve 5 mbar | 19 Ball valve, sample extraction, inlet |
| 4 Safety valve, 3 bar | 12 Return to overflow container | 20 Switchgear cabinet |
| 5 Ball valve, inlet | 13 Engine | 21 Pump |
| 6 Pressure gage | 14 Overflow container | 22 Coarse filter |
| 7 Ventilation, sample extraction | 15 Water separator filter | 23 Fuel supply from tank |
| 8 Differential pressure gage | 16 Ball valve, drain | 24 Tank |

Switching on fuel treatment system

1. Switch on fuel treatment system (→ Page 84).
2. Check differential pressure at differential pressure gage (8). Differential pressure in a new system: 0.1 bar to 0.3 bar.

Result: If no differential pressure is measured, the coalescer filter element is probably being bypassed.

1. Remove coalescer filter element (→ Page 257).
2. Check sealing surfaces on coalescer filter element and in the pressure tank.

Initial operation: HAT

1. Replace fuel filter on engine (→ Page 187).

Note: Determine the suction pressure upstream of the engine-mounted fuel delivery pump.

2. Install pressure gage in fuel supply line from Yard fuel system to engine.
3. Switch on fuel treatment system and operate it for some minutes (→ Page 84).

Result: The fuel is drawn from tank (24), cleaned by the water separator filter (15) and then routed via overflow tank (14) back to tank (24). Water that collects in the tank is separated.

4. Start engine (→ Page 77).
5. Run engine at idling speed.
6. Check suction pressure (see technical data of the engine) at the engine-mounted fuel delivery pump.

Note: If the suction pressure is within the permissible limits and engine operation is satisfactory.

7. Increase engine speed to 1000 rpm and monitor suction pressure.
8. Check suction pressure at the engine-mounted fuel delivery pump.

Result: If the values are within the limits specified by the manufacturer, the system is ready to start filter replacement simulation with the engine running as part of the Harbor Acceptance Tests.

Simulation of filter replacement with the engine running: HAT

1. Switch on fuel treatment system (→ Page 84).
2. Start engine (→ Page 77).
3. Run engine at idling speed.
4. Close ball valve (5) at inlet to fuel treatment system.

Result: The pressure upstream of the fuel treatment system increases until the overflow valve at the pump unit opens and fuel flows through bypass (3) and bypass (2).

5. Open ball valve (19) .

Result: Fuel emerges. If no fuel emerges:

- Open ball valve (5) at inlet to fuel treatment system.
- No function of bypasses (2) and (3); carry out functional test of bypasses (2) and (3) .

6. Check suction pressure (see technical data of the engine) at the fuel delivery pump.

Note: If the suction pressure is within the permissible limits and engine operation is satisfactory.

7. Increase engine speed to 1000 rpm and monitor suction pressure.

Result: If all engine operating values are within the specified limits, open ball valve (5) at inlet to fuel treatment system.

Simulation of power failure (emergency): HAT

1. Switch on fuel treatment system (→ Page 84).
2. Start engine (→ Page 77).
3. Run engine at idling speed.
4. Switch off pump (21) at switchgear cabinet (20).

Result: The engine-mounted fuel delivery pump draws fuel via bypass (2) directly from tank (24).

5. Check suction pressure at the engine-mounted fuel delivery pump.

Note: If the suction pressure is within the permissible limits and engine operation is satisfactory.

6. Increase engine speed to 1000 rpm and monitor suction pressure.

Result: If the suction pressure is within the specified limits, simulation was successful.

Simulation of power failure (emergency): SAT

1. Switch on fuel treatment system (→ Page 84).
2. Start engine (→ Page 77).
3. Run engine at idling speed.
4. Switch off pump (21) at switchgear cabinet (20).

Result: The engine-mounted fuel delivery pump draws fuel via bypass (2) directly from tank (24).

5. Check suction pressure at the engine-mounted fuel delivery pump.

Note: If the suction pressure is within the permissible limits and engine operation is satisfactory.

6. Operate engine at full load and monitor suction pressure.

Result: If the suction pressure is within the specified limits, simulation was successful.

3.9 Fuel treatment system – Switching on

Preconditions

- ☑ The on-board power supply is switched on.

NOTICE



Risk of damage to engine/system.

Risk of severe damage to property!

- Before switching on, ensure that the engine/system is ready for operation.
- Before switching on, ensure that all housings are closed.
- Before switching on, ensure that no work is in progress anywhere on the entire system.

Fuel treatment system – Switching on

1. Carry out checks prior to start-up (→ Page 80).
2. Switch on master switch on switchgear cabinet.

Result: Signal lamp “Control voltage present” lights up.

3. Switch on switch for pump.

Result: Signal lamp “Pump running” lights up.

3.10 Fuel treatment system – Shutdown

Shutting down fuel treatment system

1. Press the illuminated pushbutton "Water drain" on the switch cabinet until water discharge from the outlet stops.
2. Switch off fuel treatment system.
3. Close ball valve at the inlet to the fuel treatment system.
4. Close ball valve at the outlet of the fuel treatment system.
5. Open drain valve until pressure has escaped from fuel treatment system.

3.11 Stopping the engine

Stopping the engine via the automation system

Refer to automation system operating instructions

3.12 Emergency engine stop

NOTICE



An emergency stop causes extreme stress to the engine plant.

Risk of overheating, damage to components!

- Initiate emergency stop only in emergency situations.

Emergency stop

1. Refer to automation system operating instructions.
2. Follow instructions.

3.13 After stopping the engine

Preconditions

☑ MTU Preservation and Re-preservation Specifications (A001070/..) are available.

After stopping the engine

Item	Measure
Coolant circuit	Drain coolant (→ Page 236) if: • freezing temperatures are expected and the engine is to remain out of service for an extended period, but engine coolant has no antifreeze additive; • the engine room is not heated; • the coolant is not kept at a suitable temperature; • the antifreeze concentration is insufficient for the engine-room temperature; • antifreeze concentration is 50% and engine-room temperature is below -40 °C.
Raw water (only on engines with engine-mounted heat exchanger)	Drain • if freezing temperatures are expected and the engine is to remain out of service for an extended period.
Engine control system	Switch off.
Air intake and exhaust system	Out-of-service-period > 1 week • Seal engine on air and exhaust sides. Out-of-service-period > 1 month • Preserve engine (→ MTU Preservation and Re-preservation specifications A001070/..).

3.14 Plant – Cleaning

Preconditions

- ☑ Engine is stopped and starting disabled.
- ☑ Operating voltage is not applied.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Steam jet cleaner	-	1
Cleaner (Hakupur 312)	30390	1

WARNING



Compressed air gun ejects a jet of pressurized air.

Risk of injury to eyes and damage to hearing, risk of rupturing internal organs!

- Never direct air jet at people.
- Always wear safety goggles/face mask and ear defenders.

WARNING



Steam jet cleaner ejects jet of pressurized water.

Risk of injury to eyes and scalding!

- Never direct water jet at people.
- Wear protective clothing, protective gloves and safety goggles/face mask.

NOTICE



Cleaning agents should not be left to take effect for too long.

Damage to components is possible!

- Observe manufacturer's instructions.

NOTICE



Blowing down product with compressed air.

Entry of dirt and damage to components is possible!

- Do not aim compressed air gun directly at seals or electronic components such as connectors or ECUs.

Plant – Cleaning

1. Carry out plant cleaning only in areas where an appropriate oil separator is provided (environmental protection).
 2. Prior to putting the cleaning unit into operation, read the Operating Instructions of the water/steam jet unit carefully and observe the safety precautions.
 3. For external cleaning of the plant with water or steam-jet cleaners:
 - The pressure of the high-pressure jet (cleaning jet) must not exceed 50 bar.
 - A minimum distance between spray nozzle and plant of 1 m must be observed.
 - The temperature of the cleaning medium must not exceed 80°C.
 4. For external cleaning with high-pressure jet, use a flat-mouth nozzle only.
- Note: Never aim compressed air directly at electronic components.
5. Carry out external cleaning as follows:
 - a) Seal all openings in a suitable way.
 - b) Remove coarse dirt.
 - c) Spray on cleaner sparingly and leave it for 1 to 5 minutes.
 - d) Use the high-pressure jet to remove the loosened dirt.
 - e) Dry engine with compressed air.

4 Maintenance

4.1 Maintenance task reference table [QL1]

The maintenance tasks and intervals for this product are defined in the Maintenance Schedule. The Maintenance Schedule is a stand-alone publication.

The task numbers in this table provide reference to the maintenance tasks specified in the Maintenance Schedule.

Task	Option	Maintenance tasks	
W0500		Check engine oil level.	(→ Page 218)
W0501		Visually inspect engine for leaks and general condition.	(→ Page 78)
W0502		Check intercooler drain(s).	(→ Page 213)
W0503		Check maintenance indicator of air filter.	(→ Page 216)
W0504		Check telltale bores of HP fuel pump .	(→ Page 78)
W0505		Check relief bores of water pump(s).	(→ Page 241)
W0506		Check engine for abnormal running noises, exhaust color and vibrations.	(→ Page 78)
W0507		Drain water and contaminants from fuel prefilter.	(→ Page 78)
W0508	X	Check reading on differential pressure gage of fuel prefilter.	(→ Page 78)
W1001		Replace fuel filter or fuel filter element.	(→ Page 187)
W1005	X	Replace air filter.	(→ Page 214)
W1006		Replace fuel injectors.	(→ Page 179)
W1008	X	Replace engine oil filter when changing engine oil, or when the interval (years) is reached, at the latest.	(→ Page 223)
W1009		Check layer thickness of the oil residue, clean out and replace filter sleeve each time the oil is changed at the latest.	(→ Page 227)
W1011		Perform endoscopic examination.	(→ Page 165)
W1016	X	Check condition of coupling.	(→ Page 251)
W1047	X	Check and clean oil indicator filter.	(→ Page 225)
W1076		Clean compressor wheel.	(→ Page 205)
W1207		Check valve clearance and adjust as necessary. ATTENTION! First adjustment after 1,000 operating hours and after 1,000 operating hours following cylinder head overhaul.	(→ Page 173)
W1244	X	Check function of rod electrode.	(→ Page 255)
W1245	X	Check alarm function of differential pressure gage.	(→ Page 254)
W1246	X	Check pump capacity.	(→ Page 256)
W1463		Check general condition of engine mounting (visual inspection).	(→ Page 250)
W1477	X	Overhaul preheater.	(→ Page 247)
W1481		Replace intermediate fuel filter or intermediate fuel filter element.	(→ Page 186)
W1581	X	Replace impactors.	(→ Page 171)

TIM-ID: 0000048360 - 001

Task	Option	Maintenance tasks	
W1675	X	Replace fuel prefilter or fuel prefilter element.	(→ Page 195)
W1713		Injector: Reset drift correction parameter (CDC).	(→ Page 266)

Table 1: Maintenance task reference table [QL 1]

5 Troubleshooting

5.1 Troubleshooting

Engine does not turn when starter is actuated

Cause	Corrective action
Battery low or faulty	► Charge or replace (see separate documentation).
Battery: Cable connections faulty	► Check firm seating of cable connections (see separate documentation).
Engine cabling or starter faulty	► Check firm seating of cable connections, contact Service.
Engine cabling defective	► Check (→ Page 265).
Loose plug connections on engine governor	► Check plug connections (→ Page 268).
Loose plug connections on Engine Interface Module (EIM)	► Check plug connections (→ Page 270).
Fuse F1 (→ Page 259) in engine wiring harness defective (fuse lamp on EIM flashes with relevant flashing code)	► Check fuse (replace if required) and re-start the system by actuating the key switch.
Running gear blocked (engine cannot be barred manually)	► Contact Service.

Engine turns on starting but does not fire

Cause	Corrective action
Poor rotation by starter: Battery low or faulty	► Charge or replace battery (see separate documentation).
Engine cabling defective	► Check (→ Page 265).
Engine governor defective	► Contact Service.

Engine fires unevenly

Cause	Corrective action
Injector faulty	► Replace (→ Page 179).
Engine cabling defective	► Check (→ Page 265).
Engine governor defective	► Contact Service.

Engine does not reach nominal speed

Cause	Corrective action
Easy-change fuel filter clogged	► Replace (→ Page 187).
Air supply: Air filter clogged	► Check signal ring position of service indicator (→ Page 216).
Fuel injection: Injector faulty	► Replace (→ Page 179).
Engine cabling defective	► Check (→ Page 265).
Engine: Overload	► Contact Service.

Engine speed not steady

Cause	Corrective action
Fuel injection: Injector faulty	► Replace (→ Page 179).
Speed transmitter defective	► Contact Service.
Engine governor defective	► Contact Service.

Charge-air temperature too high

Cause	Corrective action
Incorrect coolant concentration	► Check (MTU test kit).
Intercooler dirty	► Contact Service.
Engine room: Air-intake temperature too high	► Check fans and air supply/ventilation ducts.

Charge-air pressure too low

Cause	Corrective action
Air supply: Air filter clogged	► Check signal ring position of service indicator (→ Page 216).
Intercooler dirty	► Contact Service.
Exhaust turbocharger defective	► Contact Service.

Coolant leaks at intercooler

Cause	Corrective action
Intercooler leaky, major coolant discharge	► Contact Service.

Black exhaust gas

Cause	Corrective action
Air supply: Air filter clogged	► Check signal ring position of service indicator (→ Page 216).
Fuel injection: Injector faulty	► Replace (→ Page 179).
Engine: Overload	► Contact Service.

Blue exhaust gas

Cause	Corrective action
Too much oil in engine	► Drain engine oil (→ Page 219).
Oil separator or oil-preseparator of crankcase breather clogged	► Replace.
Exhaust turbocharger, cylinder head, piston rings, cylinder liner defective	► Contact Service.

White exhaust gas

Cause	Corrective action
Engine is not at operating temperature	▶ Run engine to reach operating temperature.
Intercooler leaky	▶ Contact Service.

5.2 Fuel treatment system – Troubleshooting

Illuminated pushbutton 'water alarm' is lit.

Cause	Corrective action
When the maximum water level is reached, the water level electrode opens the water drain valve and water is discharged. If the opening period of the valve exceeds a preset limit (4 minutes), the pump will switch off and an alarm is initiated.	1. Press illuminated pushbutton 'Water alarm' for acknowledgment. 2. In addition to the automatic water drain function, water can also be drained manually. To do so, press the illuminated pushbutton 'Water drain' to open the drain valve.

Signal lamp 'Pump fault' is lit.

Cause	Corrective action
The drive motor is equipped with an overload protection. If the maximum permissible current consumption is exceeded, e.g. in case of a blockage or dry-running, the motor protection relay triggers and the pump is switched off.	► Reset motor protection relay.

Signal lamp 'Pre-alarm' is lit.

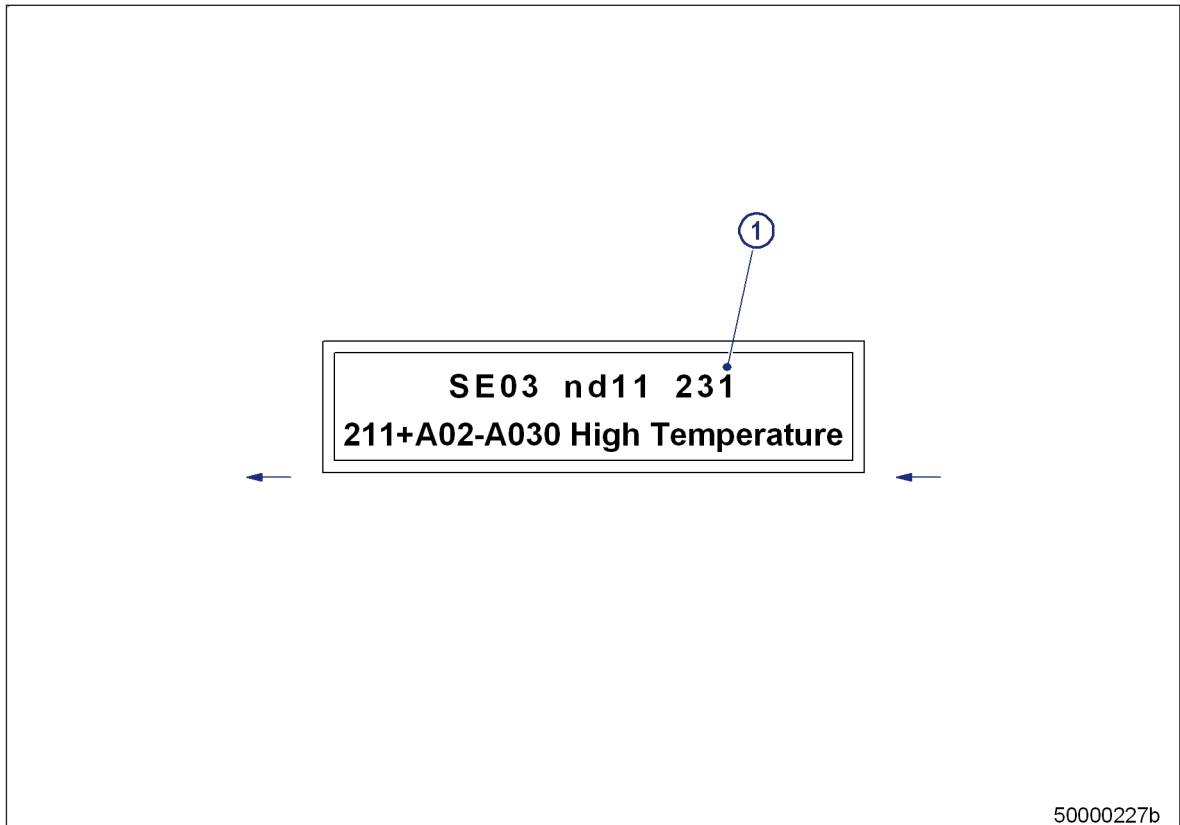
Cause	Corrective action
The differential pressure exceeded 1.3 bar.	► Replace coalescer filter element (→ Page 257).

Illuminated pushbutton 'Replace filter element' is lit.

Cause	Corrective action
The max. permissible differential pressure of 1.5 bar was exceeded. If the coalescer filter element is not replaced, pressure will increase further and the safety valve will open. Fuel will be led via the bypass directly into the overflow tank.	1. Replace coalescer filter element (→ Page 257). 2. Press illuminated pushbutton 'Replace filter element' for acknowledgment.

5.3 Engine governor ADEC (ECU 7) fault messages for Series 4000 engines, marine application

The fault code numbers are generated by the engine governor and transmitted to the display below (if fitted).



The fault code (1) comprises 3 digits.

Fault messages may also be caused by faulty sensors/actuators. Contact Service to have sensors/actuators tested and replaced as necessary if troubleshooting as described in the table (→ Page 97) proves unsuccessful.

For explanations of alarm configuration parameters, refer to PR 2.8008.100.

Fault code list (→ Page 97).

5.4 Engine governor ADEC (ECU 7) – Fault codes

3 – HI T-Fuel

ZKP-Number: 2.0122.931

Fuel temperature too high (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Fuel tank may be exposed to heat.	1. Reduce power. 2. Contact Service.

4 – SS T-Fuel

ZKP-Number: 2.0122.932

Fuel temperature too high (limit value 2)

Red alarm; engine shutdown

Cause	Corrective action
Fuel tank may be exposed to heat.	► Contact Service.

5 – HI T-Charge Air

ZKP-Number: 2.0121.931

Charge-air temperature too high (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Charge-air cooler not functioning correctly.	1. Reduce power. 2. Check charge-air cooler. 3. Contact Service.

6 – SS T-Charge Air

ZKP-Number: 2.0121.932

Charge-air temperature too high (limit value 2)

Red alarm; engine shutdown

Cause	Corrective action
Charge-air cooler not functioning correctly.	1. Check charge-air cooler. 2. Contact Service.

9 – HI T-Coolant charge-air cooler

ZKP-Number: 2.0124.931

Coolant temperature in charge-air cooler too high (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Coolant circuit for charge air defective.	1. Reduce power. 2. Check charge-air cooler and coolant cooler. 3. Contact Service.

10 – SS T-Coolant charge-air cooler

ZKP-Number: 2.0124.932

Coolant temperature in charge-air cooler too high (limit value 2)

Red alarm; engine shutdown

Cause	Corrective action
Coolant circuit for charge air defective.	1. Check charge-air cooler and coolant cooler. 2. Contact Service.

15 – LO P-Lube Oil

ZKP-Number: 2.0100.921

Lube-oil pressure too low (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Insufficient oil.	1. Check oil level, top up as necessary (→ Page 218). 2. Contact Service.

16 – SS P-Lube Oil

ZKP-Number: 2.0100.922

Lube-oil pressure too low (limit value 2)

Red alarm; engine shutdown

Cause	Corrective action
Insufficient oil.	1. Check oil level, top up as necessary (→ Page 218). 2. Acknowledge alarm. 3. Restart engine (→ Page 77). 4. Contact Service.

19 – HI T-Exhaust A

ZKP-Number: 2.0126.931

Exhaust temperature too high, A-side (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Wiring damage.	1. Check air filter and wiring (→ Page 265). 2. Contact Service.

20 – SS T-Exhaust A

ZKP-Number: 2.0126.932

Exhaust temperature too high, A-side (limit value 2)

Red alarm; engine shutdown

Cause	Corrective action
Wiring damage.	1. Check air filter and wiring (→ Page 265). 2. Contact Service.

21 – HI T-Exhaust B

ZKP-Number: 2.0127.931

Exhaust temperature too high, B-side (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Wiring damage.	1. Check air filter and wiring (→ Page 265). 2. Contact Service.

22 – SS T-Exhaust B

ZKP-Number: 2.0127.932

Exhaust temperature too high, B-side (limit value 2)

Red alarm; engine shutdown

Cause	Corrective action
Wiring damage.	1. Check air filter and wiring (→ Page 265). 2. Contact Service.

23 – LO Coolant Level

ZKP-Number: 2.0152.921

Coolant level too low (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Leak in coolant circuit.	► Check coolant level in expansion tank (→ Page 234).

25 – HI P-Diff. Lube Oil

ZKP-Number: 2.0154.931

Differential oil pressure at oil filter too high (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Oil filter not functioning correctly.	► Replace oil filter (→ Page 223).

26 – HI P-Diff. Lube Oil

ZKP-Number: 2.0154.932

Differential oil pressure at oil filter too high (limit value 2)

Red alarm; engine shutdown

Cause	Corrective action
Oil filter not functioning correctly.	1. Replace oil filter (→ Page 223). 2. Contact Service.

27 – HI Level Leakage Fuel

ZKP-Number: 2.0151.931

Leak-off fuel level too high (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Fuel lines leaking.	1. Check fuel system. 2. Contact Service.

29 – HI ETC Idle Speed Too High

ZKP-Number: 1.8004.206

Yellow alarm; warning

Cause	Corrective action
Idling speed of one of the secondary turbochargers is too high.	► Contact Service.

30 – SS Engine Overspeed

ZKP-Number: 2.2510.932

Engine overspeed (limit value 2)

Red alarm; engine shutdown

Cause	Corrective action
No fuel injection.	1. Restart engine. Fault can possibly be eliminated by a restart (→ Page 77). 2. Contact Service.

31 – HI ETC1 Overspeed

ZKP-Number: 2.3011.931

Speed of primary turbocharger too high (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Clogged charge-air circuit or fault in turbocharger.	1. Reduce power. 2. Check air filter. 3. Contact Service.

32 – SS ETC1 Overspeed

ZKP-Number: 2.3012.932

Speed of primary turbocharger too high (limit value 2)

Red alarm; engine shutdown

Cause	Corrective action
Clogged charge-air circuit or fault in turbocharger.	1. Check air filter. 2. Contact Service.

33 – HI P-Diff-Fuel

ZKP-Number: 2.0114.931

Fuel filter differential oil pressure too high (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Fuel filter not functioning correctly.	1. Replace fuel filter (→ Page 187). 2. Contact Service.

34 – SS P-Diff-Fuel

ZKP-Number: 2.0114.932

Fuel filter differential oil pressure too high (limit value 2)

Red alarm; engine shutdown

Cause	Corrective action
Fuel filter not functioning correctly.	1. Replace fuel filter (→ Page 187). 2. Contact Service.

36 – HI ETC2 Overspeed

ZKP-Number: 2.3013.931

Speed of 1st secondary turbocharger too high (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Clogged charge-air circuit or fault in turbocharger.	1. Reduce power. 2. Contact Service.

37 – SS ETC2 Overspeed

ZKP-Number: 2.3013.912

Speed of 1st secondary turbocharger too high (limit value 2)

Red alarm; engine shutdown

Cause	Corrective action
Clogged charge-air circuit or fault in turbocharger.	► Contact Service.

38 – AL ETC Speed Deviation

ZKP-Number: 1.8004.205

Yellow alarm; warning

Cause	Corrective action
Synchro fault between primary turbocharger and one of the secondary turbochargers.	► Contact Service.

39 – AL ETC2 Cut-in Fault

ZKP-Number: 1.8004.204

Yellow alarm; warning

Cause	Corrective action
ETC2 failed to cut in.	► Contact Service.

44 – LO Coolant Level Charge-Air Cooler

ZKP-Number: 2.0153.921

Coolant level of charge-air cooler too low (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Insufficient charge-air coolant, e.g. due to leaks in the charge-air coolant circuit.	1. Check coolant level (→ Page 234). 2. Contact Service.

51 – HI T-Lube Oil

ZKP-Number: 2.0125.931

Lube oil temperature too high (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Insufficient oil.	1. Reduce power. 2. Check engine oil level (→ Page 218). 3. Contact Service.

TIM-ID: 0000045495 - 001

52 – SS T-Lube Oil

ZKP-Number: 2.0125.932

Lube oil temperature too high (limit value 2)

Red alarm; engine shutdown

Cause	Corrective action
Insufficient oil.	1. Check engine oil level (→ Page 218). 2. Contact Service.

57 – LO P-Coolant

ZKP-Number: 2.0101.921

Coolant pressure too low (limit value 1).

Yellow alarm; warning

Cause	Corrective action
Leak in coolant circuit.	1. Check coolant level (→ Page 234). 2. Check coolant circuit.

58 – SS P-Coolant

ZKP-Number: 2.0101.922

Coolant pressure too low (limit value 2)

Red alarm - engine stop or reduced injection quantity

Cause	Corrective action
Leak in coolant circuit.	1. Check coolant level (→ Page 234). 2. Check coolant circuit.

59 – SS T-Coolant L3

ZKP-Number: 2.0120.933

Coolant temperature too high / low (limit value 3)

Red alarm; forced idle

Cause	Corrective action
Coolant circuit not functioning correctly (e.g. damage, leaks, low coolant level).	1. Activate fan emergency operating mode if required. 2. Allow engine to cool down. 3. Check coolant cooler, clean if dirty. 4. Acknowledge alarm. 5. Restart engine (→ Page 77). 6. Contact Service.

60 – SS T-Coolant L4

ZKP-Number: 2.0120.934

Coolant temperature too high / low (limit value 4)

Red alarm; engine shutdown

Cause	Corrective action
Coolant circuit not functioning correctly (e.g. damage, leaks, low coolant level).	1. Activate fan emergency operating mode if required. 2. Allow engine to cool down. 3. Check coolant cooler, clean if dirty. 4. Acknowledge alarm. 5. Restart engine (→ Page 77). 6. Contact Service.

63 – HI P-Crankcase

ZKP-Number: 2.0106.931

Crankcase pressure too high (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Crankcase exhaust system clogged or leaking.	1. Reduce power. 2. Replace oil mist fine separator element. 3. Contact Service.

64 – SS P-Crankcase

ZKP-Number: 2.0106.932

Crankcase pressure too high (limit value 2)

Red alarm; engine shutdown

Cause	Corrective action
Crankcase exhaust system clogged or leaking.	1. Reduce power. 2. Replace oil mist fine separator element. 3. Contact Service.

65 – LO P-Fuel

ZKP-Number: 2.0102.921

Fuel supply pressure too low (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Leaking or clogged fuel lines or fuel filter.	1. Check fuel lines for leakage. 2. Check filter, fuel low-pressure side. 3. Replace fuel filter (→ Page 187).

TIM-ID: 0000045495 - 001

66 – SS P-Fuel

ZKP-Number: 2.0102.922

Fuel supply pressure too low (limit value 2)

Red alarm; engine shutdown

Cause	Corrective action
Leaking or clogged fuel lines or fuel filter.	1. Check fuel lines for leakage. 2. Check filter, fuel low-pressure side. 3. Replace fuel filter (→ Page 187). 4. Contact Service.

67 – HI T-Coolant

ZKP-Number: 2.0120.931

Coolant temperature too high (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Coolant circuit not functioning correctly (e.g. damage, leaks, low coolant level).	1. Reduce power. 2. Check coolant circuit.

68 – SS T-Coolant

ZKP-Number: 2.0120.932

Coolant temperature too high (limit value 2)

Red alarm; engine shutdown

Cause	Corrective action
Coolant circuit not functioning correctly (e.g. damage, leaks, low coolant level).	► Check coolant circuit.

81 – AL Rail Leakage

ZKP-Number: 1.8004.046

Leak

Yellow alarm; warning

Cause	Corrective action
During start: Insufficient pressure gradient in rail (HP system leaking, air in system).	1. Check engine for leaks. 2. Contact Service.
During stop: Pressure gradient in rail too high.	1. Seal engine system. 2. Contact Service.

82 – HI P-Fuel (Common Rail)

ZKP-Number: 2.0104.931

Rail pressure > set value

Red alarm - DBR fuel limitation, start of injection retarded;

Cause	Corrective action
Suction restrictor of HP fuel block jamming or HP fuel control block wiring faulty.	1. Check wiring (→ Page 265). 2. Contact Service.

83 – LO P-Fuel (Common Rail)

ZKP-Number: 2.0104.921

Rail pressure < set value

Red alarm - DBR fuel limitation

Cause	Corrective action
HP fuel control block defective or leak in HP system.	► Contact Service.

085 – HI T-Recirculation

ZKP-Number: 2.0128.931

Recirculation temperature too high (limit value 1)

Cause	Corrective action
Charge-air temperature before recirculation valve too high.	► Reduce power.

086 – SS T-Recirculation

ZKP-Number: 2.0128.932

Recirculation temperature too high (limit value 2)

Cause	Corrective action
Charge-air temperature before recirculation valve too high.	► Reduce power.

89 – SS Engine Speed too Low

ZKP-Number: 2.2500.030

Engine speed too low

Red alarm; engine shutdown

Cause	Corrective action
Various causes possible.	1. Acknowledge alarm. 2. Check for additional messages. 3. Contact Service.

TIM-ID: 00000045495 - 001

90 – SS Starter Speed Not Reached

ZKP-Number: 2.1090.925

Idling speed not attained

Red alarm; warning

Cause	Corrective action
Various causes possible.	1. Check for additional messages. 2. Contact Service.

91 – SS Release Speed Not Reached

ZKP-Number: 2.1090.924

Runup speed was not attained

Red alarm; warning

Cause	Corrective action
Various causes possible.	1. Check for additional messages. 2. Contact Service.

92 – SS Starter Speed Not Reached

ZKP-Number: 2.1090.923

Starter speed not reached

Red alarm; warning

Cause	Corrective action
Starter rotates too slowly or does not rotate at all.	1. Check for additional messages. 2. Contact Service.

93 – SS T-Preheat

ZKP-Number: 2.1090.922

Preheating temperature too low (limit value 2)

Red alarm; engine start interlock

Cause	Corrective action
Preheating unit not functioning.	1. Check preheater. 2. Contact Service.

94 – LO T-Preheat

ZKP-Number: 2.1090.921

Preheating temperature too low (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Coolant temperature too low for engine start because preheating unit is not functioning.	1. Check preheating unit. 2. Contact Service.

95 – AL Prelubrication Fault

ZKP-Number: 2.1090.920

Oil priming fault

Yellow alarm; warning

Cause	Corrective action
Priming oil pressure not reached.	1. Check priming system. 2. Contact Service.

102 – AL Fuel Cons. Counter Defect

ZKP-Number: 1.8004.624

Error in fuel consumption checksum

Yellow alarm; warning

Cause	Corrective action
Consumption meter faulty.	► Contact Service.

104 – AL Eng Hours Counter Defect

ZKP-Number: 1.8004.623

Operating hours monitoring system faulty

Yellow alarm; warning

Cause	Corrective action
Hour meter faulty.	► Contact Service.

118 – LO ECU Power Supply Voltage

ZKP-Number: 2.0140.921

Supply voltage too low (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Supply voltage at engine governor too low.	1. Check engine governor supply voltage. 2. Contact Service.

119 – LOLO ECU Power Supply Voltage

ZKP-Number: 2.0140.922

Supply voltage too low (limit value 2)

Red alarm; start cancelation

Cause	Corrective action
Supply voltage at engine governor too low.	1. Check Engine Control Unit supply voltage. 2. Contact Service.

TIM-ID: 0000045495 - 001

120 – HI ECU Power Supply Voltage

ZKP-Number: 2.0140.931

Supply voltage too high (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Supply voltage at engine governor too high.	1. Check Engine Control Unit supply voltage. 2. Contact Service.

121 – HIHI ECU Power Supply Voltage

ZKP-Number: 2.0140.932

Supply voltage too high (limit value 2)

Red alarm - start cancelation of engine stop

Cause	Corrective action
Supply voltage at engine governor too high.	1. Check Engine Control Unit supply voltage. 2. Contact Service.

122 – HI T-ECU

ZKP-Number: 2.0132.921

Electronics temperature too high (limit value 1).

Yellow alarm; warning

Cause	Corrective action
Electronics overheated.	1. Reduce power. 2. Improve engine room ventilation.

141 – AL Power too high

ZKP-Number: 1.1088.007

Maximum value exceeded

Yellow alarm; warning

Cause	Corrective action
Power mean value has exceeded the specified maximum value in the last 24 hours.	► Contact Service.

142 – AL MCR exceeded 1 hour

ZKP-Number: 1.1088.006

MCR exceeded

Yellow alarm; warning

Cause	Corrective action
MCR was exceeded in the last 12 hours for longer than one hour.	► Contact Service.

176 – AL LifeData not available

ZKP-Number: 2.4000.004

No (matching) LifeData backup system available

Yellow alarm; warning

Cause	Corrective action
After a wait time has elapsed after ECU reset: Backup system has no LifeData function or CAN bus to backup system disconnected.	► Contact Service.

177 – AL LifeData restore incomplete

ZKP-Number: 2.4000.006

Yellow alarm; warning

Cause	Corrective action
This error message is generated if a CRC is faulty during a data upload (to the engine governor) (indicated for each indiv. module).	► Contact Service.

180 – AL CAN1 Node Lost

ZKP-Number: 2.0500.680

Connection to a node on CAN bus 1 failed

Yellow alarm; warning

Cause	Corrective action
Connection or communication with a node on CAN bus 1 has failed.	1. Check devices connected to CAN. 2. Check wiring (→ Page 265). 3. Contact Service.

181 – AL CAN2 Node Lost

ZKP-Number: 2.0500.681

Connection to a node on CAN bus 2 failed

Yellow alarm; warning

Cause	Corrective action
Connection or communication with a node on CAN bus 2 has failed.	1. Check devices connected to CAN. 2. Check wiring (→ Page 265). 3. Contact Service.

TIM-ID: 0000045495 - 001

182 – AL CAN Wrong Parameters

ZKP-Number: 2.0500.682

Incorrect parameters on CAN

Yellow alarm; warning

Cause	Corrective action
Wrong parameter value entered in data record.	► Contact Service.

183 – AL CAN No PU-Data

ZKP-Number: 2.0500.683

CAN PU data not present or available

Yellow alarm; warning

Cause	Corrective action
The selected CAN mode initializes communication by means of the application environment data module. A faulted occurred during an attempt to copy a received data module to the engine governor.	1. Check devices connected to CAN. 2. Contact Service.

184 – AL CAN PU-Data Flash Error

ZKP-Number: 2.0500.684

CAN PU data flash error

Cause	Corrective action
A program fault occurred while trying to copy a received PU data module into the flash module.	► Contact electronic Service.

186 – AL CAN1 Bus Off

ZKP-Number: 2.0500.686

CAN controller 1 is in "Bus-Off" status

Yellow alarm; automatic changeover to CAN 2

Cause	Corrective action
Short circuit, massive interference or Baud rate incompatibility.	1. Check CAN bus for short circuit, rectify short circuit as necessary. 2. Check shielding, improve shielding as necessary. 3. Contact Service.

187 – AL CAN1 Error Passive

ZKP-Number: 2.0500.687

CAN controller 1 error

Yellow alarm; warning

Cause	Corrective action
Missing associated node, minor disruptions or temporary bus overload.	1. Check CAN bus for short circuit, rectify short circuit as necessary. 2. Check shielding, improve shielding as necessary. 3. Contact Service.

188 – AL CAN2 Bus Off

ZKP-Number: 2.0500.688

CAN controller 2 is in "Bus-Off" status

Yellow alarm; automatic changeover to CAN 1

Cause	Corrective action
Short circuit, massive interference or Baud rate incompatibility.	1. Check CAN bus for short circuit, rectify short circuit as necessary. 2. Check shielding, improve shielding as necessary. 3. Contact Service.

189 – AL CAN2 Error Passive

ZKP-Number: 2.0500.689

CAN controller 2 error

Yellow alarm; warning

Cause	Corrective action
Missing associated node, minor disruptions or temporary bus overload.	1. Check CAN bus for short circuit, rectify short circuit as necessary. 2. Check shielding, improve shielding as necessary. 3. Contact Service.

190 – AL EMU Parameter Not Supported

ZKP-Number: 2.0500.690

Yellow alarm; warning

Cause	Corrective action
EMU parameters are not supported. ==> Incompatibility	► Contact Service.

TIM-ID: 0000045495 - 001

201 – SD T-Coolant

ZKP-Number: 1.8004.570

Signal error, coolant temperature sensor

Yellow alarm; warning

Cause	Corrective action
Coolant temperature sensor faulty. Short circuit or wire break.	1. Check sensor and wiring (B6), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

202 – SD T-Fuel

ZKP-Number: 1.8004.572

Signal error, fuel temperature sensor

Yellow alarm; warning

Cause	Corrective action
Fuel temperature sensor faulty. Short circuit or wire break.	1. Check sensor and wiring (B33), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

203 – SD T-Charge Air

ZKP-Number: 1.8004.571

Signal error, charge-air temperature sensor

Yellow alarm; warning

Cause	Corrective action
Charge air temperature sensor faulty. Short circuit or wire break.	1. Check sensor and wiring (B9), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted. (→ Page 77) 3. Contact Service.

204 – SD Level Lube Oil

ZKP-Number: 1.8004.602

Signal error, lube oil level sensor

Yellow alarm; warning

Cause	Corrective action
Lube oil level sensor faulty. Short circuit or wire break.	1. Check sensor and wiring, replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

205 – SD T-Coolant Charge-Air Cooler

ZKP-Number: 1.8004.574

Signal error, coolant temperature sensor

Yellow alarm; warning

Cause	Corrective action
Coolant pressure sensor of charge-air cooler faulty. Short circuit or wire break.	1. Check sensor and wiring (B26), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

206 – SD T-Exhaust A

ZKP-Number: 1.8004.576

Signal error, exhaust temperature sensor on A side

Yellow alarm; warning

Cause	Corrective action
Exhaust temperature sensor on A side faulty. Short circuit or wire break.	1. Check sensor and wiring (B4.21), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

207 – SD T-Exhaust B

ZKP-Number: 1.8004.577

Signal error, exhaust temperature sensor on B side

Yellow alarm; warning

Cause	Corrective action
Exhaust temperature sensor on B-side faulty. Short circuit or wire break.	1. Check sensor and wiring (B4.22), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

208 – SD P-Charge Air

ZKP-Number: 1.8004.566

Signal error, charge-air pressure sensor

Yellow alarm; warning

Cause	Corrective action
Charge air pressure sensor faulty. Short circuit or wire break.	1. Check sensor and wiring (B10), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

TIM-ID: 0000045495 - 001

211 – SD P-Lube Oil

ZKP-Number: 1.8004.563

Signal error, lube oil pressure sensor

Yellow alarm; warning

Cause	Corrective action
Lube-oil pressure sensor faulty. Short circuit or wire break.	1. Check sensor and wiring (B5), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

212 – SD P-Coolant

ZKP-Number: 1.8004.564

Signal error, coolant pressure sensor

Yellow alarm; warning

Cause	Corrective action
Coolant pressure sensor faulty. Short circuit or wire break.	1. Check sensor and wiring (B16), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

213 – SD P-Coolant Charge-Air Cooler

ZKP-Number: 1.8004.569

Charge-air cooler coolant pressure sensor faulty

Yellow alarm; warning

Cause	Corrective action
Charge-air cooler coolant pressure sensor faulty. Short circuit or wire break.	1. Check sensor and wiring (B43), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

214 – SD P-Crankcase

ZKP-Number: 1.8004.568

Signal error, crankcase pressure sensor

Yellow alarm; warning

Cause	Corrective action
Crankcase pressure sensor faulty. Short circuit or wire break.	1. Check sensor and wiring (B50), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

215 – SD P-HD

ZKP-Number: 1.8004.567

Signal error, rail pressure sensor

Yellow alarm; high-pressure regulator emergency operation

Cause	Corrective action
Rail pressure sensor faulty. ==> high-pressure regulator emergency operation. Short circuit or wire break.	1. Check sensor and wiring (B48), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

216 – SD T-Lube Oil

ZKP-Number: 1.8004.575

Signal error, lube oil temperature sensor

Yellow alarm; warning

Cause	Corrective action
Lube oil temperature sensor faulty. Short circuit or wire break.	1. Check sensor and wiring (B7), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

219 – SD T-Intake Air

ZKP-Number: 1.8004.573

Signal error, intake air temperature sensor

Yellow alarm; warning

Cause	Corrective action
Intake air temperature sensor faulty. Short circuit or wire break.	1. Check sensor and cabling (B3), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

220 – SD Level Coolant Water

ZKP-Number: 1.8004.584

Signal error, coolant level sensor

Yellow alarm; warning

Cause	Corrective action
Coolant level sensor faulty. Short circuit or wire break.	1. Check sensor and cabling (F33), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

TIM-ID: 0000045495 - 001

221 – SD P-Diff Lube Oil

ZKP-Number: 1.8004.585

Signal error, lube oil differential pressure sensor faulty

Yellow alarm; warning

Cause	Corrective action
Lube oil differential pressure sensor faulty. Short circuit or wire break.	1. Check sensor and cabling (F25), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

222 – SD Level Leak-off Fuel

ZKP-Number: 1.8004.582

Signal error, leak fuel level sensor

Yellow alarm; warning

Cause	Corrective action
Leak fuel level sensor faulty. Short circuit or wire break.	1. Check sensor and wiring (F46), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

223 – SD Level Coolant Charge-Air Cooler

ZKP-Number: 1.8004.583

Charge-air cooler coolant level sensor faulty

Yellow alarm; warning

Cause	Corrective action
Charge-air cooler coolant level sensor faulty. Short circuit or wire break.	1. Check sensor and wiring (F57), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

227 – SD P- Lube Oil before Filter

ZKP-Number: 1.8004.620

Signal error, lube oil pressure sensor before filter

Yellow alarm; warning

Cause	Corrective action
Lube oil pressure sensor before filter faulty. Short circuit or wire break.	1. Check sensor and wiring (B34.2), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

228 – SD P-Fuel before Filter

ZKP-Number: 1.8004.595

Signal error, fuel pressure sensor

Yellow alarm; warning

Cause	Corrective action
Fuel pressure sensor faulty. Short circuit or wire break.	1. Check sensor and wiring (B5.3), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

229 – AL Stop Camshaft Sensor Defect

ZKP-Number: 1.8004.562

Stop signal error, camshaft sensor

Red alarm; engine shutdown

Cause	Corrective action
Camshaft sensor faulty (and a fault that occurred previously in the crankshaft sensor in the same operating cycle).	1. Check sensor and wiring to connector B1, replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

230 – SD Crankshaft Speed

ZKP-Number: 1.8004.498

Signal error, crankshaft sensor

Yellow alarm; warning

Cause	Corrective action
Crankshaft sensor faulty. Short circuit or wire break.	1. Check sensor and wiring (B13), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

231 – SD Camshaft Speed

ZKP-Number: 1.8004.499

Signal error, camshaft sensor

Yellow alarm; warning

Cause	Corrective action
Camshaft sensor faulty. Short circuit or wire break.	1. Check sensor and wiring (B1), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

TIM-ID: 0000045495 - 001

232 – SD Charger 1 Speed

ZKP-Number: 1.3011.128

Signal error, primary turbocharger speed sensor

Yellow alarm; warning

Cause	Corrective action
Speed sensor of primary turbocharger faulty. Short circuit or wire break.	1. Check sensor and wiring (B44.1), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

233 – SD Charger 2 Speed

ZKP-Number: 1.3011.129

Signal error, secondary turbocharger speed sensor

Yellow alarm; warning

Cause	Corrective action
Speed sensor of secondary turbocharger faulty. Short circuit or wire break.	1. Check sensor and wiring (B44.2), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

239 – SD P-Diff Fuel

ZKP-Number: 1.8004.598

Differential pressure sensor for fuel faulty (only occurs with SD alarm 'fuel before filter' or 'fuel after filter').

Yellow alarm; warning

Cause	Corrective action
Fuel differential pressure sensor faulty.	► Check for additional messages.

240 – SD P-Fuel

ZKP-Number: 1.8004.565

Signal error, fuel pressure sensor

Yellow alarm; warning

Cause	Corrective action
Fuel pressure sensor faulty. Short circuit or wire break.	1. Check sensor and wiring (B34), replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

241 – SD T-Recirculation

ZKP-Number: 1.8004.581

Cause	Corrective action
Recirculation sensor faulty; Short circuit or wire break.	► Check sensor and wiring (B49), replace as necessary. Fault is rectified following engine restart.

242 – SD T-Coolant (R)

ZKP-Number: 1.8004.622

Cause	Corrective action
Redundant coolant pressure sensor faulty; Short circuit or wire break.	► Check sensor and wiring, replace as necessary. Fault is rectified following engine restart.

244 – SD P-Lube Oil (R)

ZKP-Number: 1.8004.621

Cause	Corrective action
Redundant lube oil pressure sensor faulty; Short circuit or wire break.	► Check sensor and wiring, replace as necessary. Fault is rectified following engine restart.

245 – SD ECU Power Supply Voltage

ZKP-Number: 2.8006.589

Signal error, engine governor supply voltage

Yellow alarm; warning

Cause	Corrective action
Internal ECU fault. Electronics faulty.	1. Replace Engine Control Unit. 2. Contact Service.

266 – SD Speed Demand

ZKP-Number: 2.8006.586

Speed setting signal error

Red alarm; forced idle

Cause	Corrective action
Analog speed setpoint faulty. Short circuit or wire break.	1. Check speed setting transmitter and wiring, replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

TIM-ID: 0000045495 - 001

268 – SD Spinning Value

ZKP-Number: 2.8006.591

Skid signal error

Yellow alarm; warning

Cause	Corrective action
Analog skid signal faulty. Short circuit or wire break.	1. Check sensor and wiring, replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

269 – SD Loadp.Analog filt.

ZKP-Number: 2.8006.588

Load pulse analog signal faulty

Yellow alarm; warning

Cause	Corrective action
The filtered analog signal from the load pulse is not present. Short circuit or wire break.	1. Check wiring, replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

270 – SD Frequency Input

ZKP-Number: 2.8006.590

Signal error, frequency input

Red alarm; forced idle

Cause	Corrective action
Frequency input faulty. Short circuit or wire break.	1. Check wiring (→ Page 265). 2. Check speed demand transmitter. 3. Contact Service.

301 – AL Timing Cylinder A1

ZKP-Number: 1.8004.500

Time-of-flight measuring fault of injector

Cause	Corrective action
Flight time value extremely low or extremely high.	► Replace injector if the fault message appears frequently (→ Page 179).

302 – AL Timing Cylinder A2

ZKP-Number: 1.8004.501

Time-of-flight measuring fault of injector

Cause	Corrective action
Flight time value extremely low or extremely high.	► Replace injector if the fault message appears frequently (→ Page 179).

303 – AL Timing Cylinder A3

ZKP-Number: 1.8004.502

Time-of-flight measuring fault of injector

Cause	Corrective action
Flight time value extremely low or extremely high.	► Replace injector if the fault message appears frequently (→ Page 179).

304 – AL Timing Cylinder A4

ZKP-Number: 1.8004.503

Time-of-flight measuring fault of injector

Cause	Corrective action
Flight time value extremely low or extremely high.	► Replace injector if the fault message appears frequently (→ Page 179).

305 – AL Timing Cylinder A5

ZKP-Number: 1.8004.504

Time-of-flight measuring fault of injector

Cause	Corrective action
Flight time value extremely low or extremely high.	► Replace injector if the fault message appears frequently (→ Page 179).

306 – AL Timing Cylinder A6

ZKP-Number: 1.8004.505

Time-of-flight measuring fault of injector

Cause	Corrective action
Flight time value extremely low or extremely high.	► Replace injector if the fault message appears frequently (→ Page 179).

307 – AL Timing Cylinder A7

ZKP-Number: 1.8004.506

Time-of-flight measuring fault of injector

Cause	Corrective action
Flight time value extremely low or extremely high.	► Replace injector if the fault message appears frequently (→ Page 179).

308 – AL Timing Cylinder A8

ZKP-Number: 1.8004.507

Time-of-flight measuring fault of injector

Cause	Corrective action
Flight time value extremely low or extremely high.	► Replace injector if the fault message appears frequently (→ Page 179).

TIM-ID: 0000045495 - 001

309 – AL Timing Cylinder A9

ZKP-Number: 1.8004.508

Time-of-flight measuring fault of injector

Cause	Corrective action
Flight time value extremely low or extremely high.	► Replace injector if the fault message appears frequently (→ Page 179).

310 – AL Timing Cylinder A10

ZKP-Number: 1.8004.509

Time-of-flight measuring fault of injector

Cause	Corrective action
Flight time value extremely low or extremely high.	► Replace injector if the fault message appears frequently (→ Page 179).

311 – AL Timing Cylinder B1

ZKP-Number: 1.8004.510

Time-of-flight measuring fault of injector

Cause	Corrective action
Flight time value extremely low or extremely high.	► Replace injector if the fault message appears frequently (→ Page 179).

312 – AL Timing Cylinder B2

ZKP-Number: 1.8004.511

Time-of-flight measuring fault of injector

Cause	Corrective action
Flight time value extremely low or extremely high.	► Replace injector if the fault message appears frequently (→ Page 179).

313 – AL Timing Cylinder B3

ZKP-Number: 1.8004.512

Time-of-flight measuring fault of injector

Cause	Corrective action
Flight time value extremely low or extremely high.	► Replace injector if the fault message appears frequently (→ Page 179).

314 – AL Timing Cylinder B4

ZKP-Number: 1.8004.513

Time-of-flight measuring fault of injector

Cause	Corrective action
Flight time value extremely low or extremely high.	► Replace injector if the fault message appears frequently (→ Page 179).

315 – AL Timing Cylinder B5

ZKP-Number: 1.8004.514

Time-of-flight measuring fault of injector

Cause	Corrective action
Flight time value extremely low or extremely high.	► Replace injector if the fault message appears frequently (→ Page 179).

316 – AL Timing Cylinder B6

ZKP-Number: 1.8004.515

Time-of-flight measuring fault of injector

Cause	Corrective action
Flight time value extremely low or extremely high.	► Replace injector if the fault message appears frequently (→ Page 179).

317 – AL Timing Cylinder B7

ZKP-Number: 1.8004.516

Time-of-flight measuring fault of injector

Cause	Corrective action
Flight time value extremely low or extremely high.	► Replace injector if the fault message appears frequently (→ Page 179).

318 – AL Timing Cylinder B8

ZKP-Number: 1.8004.517

Time-of-flight measuring fault of injector

Cause	Corrective action
Flight time value extremely low or extremely high.	► Replace injector if the fault message appears frequently (→ Page 179).

319 – AL Timing Cylinder B9

ZKP-Number: 1.8004.518

Time-of-flight measuring fault of injector

Cause	Corrective action
Flight time value extremely low or extremely high.	► Replace injector if the fault message appears frequently (→ Page 179).

320 – AL Timing Cylinder B10

ZKP-Number: 1.8004.519

Time-of-flight measuring fault of injector

Cause	Corrective action
Flight time value extremely low or extremely high.	► Replace injector if the fault message appears frequently (→ Page 179).

TIM-ID: 0000045495 - 001

321 – AL Wiring Cylinder A1

ZKP-Number: 1.8004.520

Wiring fault cylinder A1

Yellow alarm; misfire

Cause	Corrective action
Short circuit fault in injector wiring cylinder A1.	1. Check injector solenoid, replace injector if necessary (→ Page 179). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

322 – AL Wiring Cylinder A2

ZKP-Number: 1.8004.521

Wiring fault cylinder A2

Yellow alarm; misfire

Cause	Corrective action
Short circuit fault in injector wiring cylinder A2.	1. Check injector solenoid, replace injector if necessary (→ Page 179). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

323 – AL Wiring Cylinder A3

ZKP-Number: 1.8004.522

Wiring fault cylinder A3

Yellow alarm; misfire

Cause	Corrective action
Short circuit fault in injector wiring cylinder A3.	1. Check injector solenoid, replace injector if necessary (→ Page 179). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

324 – AL Wiring Cylinder A4

ZKP-Number: 1.8004.523

Wiring fault cylinder A4

Yellow alarm; misfire

Cause	Corrective action
Short circuit fault in injector wiring cylinder A4.	1. Check injector solenoid, replace injector if necessary (→ Page 179). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

325 – AL Wiring Cylinder A5

ZKP-Number: 1.8004.524

Wiring fault cylinder A5

Yellow alarm; misfire

Cause	Corrective action
Short circuit fault in injector wiring cylinder A5.	1. Check injector solenoid, replace injector if necessary (→ Page 179). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

326 – AL Wiring Cylinder A6

ZKP-Number: 1.8004.525

Wiring fault cylinder A6

Yellow alarm; misfire

Cause	Corrective action
Short circuit fault in injector wiring cylinder A6.	1. Check injector solenoid, replace injector if necessary (→ Page 179). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

327 – AL Wiring Cylinder A7

ZKP-Number: 1.8004.526

Wiring fault cylinder A7

Yellow alarm; misfire

Cause	Corrective action
Short circuit fault in injector wiring cylinder A7.	1. Check injector solenoid, replace injector if necessary (→ Page 179). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

328 – AL Wiring Cylinder A8

ZKP-Number: 1.8004.527

Wiring fault cylinder A8

Yellow alarm; misfire

Cause	Corrective action
Short circuit fault in injector wiring cylinder A8.	1. Check injector solenoid, replace injector if necessary (→ Page 179). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

TIM-ID: 0000045495 - 001

329 – AL Wiring Cylinder A9

ZKP-Number: 1.8004.528

Wiring fault cylinder A9

Yellow alarm; misfire

Cause	Corrective action
Short circuit fault in injector wiring cylinder A9.	1. Check injector solenoid, replace injector if necessary (→ Page 179). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

330 – AL Wiring Cylinder A10

ZKP-Number: 1.8004.529

Wiring fault cylinder A10

Yellow alarm; misfire

Cause	Corrective action
Short circuit fault in injector wiring cylinder A10.	1. Check injector solenoid, replace injector if necessary (→ Page 179). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

331 – AL Wiring Cylinder B1

ZKP-Number: 1.8004.530

Wiring fault cylinder B1

Yellow alarm; misfire

Cause	Corrective action
Short circuit fault in injector wiring cylinder B1.	1. Check injector solenoid, replace injector if necessary (→ Page 179). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

332 – AL Wiring Cylinder B2

ZKP-Number: 1.8004.531

Wiring fault cylinder B2

Yellow alarm; misfire

Cause	Corrective action
Short circuit fault in injector wiring cylinder B2.	1. Check injector solenoid, replace injector if necessary (→ Page 179). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

333 – AL Wiring Cylinder B3

ZKP-Number: 1.8004.532

Wiring fault cylinder B3

Yellow alarm; misfire

Cause	Corrective action
Short circuit fault in injector wiring cylinder B3.	1. Check injector solenoid, replace injector if necessary (→ Page 179). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

334 – AL Wiring Cylinder B4

ZKP-Number: 1.8004.533

Wiring fault cylinder B4

Yellow alarm; misfire

Cause	Corrective action
Short circuit fault in injector wiring cylinder B4.	1. Check injector solenoid, replace injector if necessary (→ Page 179). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

335 – AL Wiring Cylinder B5

ZKP-Number: 1.8004.534

Wiring fault cylinder B5

Yellow alarm; misfire

Cause	Corrective action
Short circuit fault in injector wiring cylinder B5.	1. Check injector solenoid, replace injector if necessary (→ Page 179). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

336 – AL Wiring Cylinder B6

ZKP-Number: 1.8004.535

Wiring fault cylinder B6

Yellow alarm; misfire

Cause	Corrective action
Short circuit fault in injector wiring cylinder B6.	1. Check injector solenoid, replace injector if necessary (→ Page 179). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

TIM-ID: 0000045495 - 001

337 – AL Wiring Cylinder B7

ZKP-Number: 1.8004.536

Wiring fault cylinder B7

Yellow alarm; misfire

Cause	Corrective action
Short circuit fault in injector wiring cylinder B7.	1. Check injector solenoid, replace injector if necessary (→ Page 179). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

338 – AL Wiring Cylinder B8

ZKP-Number: 1.8004.537

Wiring fault cylinder B8

Yellow alarm; misfire

Cause	Corrective action
Short circuit fault in injector wiring cylinder B8.	1. Check injector solenoid, replace injector if necessary (→ Page 179). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

339 – AL Wiring Cylinder B9

ZKP-Number: 1.8004.538

Wiring fault cylinder B9

Yellow alarm; misfire

Cause	Corrective action
Short circuit fault in injector wiring cylinder B9.	1. Check injector solenoid, replace injector if necessary (→ Page 179). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

340 – AL Wiring Cylinder B10

ZKP-Number: 1.8004.539

Wiring fault cylinder B10

Yellow alarm; misfire

Cause	Corrective action
Short circuit fault in injector wiring cylinder B10.	1. Check injector solenoid, replace injector if necessary (→ Page 179). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

341 – AL Open Load Cylinder A1

ZKP-Number: 1.8004.540

Injector wiring fault cylinder A1

Yellow alarm; misfire

Cause	Corrective action
Disruption fault in injector wiring cylinder A1.	1. Check injector wiring for open circuit. 2. Exclude possible injector solenoid fault, replace injector if necessary (→ Page 179). 3. Fault rectified after each working cycle. 4. Contact Service.

342 – AL Open Load Cylinder A2

ZKP-Number: 1.8004.541

Injector wiring fault cylinder A2

Yellow alarm; misfire

Cause	Corrective action
Disruption fault in injector wiring cylinder A2.	1. Check injector wiring for open circuit. 2. Exclude possible injector solenoid fault, replace injector if necessary (→ Page 179). 3. Fault rectified after each working cycle. 4. Contact Service.

343 – AL Open Load Cylinder A3

ZKP-Number: 1.8004.542

Injector wiring fault cylinder A3

Yellow alarm; misfire

Cause	Corrective action
Disruption fault in injector wiring cylinder A3.	1. Check injector wiring for open circuit. 2. Exclude possible injector solenoid fault, replace injector if necessary (→ Page 179). 3. Fault rectified after each working cycle. 4. Contact Service.

344 – AL Open Load Cylinder A4

ZKP-Number: 1.8004.543

Injector wiring fault cylinder A4

Yellow alarm; misfire

Cause	Corrective action
Disruption fault in injector wiring cylinder A4.	1. Check injector wiring for open circuit. 2. Exclude possible injector solenoid fault, replace injector if necessary (→ Page 179). 3. Fault rectified after each working cycle. 4. Contact Service.

TIM-ID: 0000045495 - 001

345 – AL Open Load Cylinder A5

ZKP-Number: 1.8004.544

Injector wiring fault cylinder A5

Yellow alarm; misfire

Cause	Corrective action
Disruption fault in injector wiring cylinder A5.	1. Check injector wiring for open circuit. 2. Exclude possible injector solenoid fault, replace injector if necessary (→ Page 179). 3. Fault rectified after each working cycle. 4. Contact Service.

346 – AL Open Load Cylinder A6

ZKP-Number: 1.8004.545

Injector wiring fault cylinder A6

Yellow alarm; misfire

Cause	Corrective action
Disruption fault in injector wiring cylinder A6.	1. Check injector wiring for open circuit. 2. Exclude possible injector solenoid fault, replace injector if necessary (→ Page 179). 3. Fault rectified after each working cycle. 4. Contact Service.

347 – AL Open Load Cylinder A7

ZKP-Number: 1.8004.546

Injector wiring fault cylinder A7

Yellow alarm; misfire

Cause	Corrective action
Disruption fault in injector wiring cylinder A7.	1. Check injector wiring for open circuit. 2. Exclude possible injector solenoid fault, replace injector if necessary (→ Page 179). 3. Fault rectified after each working cycle. 4. Contact Service.

348 – AL Open Load Cylinder A8

ZKP-Number: 1.8004.547

Injector wiring fault cylinder A8

Yellow alarm; misfire

Cause	Corrective action
Disruption fault in injector wiring cylinder A8.	1. Check injector wiring for open circuit. 2. Exclude possible injector solenoid fault, replace injector if necessary (→ Page 179). 3. Fault rectified after each working cycle. 4. Contact Service.

349 – AL Open Load Cylinder A9

ZKP-Number: 1.8004.548

Injector wiring fault cylinder A9

Yellow alarm; misfire

Cause	Corrective action
Disruption fault in injector wiring cylinder A9.	1. Check injector wiring for open circuit. 2. Exclude possible injector solenoid fault, replace injector if necessary (→ Page 179). 3. Fault rectified after each working cycle. 4. Contact Service.

350 – AL Open Load Cylinder A10

ZKP-Number: 1.8004.549

Injector wiring fault cylinder A10

Yellow alarm; misfire

Cause	Corrective action
Disruption fault in injector wiring cylinder A10.	1. Check injector wiring for open circuit. 2. Exclude possible injector solenoid fault, replace injector if necessary (→ Page 179). 3. Fault rectified after each working cycle. 4. Contact Service.

351 – AL Open Load Cylinder B1

ZKP-Number: 1.8004.550

Injector wiring fault cylinder B1

Yellow alarm; misfire

Cause	Corrective action
Disruption fault in injector wiring cylinder B1.	1. Check injector wiring for open circuit. 2. Exclude possible injector solenoid fault, replace injector if necessary (→ Page 179). 3. Fault rectified after each working cycle. 4. Contact Service.

352 – AL Open Load Cylinder B2

ZKP-Number: 1.8004.551

Injector wiring fault cylinder B2

Yellow alarm; misfire

Cause	Corrective action
Disruption fault in injector wiring cylinder B2.	1. Check injector wiring for open circuit. 2. Exclude possible injector solenoid fault, replace injector if necessary (→ Page 179). 3. Fault rectified after each working cycle. 4. Contact Service.

TIM-ID: 0000045495 - 001

353 – AL Open Load Cylinder B3

ZKP-Number: 1.8004.552

Injector wiring fault cylinder B3

Yellow alarm; misfire

Cause	Corrective action
Disruption fault in injector wiring cylinder B3.	1. Check injector wiring for open circuit. 2. Exclude possible injector solenoid fault, replace injector if necessary (→ Page 179). 3. Fault rectified after each working cycle. 4. Contact Service.

354 – AL Open Load Cylinder B4

ZKP-Number: 1.8004.553

Injector wiring fault cylinder B4

Yellow alarm; misfire

Cause	Corrective action
Disruption fault in injector wiring cylinder B4.	1. Check injector wiring for open circuit. 2. Exclude possible injector solenoid fault, replace injector if necessary (→ Page 179). 3. Fault rectified after each working cycle. 4. Contact Service.

355 – AL Open Load Cylinder B5

ZKP-Number: 1.8004.554

Injector wiring fault cylinder B5

Yellow alarm; misfire

Cause	Corrective action
Disruption fault in injector wiring cylinder B5.	1. Check injector wiring for open circuit. 2. Exclude possible injector solenoid fault, replace injector if necessary (→ Page 179). 3. Fault rectified after each working cycle. 4. Contact Service.

356 – AL Open Load Cylinder B6

ZKP-Number: 1.8004.555

Injector wiring fault cylinder B6

Yellow alarm; misfire

Cause	Corrective action
Disruption fault in injector wiring cylinder B6.	1. Check injector wiring for open circuit. 2. Exclude possible injector solenoid fault, replace injector if necessary (→ Page 179). 3. Fault rectified after each working cycle. 4. Contact Service.

357 – AL Open Load Cylinder B7

ZKP-Number: 1.8004.556

Injector wiring fault cylinder B7

Yellow alarm; misfire

Cause	Corrective action
Disruption fault in injector wiring cylinder B7.	1. Check injector wiring for open circuit. 2. Exclude possible injector solenoid fault, replace injector if necessary (→ Page 179). 3. Fault rectified after each working cycle. 4. Contact Service.

358 – AL Open Load Cylinder B8

ZKP-Number: 1.8004.557

Injector wiring fault cylinder B8

Yellow alarm; misfire

Cause	Corrective action
Disruption fault in injector wiring cylinder B8.	1. Check injector wiring for open circuit. 2. Exclude possible injector solenoid fault, replace injector if necessary (→ Page 179). 3. Fault rectified after each working cycle. 4. Contact Service.

359 – AL Open Load Cylinder B9

ZKP-Number: 1.8004.558

Injector wiring fault cylinder B9

Yellow alarm; misfire

Cause	Corrective action
Disruption fault in injector wiring cylinder B9.	1. Check injector wiring for open circuit. 2. Exclude possible injector solenoid fault, replace injector if necessary (→ Page 179). 3. Fault rectified after each working cycle. 4. Contact Service.

360 – AL Open Load Cylinder B10

ZKP-Number: 1.8004.559

Injector wiring fault cylinder B10

Yellow alarm; misfire

Cause	Corrective action
Disruption fault in injector wiring cylinder B10.	1. Check injector wiring for open circuit. 2. Exclude possible injector solenoid fault, replace injector if necessary (→ Page 179). 3. Fault rectified after each working cycle. 4. Contact Service.

TIM-ID: 0000045495 - 001

361 – AL Power Stage Low

ZKP-Number: 1.8004.496

Internal electronic fault

Red alarm; engine shutdown possible

Cause	Corrective action
Electronics faulty.	1. Start ITS. 2. Replace engine governor if required. 3. Check additional messages if ITS indicates diagnosis "Electronics OK" (e.g. wiring faulty). 4. Check solenoid valve wiring. 5. Contact Service.

362 – AL Power Stage high

ZKP-Number: 1.8004.497

Internal electronic fault.

Red alarm; engine shutdown possible

Cause	Corrective action
Electronics faulty.	1. Start ITS. 2. Replace engine governor if required. 3. Check additional messages if ITS indicates diagnosis "Electronics OK" (e.g. wiring faulty). 4. Check solenoid valve wiring. 5. Contact Service.

363 – AL Stop Power Stage

ZKP-Number: 1.8004.560

Internal electronic fault.

Red alarm; engine shutdown

Cause	Corrective action
Electronics faulty.	1. Start ITS. 2. Replace engine governor. 3. Check additional messages if ITS indicates diagnosis "Electronics OK" (e.g. wiring faulty). 4. Check solenoid valve wiring. 5. Contact Service.

365 – AL Stop MV-Wiring Ground

ZKP-Number: 1.8004.561

Injector wiring error

Red alarm - engine shutdown via Protection Module possible

Cause	Corrective action
Short circuit of injector positive connection to ground of one or more injectors. Short circuit of the negative injector connection or of one or more injectors to ground.	1. Check wiring (→ Page 265). 2. Engine restart (→ Page 77). 3. Replace wiring harness if necessary (→ Contact Service).

371 – AL Wiring TO 1

ZKP-Number: 1.8004.634

Line disruption

Cause	Corrective action
Short circuit or wire break on transistor output 1 (TO 1).	1. Check charger valve/wiring, repair as necessary. 2. Replace engine governor.

372 – AL Wiring TO 2

ZKP-Number: 1.8004.635

Line disruption

Cause	Corrective action
Short circuit or wire break on transistor output 2 (TO 2).	1. Check recirculation valve/wiring, repair as necessary. 2. Replace engine governor.

373 – AL Wiring TO 3

ZKP-Number: 1.8004.636

Line disruption

Cause	Corrective action
Short circuit or wire break on transistor output 3 (TO 3).	► -

374 – AL Wiring TO 4

ZKP-Number: 1.8004.637

Line disruption

Cause	Corrective action
Short circuit or wire break on transistor output 4 (TO 4).	► -

TIM-ID: 0000045495 - 001

381 – AL Wiring TOP 1

ZKP-Number: 2.8006.638

Line disruption on digital input 1

Yellow alarm; warning

Cause	Corrective action
Short circuit or wire break on transistor output, plant-side 1 (TOP 1).	► Check wiring to plant.

382 – AL Wiring TOP 2

ZKP-Number: 2.8006.639

Line disruption on digital input 2

Yellow alarm; warning

Cause	Corrective action
Short circuit or wire break on transistor output, plant-side 2 (TOP 2).	► Check wiring to plant.

383 – AL Wiring TOP 3

ZKP-Number: 2.8006.640

Line disruption on digital input 3

Yellow alarm; warning

Cause	Corrective action
Short circuit or wire break on transistor output, plant-side 3 (TOP 3).	► Check wiring to plant.

384 – AL Wiring TOP 4

ZKP-Number: 2.8006.641

Line disruption on digital input 4

Yellow alarm; warning

Cause	Corrective action
Short circuit or wire break on transistor output, plant-side 4 (TOP 4).	► Check wiring to plant.

390 – AL MCR exceeded

ZKP-Number: 1.1085.009

Speed limiter/MCR function: the maximum continuous rate was exceeded

Yellow alarm; engine power limited to permissible continuous power

Cause	Corrective action
Engine was overloaded continuously.	► With a continuous alarm, contact Service.

392 – HI T-Coolant Red

ZKP-Number: 2.0129.931

Limit value 1

Cause	Corrective action
Redundant coolant temperature reading too high.	1. Check wiring. 2. Contact Service.

393 – SS T-Coolant Red

ZKP-Number: 2.0129.932

Limit value 2

Cause	Corrective action
Redundant coolant temperature reading too high; engine stop.	1. Check wiring and sensor. 2. Contact Service.

394 – LO P-Lube Oil Red

ZKP-Number: 2.0112.921

Limit value 1

Cause	Corrective action
Redundant lube oil pressure reading too low.	1. Check wiring and sensor. 2. Contact Service.

395 – SS P-Lube Oil Red

ZKP-Number: 2.0112.922

Limit value 2

Cause	Corrective action
Redundant lube oil pressure reading too low.	1. Check wiring and sensor. 2. Contact Service.

396 – TD T-Coolant Sensor Deviation

ZKP-Number: 1.0480.193

Cause	Corrective action
Maximum coolant temperature deviation.	1. Check wiring and sensor. 2. Contact Service.

TIM-ID: 0000045495 - 001

397 – TD P-Oil Sensor Deviation

ZKP-Number: 1.0480.293

Cause	Corrective action
Maximum lube oil pressure deviation.	1. Check wiring and sensor. 2. Contact Service.

400 – AL Open Load Digital Input 1

ZKP-Number: 2.8006.625

Line disruption on digital input 1

Yellow alarm; warning

Cause	Corrective action
Wiring faulty. No resistance over switch.	1. Check wiring (→ Page 265). 2. Check target device input. 3. Contact Service.

401 – AL Open Load Digital Input 2

ZKP-Number: 2.8006.626

Line disruption on digital input 2

Yellow alarm; warning

Cause	Corrective action
Wiring faulty. No resistance over switch.	1. Check wiring (→ Page 265). 2. Check target device input. 3. Contact Service.

402 – AL Open Load Digital Input 3

ZKP-Number: 2.8006.627

Line disruption on digital input 3

Yellow alarm; warning

Cause	Corrective action
Wiring faulty. No resistance over switch.	1. Check wiring (→ Page 265). 2. Check target device input. 3. Contact Service.

403 – AL Open Load Digital Input 4

ZKP-Number: 2.8006.628

Line disruption on digital input 4

Yellow alarm; warning

Cause	Corrective action
Wiring faulty. No resistance over switch.	1. Check wiring (→ Page 265). 2. Check target device input. 3. Contact Service.

404 – AL Open Load Digital Input 5

ZKP-Number: 2.8006.629

Line disruption on digital input 5

Yellow alarm; warning

Cause	Corrective action
Wiring faulty. No resistance over switch.	1. Check wiring (→ Page 265). 2. Check target device input. 3. Contact Service.

405 – AL Open Load Digital Input 6

ZKP-Number: 2.8006.630

Line disruption on digital input 6

Yellow alarm; warning

Cause	Corrective action
Wiring faulty. No resistance over switch.	1. Check wiring (→ Page 265). 2. Check target device input. 3. Contact Service.

406 – AL Open Load Digital Input 7

ZKP-Number: 2.8006.631

Line disruption on digital input 7

Yellow alarm; warning

Cause	Corrective action
Wiring faulty. No resistance over switch.	1. Check wiring (→ Page 265). 2. Check target device input. 3. Contact Service.

407 – AL Open Load Digital Input 8

ZKP-Number: 2.8006.632

Line disruption on digital input 8

Yellow alarm; warning

Cause	Corrective action
Wiring faulty. No resistance over switch.	1. Check wiring (→ Page 265). 2. Check target device input. 3. Contact Service.

408 – AL Open Load Emerg. Stop Input ESI

ZKP-Number: 2.8006.633

Line disruption at input for emergency stop

Yellow alarm; warning

Cause	Corrective action
Wiring faulty or no resistance over switch.	1. Check wiring (→ Page 265). 2. Check target device input. 3. Contact Service.

410 – LO U-PDU

ZKP-Number: 2.0141.921

Injector voltage too low (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Wiring damage or faulty current supply.	1. Check wiring (→ Page 265). 2. Check supply. 3. Contact Service.

411 – LOLO U-PDU

ZKP-Number: 2.0141.922

Injector voltage too low (limit value 2)

Red alarm; engine shutdown

Cause	Corrective action
Wiring damage or faulty current supply.	1. Check wiring (→ Page 265). 2. Check supply. 3. Acknowledge alarm. 4. Contact Service.

412 – HI U-PDU

ZKP-Number: 2.0141.931

Injector voltage too high (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Wiring damage or faulty current supply.	1. Check wiring (→ Page 265). 2. Check supply. 3. Contact Service.

413 – HIHI U-PDU

ZKP-Number: 2.0141.932

Injector voltage too high (limit value 2)

Red alarm; engine shutdown

Cause	Corrective action
Wiring damage or faulty current supply.	1. Check wiring (→ Page 265). 2. Check supply. 3. Acknowledge alarm. 4. Contact Service.

414 – HI Level Water Fuel Prefilter

ZKP-Number: 2.0156.931

Water level in fuel prefilter too high (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Water content in fuel too high. Water ingress in fuel tank.	► Empty fuel prefilter.

415 – LO P-Coolant Charge-Air Cooler

ZKP-Number: 2.0107.921

Coolant pressure in charge-air cooler too low (limit 1)

Yellow alarm; warning

Cause	Corrective action
Leak in coolant circuit.	► Top up coolant.

416 – SS P-Coolant Charge-Air Cooler

ZKP-Number: 2.0107.922

Coolant pressure in charge-air cooler too low (limit 2)

Red alarm; engine shutdown

Cause	Corrective action
Leak in coolant circuit.	► Top up coolant.

417 – SD Level Water Fuel Prefilter

ZKP-Number: 1.8004.594

Signal error, fuel prefilter water level sensor

Yellow alarm; warning

Cause	Corrective action
Fuel prefilter water level sensor faulty. Short circuit or wire break.	1. Check sensor and wiring, replace as necessary (→ Page 265). 2. Contact Service.

419 – SD T-Coolant b.Engine

ZKP-Number: 18.004.604

Cause	Corrective action
Coolant inlet temperature sensor faulty. Short circuit or wire break	► Check sensor and wiring (B3), replace as necessary.

420 – AL L1 Aux 1

ZKP-Number: 2.0160.921

Limit value 1

Cause	Corrective action
Input signal of Aux 1 has exceeded/not attained limit value 1, depending on configuration.	► Determine cause of limit value violation and rectify fault.

421 – AL L2 Aux 1

ZKP-Number: 2.0160.922

Limit value 2

Cause	Corrective action
Input signal of Aux 1 has exceeded/not attained limit value 2, depending on configuration.	► Determine cause of limit value violation and rectify fault.

428 – AL L1 T-Aux 1

ZKP-Number: 2.0130.921

Limit value 1

Cause	Corrective action
Temperature signal of Aux 1 has exceeded / not attained limit value 1, depending on configuration.	► Determine cause of limit value violation and rectify fault.

434 – AL L2 P-Aux 1

ZKP-Number: 2.0173.931

Limit value 1

Cause	Corrective action
Coolant temperature too high.	► Check coolant circuit.

440 – AL L1 P-Aux 1

ZKP-Number: 2.0110.921

Limit value 1

Cause	Corrective action
Pressure signal of Aux 1 has exceeded / not attained limit value 1, depending on configuration.	► Determine cause of limit value violation and rectify fault.

442 – AL L2 P-Aux 1

ZKP-Number: 2.0110.931

Limit value 2

Cause	Corrective action
Pressure signal of Aux 1 has exceeded / not attained limit value 2, depending on configuration.	► Determine cause of limit value violation and rectify fault.

444 – SD U-PDU

ZKP-Number: 1.8004.578

Injector power stage supply voltage fault

Yellow alarm; warning

Cause	Corrective action
Sensor defect of injector power stage, or internal fault of engine governor.	► Replace Engine Control Unit.

445 – SD P-Ambient Air

ZKP-Number: 1.8004.580

Signal error, ambient air pressure sensor

Yellow alarm; warning

Cause	Corrective action
Ambient air pressure sensor faulty.	► Replace Engine Control Unit.

446 – SD P-HD2

ZKP-Number: 1.8004.599

Signal error, rail pressure sensor

Yellow alarm; high-pressure regulator emergency operation

Cause	Corrective action
Rail pressure sensor faulty. Short circuit or wire break.	1. Check sensor and wiring (B48), replace as necessary (→ Page 265). 2. Contact Service.

448 – HI P-Charge Air

ZKP-Number: 2.0103.931

Charge-air pressure too high (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Fault at turbine bypass flap.	► Contact Service.

449 – SS P-Charge Air

ZKP-Number: 2.0103.932

Charge-air pressure too high (limit value 2)

Red alarm; engine shutdown

Cause	Corrective action
Fault at turbine bypass flap.	► Contact Service.

450 – SD Idle/End-Torque Input [%]

ZKP-Number: 2.8006.592

Signal error, start/end torque

Yellow alarm; warning

Cause	Corrective action
Input signal for start/end torque faulty. Short circuit or wire break.	1. Check signal transmitter and wiring, replace as necessary. (→ Page 265) 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

454 – SS Power Reduction Active

ZKP-Number: 2.7000.011

Power reduction activated

Red alarm - power reduction activated

Cause	Corrective action
Engine operation outside standard limit values. This message has the following possible causes: Intake depression, exhaust back pressure, charge-air coolant temperature or intake air temperature outside the limit values	► Check for additional messages.

455 – AL L1 Aux1 Plant

ZKP-Number: 2.8006.650

Limit value 1

Cause	Corrective action
Input signal of Aux 1 (plant side) has exceeded/not attained limit value 1, depending on configuration.	► Determine cause of limit value violation and rectify fault.

456 – AL L2 Aux1 Plant

ZKP-Number: 2.8006.651

Limit value 2

Cause	Corrective action
Input signal of Aux 1 (plant side) has exceeded/not attained limit value 2, depending on configuration.	► Determine cause of limit value violation and rectify fault.

460 – HI T-Exhaust EMU

ZKP-Number: 2.8006.652

Limit value 1

Cause	Corrective action
EMU exhaust gas temperature value too high.	1. Check wiring. 2. Contact Service.

TIM-ID: 0000045495 - 001

461 – LO T-Exhaust EMU

ZKP-Number: 2.8006.653

Limit value 1

Cause	Corrective action
EMU exhaust gas temperature value too low.	1. Check wiring. 2. Contact Service.

462 – HI T-Coolant EMU

ZKP-Number: 2.8006.654

Limit value 1

Cause	Corrective action
EMU coolant temperature value too high / low.	► Check configuration with DiaSys.

464 – SD P-AUX 1

ZKP-Number: 1.8004.589

Cause	Corrective action
Analog input signal for Aux 1 pressure faulty; short circuit or wire break.	► Check pressure transmitter and wiring, replace as necessary. Fault is rectified following engine restart.

467 – AL L2 T-Aux 1

ZKP-Number: 2.0130.922

Limit value 2

Cause	Corrective action
Temperature signal of Aux 1 has exceeded / not attained limit value 2, depending on configuration.	► Determine cause of limit value violation and rectify fault.

468 – SD T-AUX 1

ZKP-Number: 1.8004.579

Signal error, temperature Aux 1

Yellow alarm; warning

Cause	Corrective action
Analog input for Aux 2 temperature faulty.	► -

469 – SD AUX 1

ZKP-Number: 1.8004.590

Cause	Corrective action
Analog input signal for Aux 1 faulty; short circuit or wire break.	► Check signal sensor and wiring, replace as necessary. Fault is rectified following engine restart.

470 – SD T-ECU

ZKP-Number: 1.8004.587

Signal error, engine governor temperature

Yellow alarm; warning

Cause	Corrective action
Temperature sensor for engine governor faulty. Short circuit or wire break.	1. Check sensor and wiring, replace as necessary (→ Page 265). 2. Engine restart (→ Page 77). 3. Contact Service.

471 – SD Coil Current

ZKP-Number: 1.8004.592

Signal error, HP fuel control block

Yellow alarm; warning

Cause	Corrective action
Actuation of HP fuel control block faulty. Short circuit or wire break.	1. Check sensor and wiring, replace as necessary (→ Page 265). 2. Contact Service.

472 – AL Stop SD

ZKP-Number: 2.8006.593

Engine stops

Red alarm; engine shutdown

Cause	Corrective action
Engine stops because 'Sensor faulty' present at channels.	1. Check wiring (→ Page 265). 2. Contact Service.

473 – AL Wiring PWM_CM2

ZKP-Number: 1.8004.593

Cause	Corrective action
Wire break or short circuit on channel PWM_CM2.	1. Check wiring. 2. Contact Service.

TIM-ID: 0000045495 - 001

474 – AL Wiring FO

ZKP-Number: 2.8006.655

Wiring fault on FO

Yellow alarm; warning

Cause	Corrective action
Wire break or short circuit on channel FO.	1. Check wiring (→ Page 265). 2. Contact Service.

475 – AL CR Engine Shutdown Trigger

ZKP-Number: 1.8010.009

Crash recorder was triggered by an engine shutdown.

Yellow alarm; warning

Cause	Corrective action
Crash recorder was triggered by an engine shutdown.	► Contact Service.

476 – AL Crash Rec. Init. Error

ZKP-Number: 1.8010.007

Initialization error of crash recorder.

Cause	Corrective action
Initialization error of crash recorder.	► Contact Service.

478 – AL Comb. Alarm Yel (Plant)

ZKP-Number: 2.8006.001

Yellow combined alarm from system

Yellow alarm; warning

Cause	Corrective action
Various causes possible.	► Check for additional messages.

479 – AL Comb. Alarm Red (Plant)

ZKP-Number: 2.8006.002

Red combined alarm from system

Red alarm

Cause	Corrective action
Various causes possible.	► Check for additional messages.

480 – AL Ext. Engine Protection

ZKP-Number: 2.0291.921

External engine protection function active

Yellow alarm; warning

Cause	Corrective action
The external engine protection function is active. Monitoring of plant signal by ECU active (plant side).	1. Check plant signal. 2. Contact Service.

482 – SD T-Exhaust C

ZKP-Number: 18.004.596

Cause	Corrective action
Exhaust temperature sensor on A side faulty. Short circuit or wire break	► Check sensor and wiring (B4.23), replace as necessary.

483 – SD T-Exhaust D

ZKP-Number: 18.004.597

Cause	Corrective action
Exhaust temperature sensor on A side faulty. Short circuit or wire break	► Check sensor and wiring (B4.24), replace as necessary.

484 – HI T-Exhaust C

ZKP-Number: 20.133.931

Limit value 1

Cause	Corrective action
Exhaust gas temperature (C-side) too high.	1. Reduce power. 2. Contact Service.

485 – SS T-Exhaust C

ZKP-Number: 20.133.932

Limit value 2

Cause	Corrective action
Exhaust gas temperature (C-side) too high.	1. Reduce power. 2. Contact Service.

TIM-ID: 0000045495 - 001

486 – HI T-Exhaust D

ZKP-Number: 20.134.931

Limit value 1

Cause	Corrective action
Exhaust gas temperature (D-side) too high.	1. Reduce power. 2. Contact Service.

487 – SS T-Exhaust D

ZKP-Number: 20.134.932

Limit value 2

Cause	Corrective action
Exhaust gas temperature (D-side) too high.	1. Reduce power. 2. Contact Service.

488 – HI ETC3 Overspeed

ZKP-Number: 2.3014.931

Speed of 2nd secondary turbocharger too high (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Clogged charge-air circuit or fault in turbocharger.	► Reduce power.

489 – SS ETC3 Overspeed

ZKP-Number: 2.3014.932

Speed of 2nd secondary turbocharger too high (limit value 2)

Red alarm; engine shutdown

Cause	Corrective action
Clogged charge-air circuit or fault in turbocharger.	► Reduce power.

490 – HI ETC4 Overspeed

ZKP-Number: 2.3015.931

Speed of the 3rd secondary turbocharger too high (limit value 1)

Yellow alarm; warning

Cause	Corrective action
Clogged charge-air circuit or fault in turbocharger.	► Reduce power.

491 – SS ETC4 Overspeed

ZKP-Number: 2.3015.932

Speed of the 3rd secondary turbocharger too high (limit value 2)

Red alarm; engine shutdown

Cause	Corrective action
Clogged charge-air circuit or fault in turbocharger.	► Reduce power.

492 – AL ETC4 Cutin Failure

ZKP-Number: 18.004.202

Yellow alarm; warning

Cause	Corrective action
ETC4 failed to cut in.	► Check control valve at turbocharger 4.

493 – AL ETC3 Cutin Failure

ZKP-Number: 18.004.203

Yellow alarm; warning

Cause	Corrective action
ETC3 failed to cut in.	► Check control valve at turbocharger 3.

500 – AL Wiring POM Starter 1

ZKP-Number: 1.4500.900

Wiring fault, connection of starter 1 at POM

Yellow alarm; warning

Cause	Corrective action
Missing consumer. Short circuit or wire break	► Check connection between POM and starter.

501 – AL Wiring POM Starter 2

ZKP-Number: 1.4500.901

Wiring fault, connection of starter 2 at POM

Yellow alarm; warning

Cause	Corrective action
Missing consumer. Short circuit or wire break	► Check connection between POM and starter.

TIM-ID: 0000045495 - 001

502 – AL Open Load POM Battery-charging Generator

ZKP-Number: 1.4500.902

Power disruption, battery-charging generator connection of POM

Yellow alarm; warning

Cause	Corrective action
Wiring faulty or no resistance over switch.	► Check connection between POM and battery-charging generator.

503 – AL Battery Not Charging

ZKP-Number: 1.4500.903

No battery charge

Yellow alarm; warning

Cause	Corrective action
Battery is not charged by battery-charging generator.	► Check battery-charging generator and wiring (→ Page 265).

504 – AL CAN POM Node Failure

ZKP-Number: 1.4500.904

POM missing on CAN bus

Yellow alarm; warning

Cause	Corrective action
If alarm 508 occurs in addition, the resistor in the POM wiring is missing.	► Check connection and POM.

506 – AL Low Starter Voltage

ZKP-Number: 1.4500.906

The battery voltage is too low for the starting process

Yellow alarm; warning

Cause	Corrective action
Wiring faulty or battery is flat.	► Check starter battery and wiring (→ Page 265).

507 – AL POM Fault

ZKP-Number: 1.4500.907

A general POM fault occurred.

Yellow alarm; warning

Cause	Corrective action
Fault in POM.	► Replace POM.

508 – AL Incorrect POM ID

ZKP-Number: 1.4500.908

POM sends a different ID number than expected

Yellow alarm; warning

Cause	Corrective action
If alarm 504 occurs in addition, the resistor in the POM wiring is missing.	► Check POM wiring harness.

510 – AL Override applied

ZKP-Number: 2.7002.010

Override was activated

Yellow alarm; warning

Cause	Corrective action
Override suppresses other alarms.	► Deactivate Override pushbutton again.

515 – AL Starter Not Engaged

ZKP-Number: 2.1090.926

Yellow alarm - possible start cancelation

Cause	Corrective action
Starter on POM could not be engaged.	1. Repeat start. 2. Check POM, starter and wiring (→ Page 265). 3. Contact Service.

519 – Oil Level Calibration Error

ZKP-Number: 1.0158.921

Error writing calibration value into flash or SD of level sensor.

Yellow alarm; warning

Cause	Corrective action
Oil level sensor or wiring faulty.	1. Check sensor and wiring, replace as necessary (→ Page 265). 2. Contact Service.

531 – AL Wiring PWM_CM1

ZKP-Number: 1.1044.900

Red alarm

Cause	Corrective action
Wire break or short circuit on channel PWM_CM1.	► Check wiring to TecJet throttle, replace TecJet throttle if necessary.

TIM-ID: 0000045495 - 001

532 – AL Wiring PWM1

ZKP-Number: 1.1046.900

Red alarm

Cause	Corrective action
Wire break or short circuit on channel PWM1.	► Check wiring to mixture throttle on A side, replace mixture throttle on A side if necessary.

533 – AL Wiring PWM2

ZKP-Number: 1.1047.900

Red alarm

Cause	Corrective action
Wire break or short circuit on channel PWM2.	► Check wiring to mixture throttle on B side, replace mixture throttle on B side if necessary.

543 – AL Multiple FDH Slaves

ZKP-Number: 2.0555.005

Yellow alarm

Cause	Corrective action
There is more than one device activated as backup medium for FDH.	► Contact Service (configuration fault).

544 – AL Configuration Changed

ZKP-Number: 2.0555.003

Yellow alarm

Cause	Corrective action
This alarm is activated when the system configuration was changed, e.g. because the ECU or SAM was exchanged.	► Contact Service (configuration fault).

549 – AL Power Disruption

ZKP-Number: 2.7001.952

Alarm from the emergency stop counter function

Yellow alarm; warning

Cause	Corrective action
Engine governor power has been disconnected with the engine still running. This may lead to overpressure in the HP system which can damage the engine.	► Instruct operators to switch off the power supply only after the engine has come to a standstill.

551 – SS Engine Overspeed Camshaft

ZKP-Number: 22.510.933

Limit value 2

Cause	Corrective action
Camshaft overspeed.	1. Acknowledge alarm. 2. Attempt engine restart.

555 – AL Call MTU Field Service

ZKP-Number: 20.555.001

Cause	Corrective action
This fault becomes active if a maintenance case has been processed by the ECU Field Data Handling (FDH) feature that results in a change of engine parameters. This fault remains active even after switching off and back on until a valid enabling code is entered via the SAM display and key controls. This enabling code can be requested via the Internet using a special procedure.	► Request activation code via Internet.

576 – AL ESCM Override

ZKP-Number: 1.1075.083

Engine overload

Yellow alarm; warning

Cause	Corrective action
Violation of corrected MCR or DBR/MCR curve.	► Reduce power.

577 – SD T-Lube Oil Pan

ZKP-Number: 1.0137.900

Signal error, oil pan temperature sensor

Yellow alarm; warning

Cause	Corrective action
Oil pan temperature sensor faulty. Short circuit or wire break.	► Check sensor and cabling, replace as necessary (→ Page 265).

TIM-ID: 0000045495 - 001

582 – AL Emergency Stop Failure

ZKP-Number: 1.1005.006

Emergency stop command was not executed

Flashing pre-alarm and alarm

Cause	Corrective action
Engine speed does not come to a standstill within a configurable period.	► Contact Service.

584 – AL CAN Start clearance failed

Yellow alarm; warning

Cause	Corrective action
Yellow alarm; warning; CAN object Start clearance was not received within the expected time period.	► Contact Service.

586 – LO P-Oil Refill Pump

ZKP-Number: 2.0159.911

Oil pressure in refill pump is too low - limit value 1

Yellow alarm; warning

Cause	Corrective action
Oil level in oil refill tank too low.	1. Check oil level, top up as necessary (→ Page 218). 2. Contact Service.

588 – SD P-Oil Refill Pump

ZKP-Number: 1.0159.910

Signal error, refill pump oil pressure sensor

Yellow alarm; warning

Cause	Corrective action
Pressure sensor defective. Short circuit or wire break.	1. Check sensor and wiring, replace as necessary (→ Page 265). 2. Contact Service.

593 – AL T-Lube Oil in Oil Pan too Low

ZKP-Number: 2.1090.929

Lube oil temperature in oil pan is too low.

Cause	Corrective action
Preheating time is insufficient.	1. Extend preheating period. 2. Contact Service.

596 – AL Test Parameters

ZKP-Number: 1.8004.645

Yellow alarm; warning

Cause	Corrective action
The parameter set is used for trials. The alarm remains set until a series parameter set is loaded.	► Contact Service.

600 – SD T-Exhaust A+B

ZKP-Number: 1.8004.646

Signal error, exhaust temperature sensor A- and B-side

Yellow alarm; warning

Cause	Corrective action
Exhaust temperature sensor on A- and B-side faulty. Short circuit or wire break.	1. Check sensor and wiring, replace as necessary (→ Page 265). 2. Contact Service.

601 – SD ETC1+ETC2

ZKP-Number: 1.3011.227

Signal error, ETC speed sensor 1 and 2

Yellow alarm; warning

Cause	Corrective action
ETC speed sensors 1 and 2 faulty. Short circuit or wire break.	1. Check sensor and wiring, replace as necessary (→ Page 265). 2. Contact Service.

602 – AL CAN Engine Start Lock

ZKP-Number: 2.1090.930

Start interlock from plant pending

Yellow alarm; warning

Cause	Corrective action
Start interlock initiated by plant.	► The alarm is reset by canceling the engine start instruction or the CAN request.

606 – AL Double Nodes Lost CAN 1+2

ZKP-Number: 2.0500.691

ECU does not detect a monitored CAN bus.

Red alarm; forced idle

Cause	Corrective action
A node on both CANs has failed. Short circuit or wire break.	1. Check wiring and power supply of plant (→ Page 265). 2. Acknowledge alarm. 3. Restart engine (→ Page 77). 4. Contact Service.

614 – AL L1 P-Fuel Supp. Filt. Diff.

ZKP-Number: 2.0119.001

Fuel prefilter differential pressure too high

Yellow alarm; warning

Cause	Corrective action
Fuel prefilter not functioning correctly.	1. Replace fuel prefilter. 2. Contact Service.

625 – SD P-Fuel b. Supp. Filter

ZKP-Number: 1.8004.600

Signal error, fuel pressure sensor before supplementary filter

Yellow alarm; warning

Cause	Corrective action
Analog input signal for fuel pressure before supplementary filter faulty. Short circuit or wire break.	1. Check pressure transmitter and wiring, replace as necessary (→ Page 265). 2. Fault is rectified when engine is restarted (→ Page 77). 3. Contact Service.

641 – AL System Restart by Watchdog

ZKP-Number: 1.8012.902

System is restarted by watchdog

Cause	Corrective action
System restart by watchdog detected.	► -

687 – SD Oil Level Switch

ZKP-Number: 1.0150.920

Level switch faulty

Cause	Corrective action
Lube oil level switch is faulty. ==> Short circuit or wire break.	1. Check sensor and wiring (B24), replace as necessary. Alarm is reset when fault is eliminated (→ Page 265). 2. Contact Service.

690 – AL Oil Level too Low

ZKP-Number: 1.0150.921

Cause	Corrective action
Alarm, lube oil level is too low.	► -

759 – AL L1 T-Fuel b. Engine

ZKP-Number: 2.0080.921

Fuel before engine (limit 1)

Cause	Corrective action
Fuel temperature before engine too high.	► -

760 – AL L2 T-Fuel b. Engine

ZKP-Number: 2.0080.922

Fuel before engine (limit 2)

Cause	Corrective action
Fuel temperature before engine too high.	► -

761 – SD T-Fuel b. Engine

ZKP-Number: 1.0080.900

Cause	Corrective action
Oil pan temperature sensor faulty. ==> Short circuit or wire break.	1. Check sensor and wiring (B24), replace as necessary. (→ Page 265). 2. Contact Service.

782 – SD P-Lube oil ETC A

ZKP-Number: 1.0222.920

Cause	Corrective action
SD turbocharger lube oil pressure.	► -

788 – Cyl. cutout detects turbocharger speed error

ZKP-Number: 1.3000.069

Cause	Corrective action
The cyl. cutout system has detected an invalid turbocharger speed at turbochargers 1 or 2.	► -

TIM-ID: 0000045495 - 001

850 – SD Alive FIP

ZKP-Number: 2.0900.002

Frequency input faulty.

Cause	Corrective action
Short circuit or wire break. Fault in Backup ECU, Alive signal not transmitted	► -

856 – SD P-Lube oil ETC B

ZKP-Number: 1.0223.920

Cause	Corrective action
ETC oil pressure sensor faulty.	► Check sensor and wiring, replace as necessary.

858 – AL L1 P-Lube Oil ETC B

ZKP-Number: 1.0223.921

Limit value 1

Cause	Corrective action
Lube oil pressure too low.	► Check ETC oil lubrication.

867 – AL L1 P-Lube Oil ETC A

ZKP-Number: 1.0222.923

Limit value 1

Cause	Corrective action
Lube oil pressure too low.	► Check ETC oil lubrication.

868 – AL L2 P-Lube Oil ETC A

ZKP-Number: 1.0222.924

Limit value 2

Cause	Corrective action
Lube oil pressure too low.	► Check ETC oil lubrication.

869 – AL L2 P-Lube Oil ETC B

ZKP-Number: 1.0223.922

Limit value 2

Cause	Corrective action
Lube oil pressure too low.	► Check ETC oil lubrication.

6 Task Description

6.1 Engine

6.1.1 Engine - Barring manually

Preconditions

- ☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Barring device	F6555766	1
Ratchet with extension	F30006212	1

DANGER



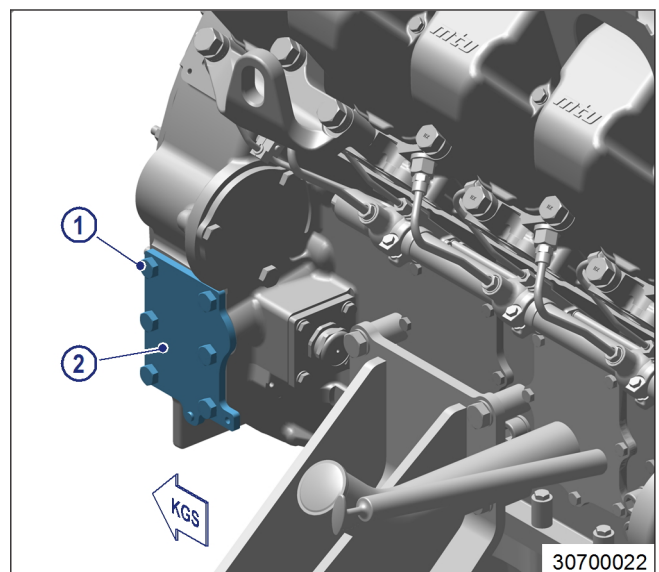
Rotating and moving engine parts.

Risk of crushing, danger of parts of the body being caught or pulled in!

- Before barring the engine, make sure that there are no persons in the engine's danger zone.
- After finishing work on the engine, make sure that all safety devices are put back in place and all tools are removed from the engine.

Barring engine manually

1. Release screws (1) and remove end cover (2) from flywheel housing.



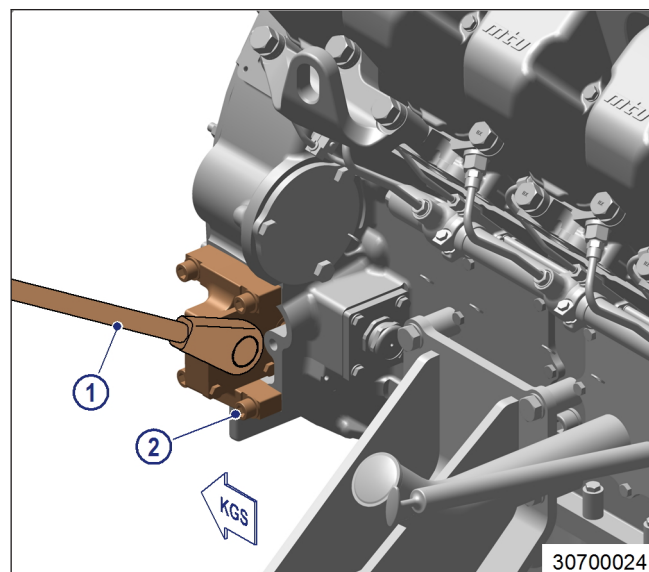
2. Engage barring device (2) in ring gear of flywheel and mount on flywheel housing.
3. Fit ratchet (1) onto barring device (2).

Note: No resistance other than compression resistance must be encountered.

4. Rotate crankshaft in engine direction of rotation.

Result: If the resistance exceeds the normal compression resistance, contact Service.

5. Barring device is removed by same procedure in reverse.



6.1.2 Engine – Barring with starting system

Barring using the automation system

Refer to automation system operating instructions

6.2 Cylinder Liner

6.2.1 Cylinder liner – Endoscopic examination

Preconditions

- ☑ Engine is stopped and starting disabled

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Rigid endoscope	Y20097353	1

Preparatory steps

1. Remove cylinder head cover (→ Page 176).
2. Remove injector (→ Page 180).

Positioning crankshaft at BDC

1. Using barring gear, turn crankshaft until crankshaft journal of the cylinder to be inspected has reached BDC.
2. Insert endoscope into cylinder liner through injector seat.

Cylinder liner – Endoscopic examination

Findings	Task
• Thin carbon coating around circumference of carbon scraper ring • Slight localized additive deposits at top edge • Localized smooth areas at bottom edge • Carbon deposits around circumference between top piston ring and bottom edge of carbon scraper ring • First signs of marks left by top piston ring • Bright mark around circumference • Faultless, even honing pattern • First signs of marks left by lower cooling bores • Running pattern seems darker	No action required.
• Darker areas of even or varying color intensity • Beginning and end of the discoloration are not sharply defined and do not cover the entire stroke area • Dark areas in the upper section of the cooling bore, remaining circumference cannot be faulted • Piston rings faultless	Further endoscopic examination required as part of maintenance work.
• On the entire circumference not only bright discoloration (not critical for operation) clearly visible darker stripes that begin at the top piston ring • Heat discoloration in the direction of stroke and honing pattern damage • Heat discoloration of piston rings	Cylinder liner must be replaced, contact Service.

1. Compile endoscopy report using the table.
2. Use technical terms for description of the liner surface (→ Page 167).
3. Depending on findings:
 - Do not take any action or
 - Carry out further endoscopic examination as part of maintenance work or
 - Contact Service; cylinder liner must be replaced.

Final steps

1. Install injector (→ Page 180).
2. Install cylinder head cover (→ Page 176).

6.2.2 Instructions and comments on endoscopic and visual examination of cylinder liners

Terms used for endoscopic examination

Use the terms listed below to describe the condition of the cylinder-liner surface in the endoscopic examination report.

Findings	Explanations/Action
Minor dirt scores	Minor dirt scores can occur during the assembly of a new engine (honing products, particles, broken-off burrs). Removed cylinders clearly show such scoring on the running surface under endoscope magnification. Cannot be felt with the fingernail. Findings not critical.
Single scores	Clearly visible scores caused by hard particles. They usually start in the TDC area and cross through the hone pattern in the direction of stroke. Findings not critical.
Scored area	These areas consist of scores of different length and depth next to one another. In most cases, they are found at the 6-o'clock and 12-o'clock positions (inlet/exhaust) along the transverse engine axis. Findings not critical.
Smoothened area	Smoothened areas are on the running surface but almost the whole honing pattern is still visible. Smoothened areas appear brighter and more brilliant than the surrounding running surface. Findings not critical.
Bright area	Bright areas are on the running surface and show local removal of the honing pattern. Grooves from honing process are not visible any more.
Discoloration	This is caused by oxidation (surface discoloration through oil or fuel) and temperature differences around the liner. It appears rather darker within the honed structure in contrast to the bright metallic running surface. The honing pattern is undisturbed. Discolorations extend in stroke direction and may be interrupted. Findings not critical.
Corrosion fields / spots	Corrosion fields / spots result from water (condensed water) with the valves in the overlap (open) position. They are clearly visible due to the dark color of the honing groove bottom. This corrosion is not critical unless there is corrosion pitting.
Black lines	Black lines are a step towards heat discoloration. They are visible as a clear discoloration from TDC to BDC in the running surface and the start of localized damage to the honing pattern. Cylinder liners with a large number of black lines around the running surface have limited service life and should be replaced.
Burn mark	This is caused by a malfunction in the liner / ring tribosystem. Usually they run over the whole ring-travel area (TDC/BDC), starting at the first TDC-ring and becoming more visible from the second TDC-ring 2 onwards and less pronounced from TDC-ring 1. The honing pattern is usually no longer visible and displays a clearly defined (straight) edge to the undisturbed surface. The damaged surface is usually discolored. The circumferential length varies. Liners with burn marks, or heat discoloration, starting in TDC-ring 1 have to be replaced.
Seizure marks, scuffing	Irregular circumference lengths and depths. Can be caused either by the piston skirt or the piston crown. Material deposits on the liner (smear), heavy discoloration. Severe, visible scoring. Replace liner.

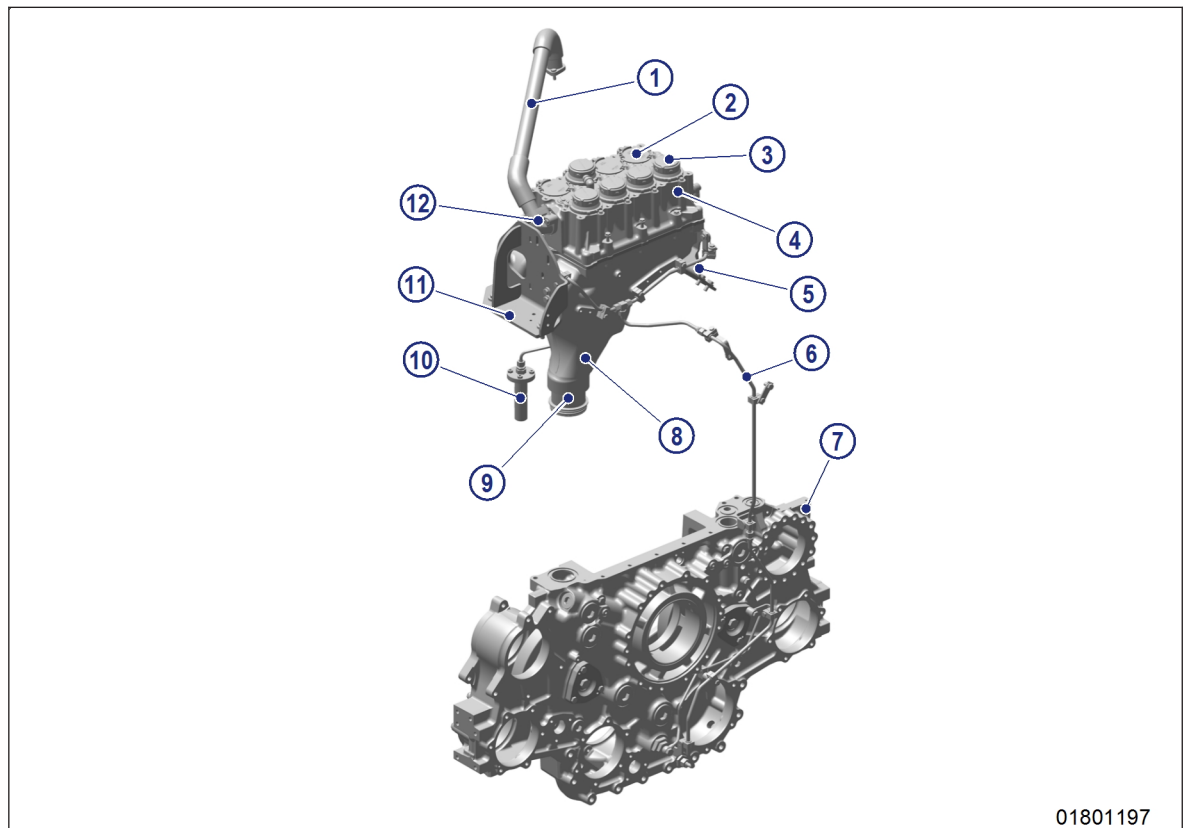
Evaluation of findings and further measures

The findings in the start phase of oxidation discoloration and heat discoloration are similar. A thorough investigation and compliance with the above evaluation criteria allow an unambiguous evaluation. To avoid unnecessary disassembly work, it is recommended that another inspection be carried out after further operation of the engine.

6.3 Crankcase Breather

6.3.1 Crankcase breather - Overview

For 12V engines



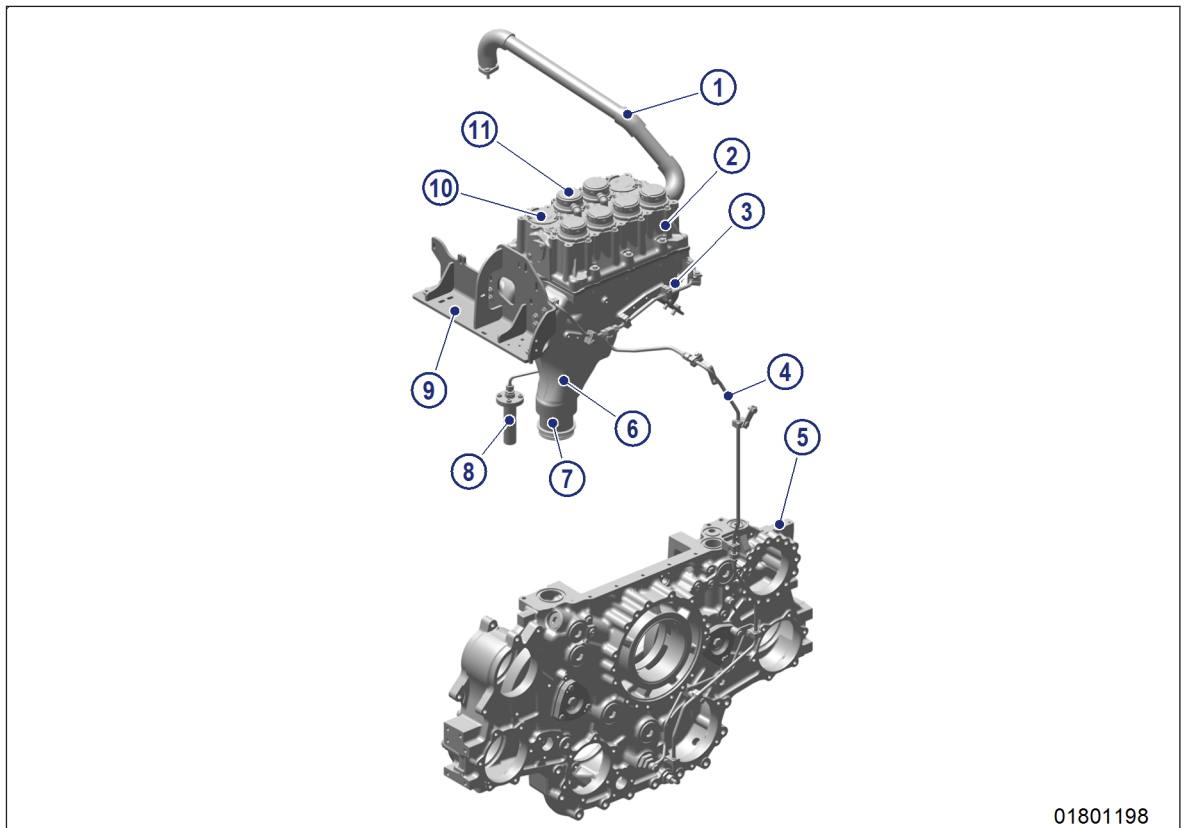
01801197

- 1 Vent pipe
- 2 Plug
- 3 Oil separator
- 4 Impactor carrier

- 5 Bracket
- 6 Oil line
- 7 Service block
- 8 Vent housing

- 9 Spigot pipe
- 10 Drain pipe
- 11 Bracket
- 12 Connection

For 16V engines



01801198

- | | | |
|--------------------|-----------------|------------------|
| 1 Vent pipe | 5 Service block | 9 Bracket |
| 2 Impactor carrier | 6 Vent housing | 10 Plug |
| 3 Bracket | 7 Spigot pipe | 11 Oil separator |
| 4 Oil line | 8 Drain pipe | |

6.3.2 Crankcase breather – Oil mist fine separator replacement

Preconditions

- ☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Engine oil		
Oil mist fine separator	(→ Spare Parts Catalog)	
O-ring	(→ Spare Parts Catalog)	

WARNING



Hot oil.

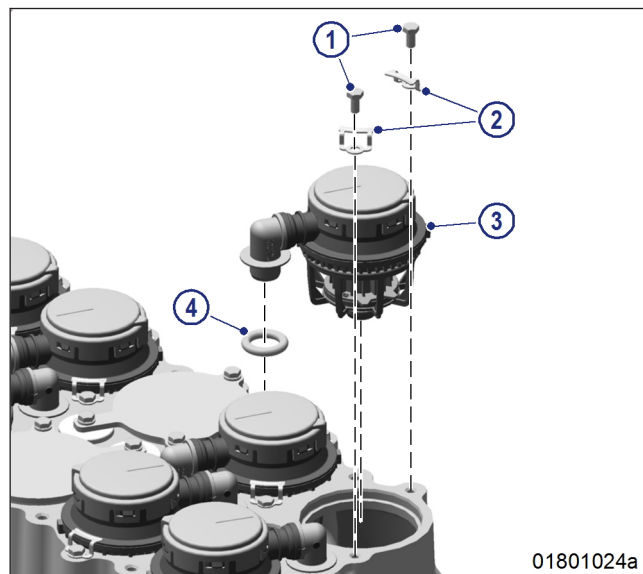
Oil can contain combustion residues which are harmful to health.

Risk of injury and poisoning!

- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

Replacing oil mist fine separator

1. Remove screws (1) and take off together with holder (2).
2. Replace oil mist fine separator (3).
3. Replace O-ring (4) if necessary.
4. Replace further oil mist fine separators in the same way.



6.4 Valve Drive

6.4.1 Valve gear – Lubrication

Preconditions

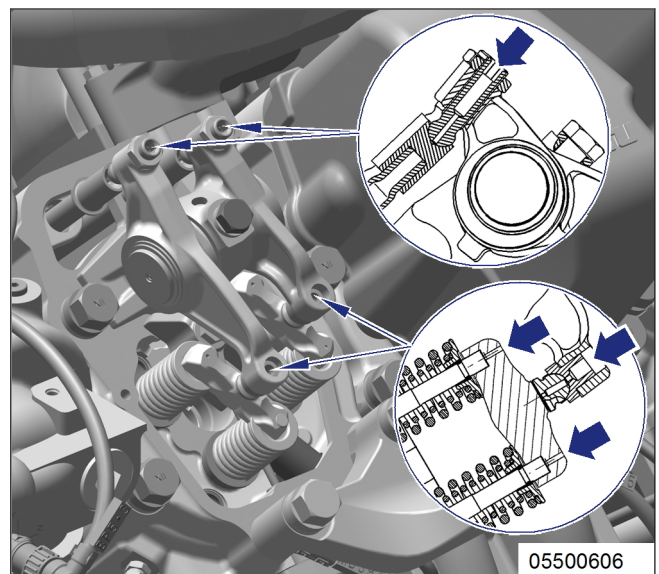
- ☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Engine oil		

Valve gear – Lubrication

1. Remove cylinder head covers (→ Page 176).
2. Fill oil chambers of valve bridges with oil.
3. Fill oil chambers of rocker arms and adjusting screws with oil.
4. Install cylinder head covers (→ Page 176).



6.4.2 Valve clearance – Check and adjustment

Preconditions

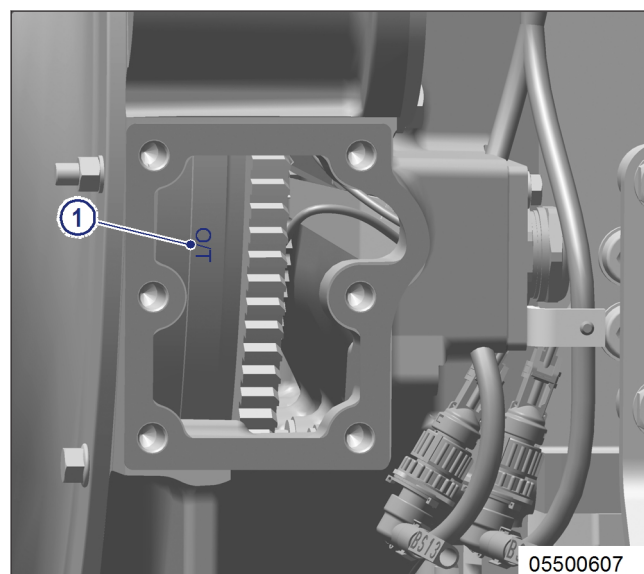
- ☒ Engine is stopped and starting disabled.
- ☒ Engine coolant temperature is max. 40 °C.
- ☒ Valves are closed.

Special tools, Material, Spare parts

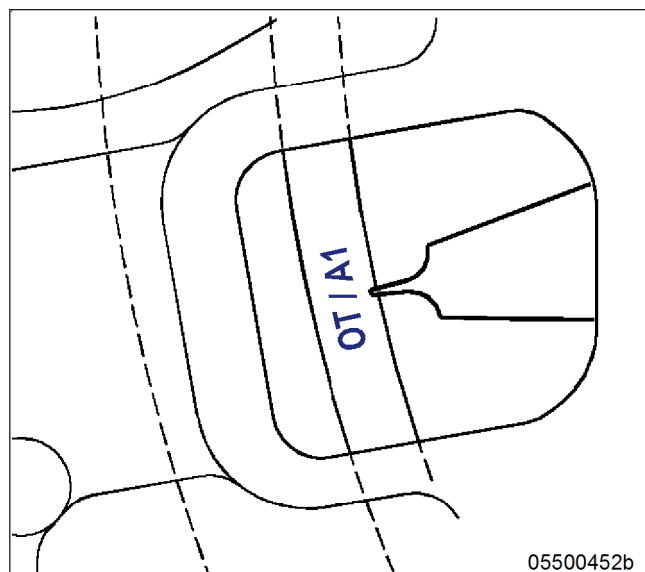
Designation / Use	Part No.	Qty.
Feeler gage	Y20010128	1
Torque wrench, 60-320 Nm	F30452768	1
Socket wrench, 24 mm	F30039526	1
Engine oil		

Preparatory steps

1. Remove cylinder head cover (→ Page 176).
2. Install barring gear (→ Page 162).
3. The OT mark (1) on the flywheel (if applicable) must not be used for reference.



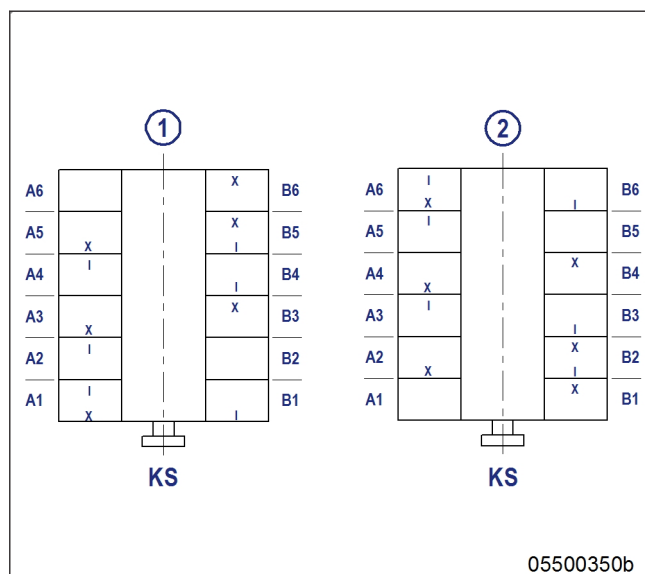
4. Rotate crankshaft with barring tool in engine direction of rotation until marking "OT-A1" and pointer are aligned.



05500452b

Diagram for 12V engines (two crankshaft positions)

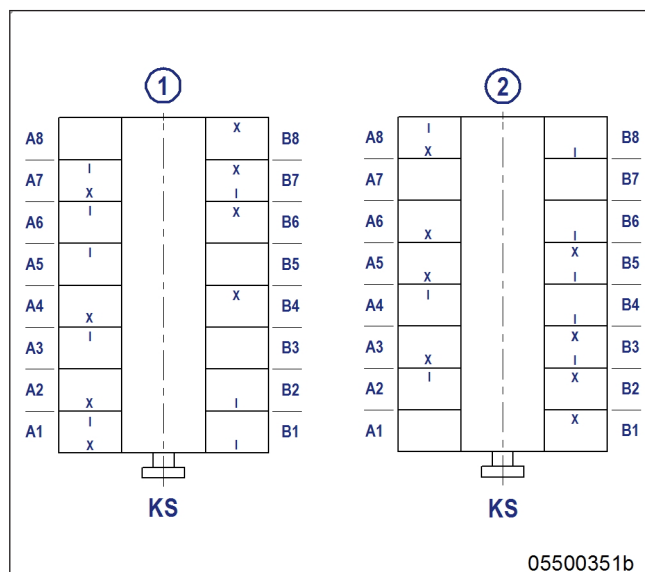
- 1 Cylinder A1 is in firing TDC
- 2 Cylinder A1 is in overlap TDC
- I Inlet valve
- X Exhaust valve



05500350b

Diagram for 16V engines (two crankshaft positions)

- 1 Cylinder A1 is in firing TDC
- 2 Cylinder A1 is in overlap TDC
- I Inlet valve
- X Exhaust valve



05500351b

Checking valve clearance in two crankshaft positions

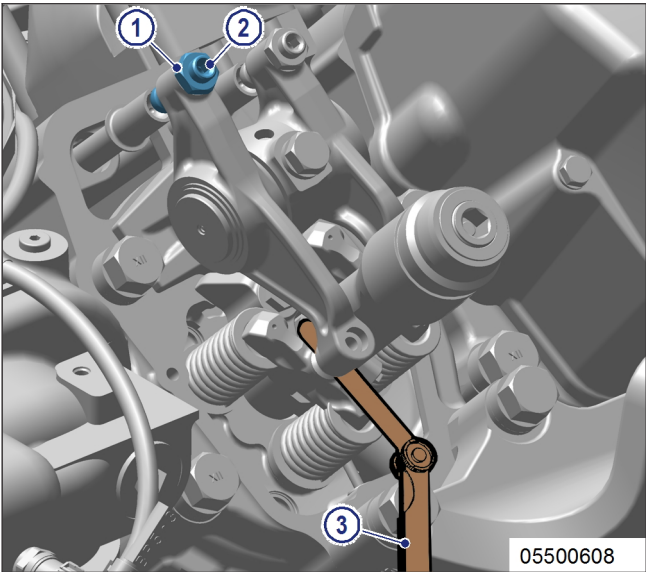
- 1. Check TDC position of piston in cylinder A1:
 - If the rocker arms are unloaded on cylinder A1, the piston is in firing TDC.
 - If the rocker arms are loaded on cylinder A1, the piston is in overlap TDC.
- 2. Check valve clearance adjustment with engine cold:
 - Inlet valves (long rocker arm) = 0.2 mm
 - Exhaust valves (short rocker arm) = 0.5 mm
- 3. Check all valve clearances at two crankshaft positions (firing and overlap TDC for cylinder A1) as per diagram.
- 4. Use feeler gage to determine the distance between valve bridge and rocker arm.
- 5. If the deviation from the reference value exceeds 0.1 mm, adjust valve clearance.

Adjusting valve clearance

- 1. Release locknut (1).
- 2. Insert feeler gage (3) between valve bridge and rocker arm.
- 3. Using Allen key, set adjusting screw (2) so that the specified valve clearance is provided.

Note: Feeler gage must just pass through the gap.

- 4. Pull feeler gage (3) between valve bridge and rocker arm.



- 5. Tighten locknut (1) to the specified tightening torque, holding adjusting screw (2) firmly.

Name	Size	Type	Lubricant	Value/Standard
Locknut	M16 x 1.5	Tightening torque	(Engine oil)	90 Nm + 9 Nm

- 6. Replace or rectify adjusting screws and/or locknuts which do not move freely.
- 7. Check valve clearance.

Final steps

- 1. Remove barring gear (→ Page 162).
- 2. Install cylinder head cover (→ Page 176).
- 3. Enable engine start.

6.4.3 Cylinder head cover – Removal and installation

Preconditions

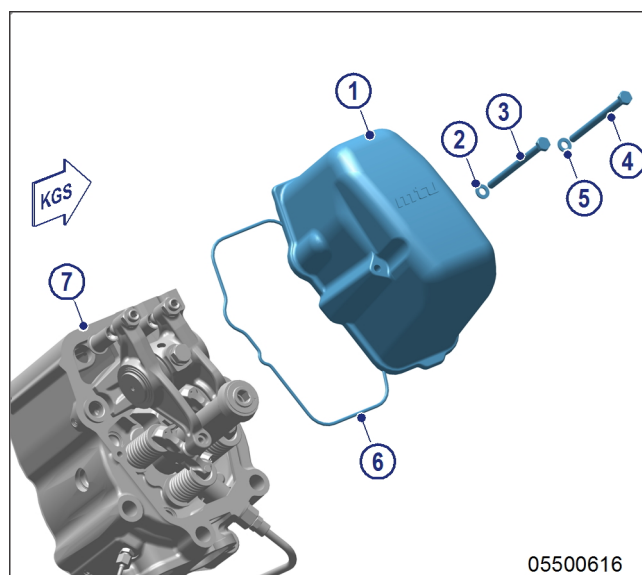
- ☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Assembly compound (Kluthe Hakuform 30-11C/Emulgier)	X00059351	1
O-ring	(→ Spare Parts Catalog)	

Removing cylinder head cover

1. Clean very dirty cylinder head covers (1) prior to removal.
2. Remove screws (3, 4) with washers (2, 5).
3. Take off cylinder head cover (1) with O-ring (6) from cylinder head (7).



Installing cylinder head cover

1. Clean mounting surface.
2. Check O-ring (6) for damage, replace as necessary.
3. Coat O-ring (6) with assembly compound.
4. Position O-ring (6) in groove of cylinder head cover (1).
5. Fit cylinder head cover (1) on cylinder head (7).
6. Install cylinder head cover (1) with screws (3, 4) and washers (2, 5).

6.5 Injection Pump / HP Pump

6.5.1 HP pump - Filling with engine oil

Preconditions

- ☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Engine oil		

WARNING



Fuels are combustible.

Risk of fire and explosion!

- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

WARNING



Oils/oil vapors are combustible/explosive.

Risk of fire and explosion!

- Avoid open flames, electric sparks and ignition sources.
- Do not smoke.

NOTICE



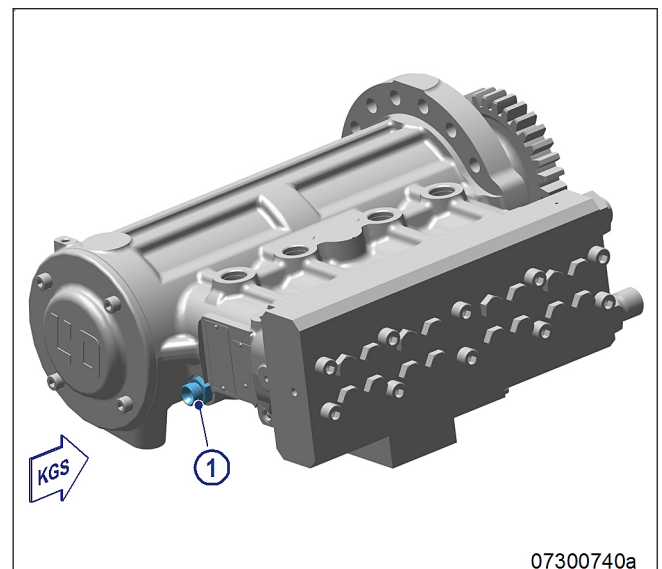
HP fuel pump not filled with engine oil.

Damage to components, major material damage!

- Ensure that th HP fuel pump is filled with engine oil before it is installed or put into operation.

Filling HP pump

1. Remove plug screw (1).
2. Use pump oiler to fill HP pump with engine oil until engine oil emerges.
3. Install plug screw (1).



07300740a

6.5.2 HP pump – Relief bore check

DANGER



Rotating and moving engine parts.

Risk of crushing, danger of parts of the body being caught or pulled in!

- Only run the engine at low power. Keep away from the engine's danger zone.

WARNING



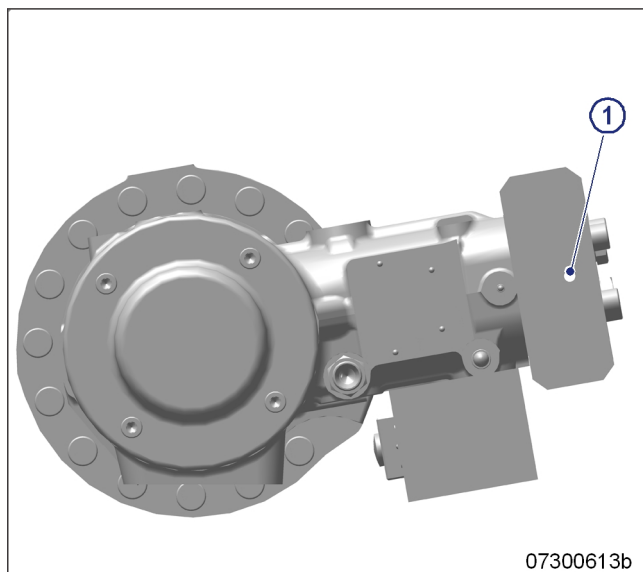
High level of engine noise when the engine is running.

Risk of damage to hearing!

- Wear ear protectors.

HP pump – Relief bore check

1. Visually inspect relief bore (1) for fuel discharge.
2. For jacketed HP lines, leakage is indicated by the yellow combined alarm.
3. If fuel discharge is found or indicated, contact Service.



07300613b

6.6 Injection Valve / Injector

6.6.1 Injector – Replacement

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Injector	(→ Spare Parts Catalog)	

Replacing injector

- Remove injector and install new injector (→ Page 180).

6.6.2 Injector – Removal and installation

Preconditions

- ☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Installation/removal jig	F6789889	1
Milling cutter	F30452739	1
Torque wrench, 0.5-5 Nm	0015384230	1
Torque wrench, 10-60 Nm	F30452769	1
Ratchet adapter	F30027340	1
Torque wrench, 60-320 Nm	F30452768	1
Ratchet adapter	F30027341	1
Assembly paste(Optimoly Paste White T)	40477	1
Assembly compound (Kluthe Hakuform 30-11C/Emulgier)	X00059351	1
Engine oil		
O-ring	(→ Spare Parts Catalog)	

WARNING



Fuels are combustible.

Risk of fire and explosion!

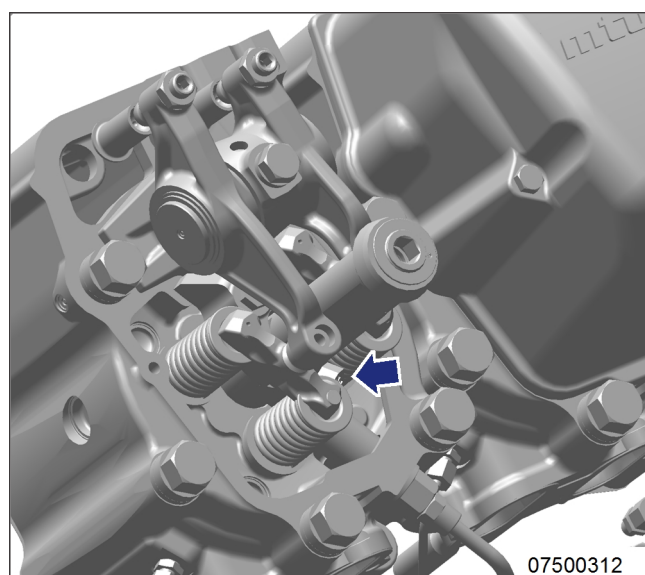
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Preparatory steps

1. Shut off fuel supply to engine.
2. Remove cylinder head cover (→ Page 176).

Removing injector

1. Disconnect connectors on injector.

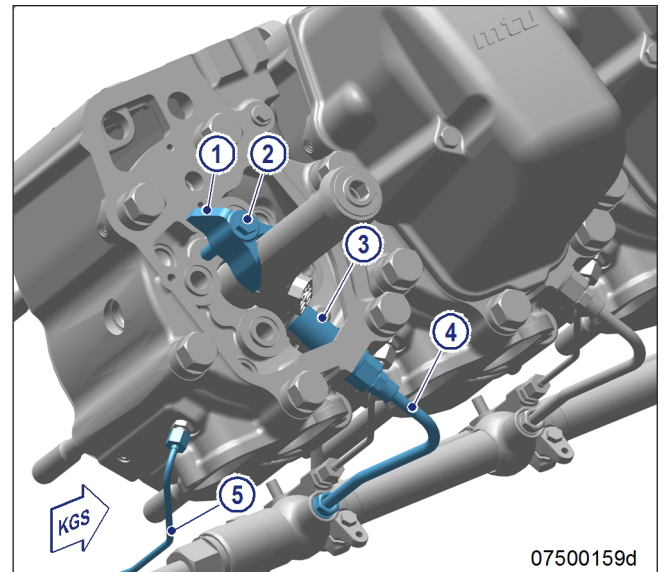


TIM-ID: 0000000925 - 012

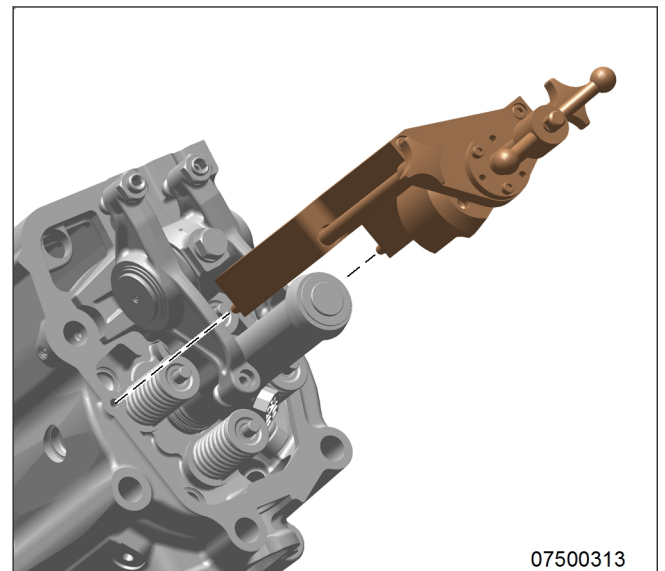
2. Remove HP fuel line 4).

Note: While the adapter is removed, the injector is drained.

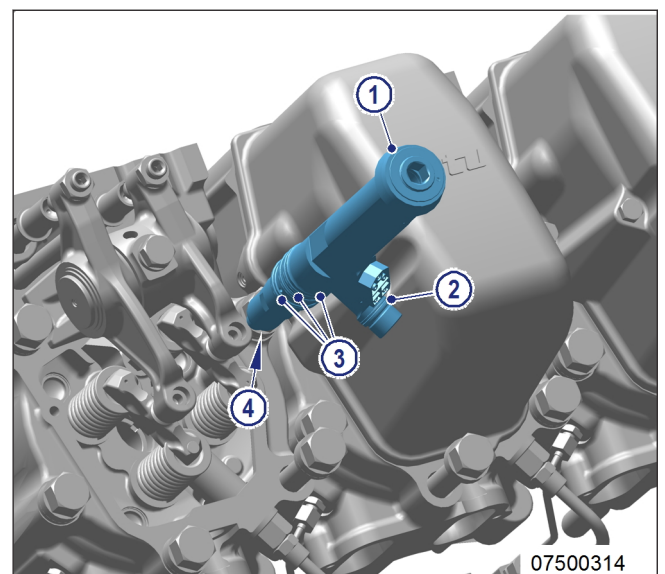
3. Remove adapter (3).
4. Remove screw (2) and take off hold-down clamp (1).



5. Install installation/removal jig on cylinder head.
6. Remove injector with installation/removal jig.
7. Remove installation/removal jig.

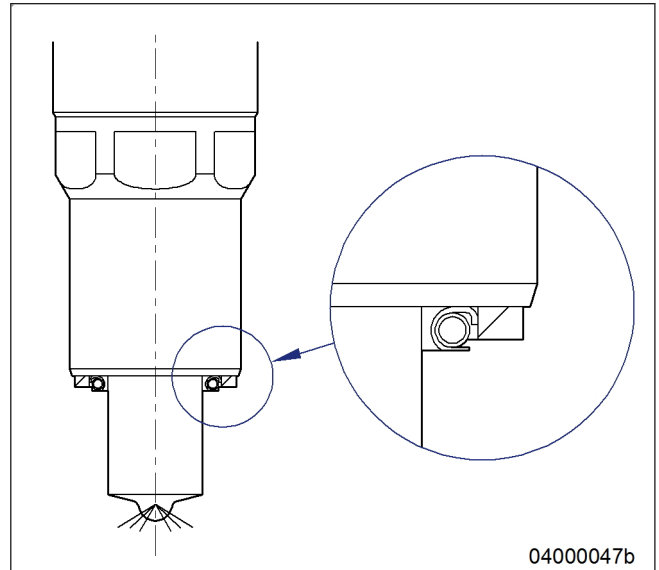


8. Remove sealing ring (4) from injector or use a self-made hook to take it out of the cylinder head.
9. Remove O-rings (3), O-ring (2) and damper ring (1) from injector.
10. Clean all mating and sealing surfaces.
11. Cover all connections and bores, or seal with suitable plugs.

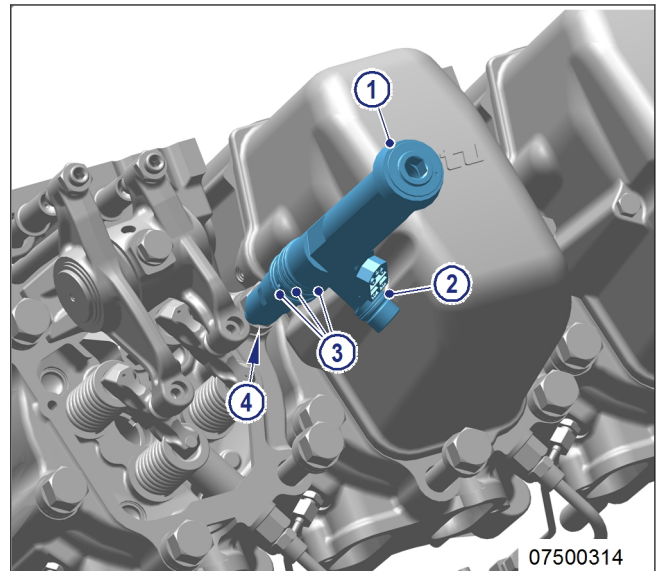


Installing injector

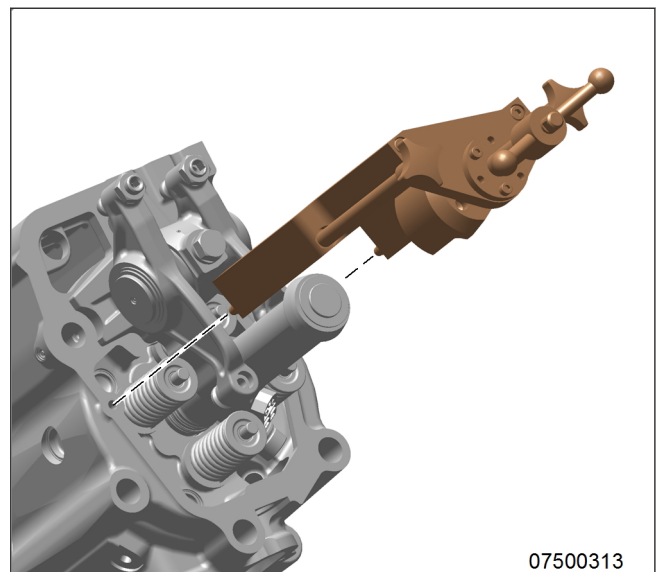
1. Remove plug before installing the injector. (Do not remove the plug from the HP line before installing the adapter).
2. Coat injector with assembly paste at the seat of the nozzle retaining nut.
3. Fit new sealing ring (included in the scope of delivery of the injector) with assembly compound on injector, observe installation position of sealing ring.
4. Fit new O-rings (3) (included in the scope of delivery of the injector), O-ring (2) and damping ring (1) onto the injector and coat with assembly compound (Kluthe Hakuform 30-11C/Emulgier).
5. Remove oil carbon from sealing face on cylinder head and protective sleeve with milling cutter.
6. Insert injector into cylinder head, ensuring that the HP line adapter is correctly aligned.
7. Press in injector with installation/removal jig.
8. Remove installation/removal jig.



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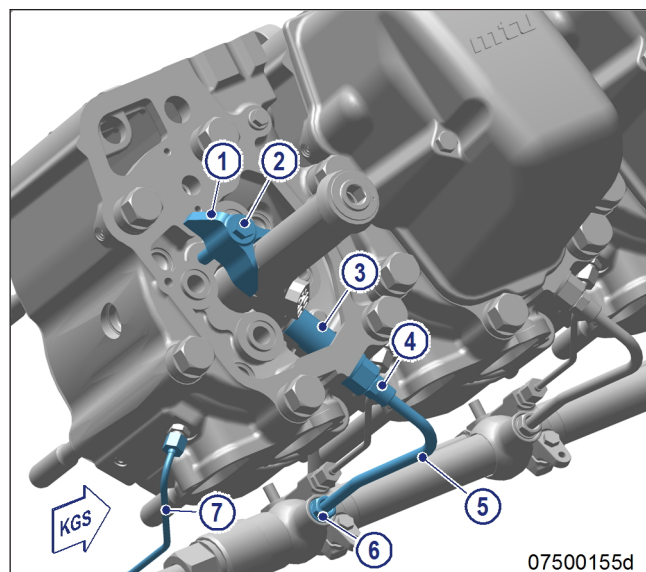
07500314



07500313

TIM-ID: 0000000925 - 012

9. Coat screw head mating face (2) and thread with engine oil.



10. Fit hold-down clamp (1) in the correct position and use torque wrench to tighten screw (2) to the specified initial tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M12	Preload torque	(Engine oil)	5 Nm to 10 Nm

Note: Ensure special cleanness.

11. Coat thread and sealing cone of adapter (3) with engine oil.
12. Install adapter (3) and use torque wrench to tighten to the specified initial tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Adapter		Preload torque	(Engine oil)	5 Nm to 10 Nm

13. Tighten screw (2) with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M12	Tightening torque		100 Nm + 10 Nm

14. Tighten adapter (3) with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Adapter		Tightening torque		100 Nm + 10 Nm

Note: Ensure special cleanness.

15. Coat thread and sealing cone of HP line (5) with engine oil.
16. Mount jacketed HP line (5) and use torque wrench to tighten to the specified torque. Tightening sequence:

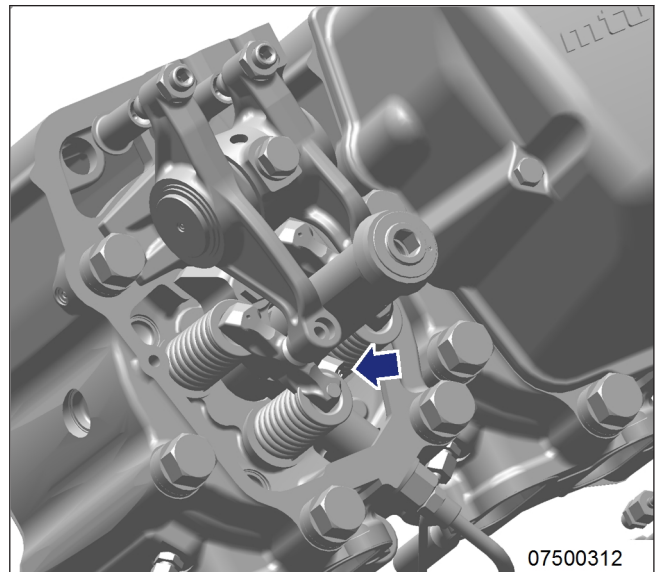
- 1 Adapter (4)
- 2 Rail (6)

Name	Size	Type	Lubricant	Value/Standard
Union nut / thrust screw		Tightening torque		40 Nm + 5 Nm

17. Fit connectors on injector.

Note: Failure to reset drift compensation (CDC) will void the emissions certification.

18. Reset drift compensation (CDC) with DiaSys® (→ E531920/...). If DiaSys® is not available, contact Service.

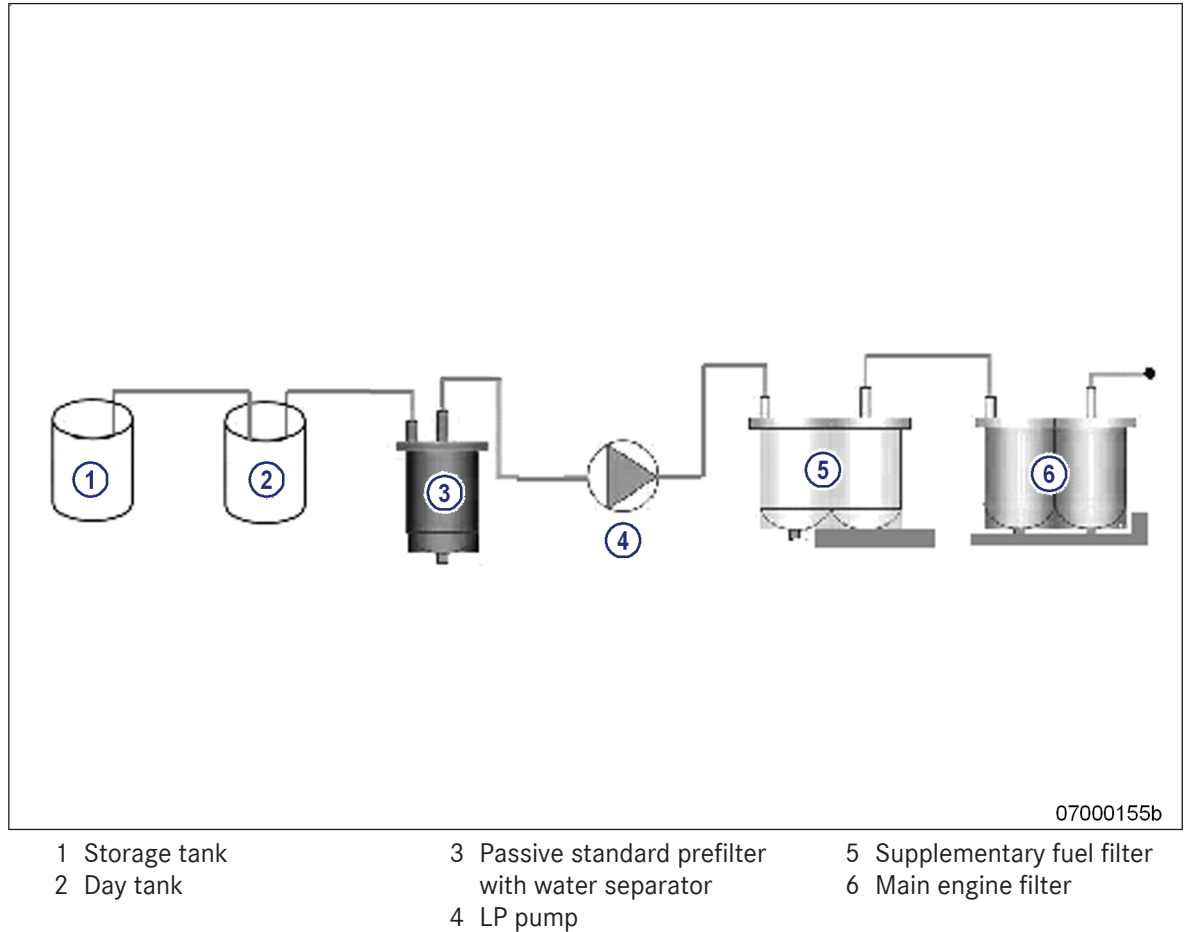


Final steps

1. Install cylinder head cover (→ Page 176).
2. Open fuel supply to engine.

6.7 Fuel Filter

6.7.1 Supplementary fuel filter - Overview



6.7.2 Additional fuel filter – Replacement

Preconditions

- ☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Filter wrench	F30379104	1
Diesel fuel		
Easy-change filter	(→ Spare Parts Catalog)	
Synthetic ring	(→ Spare Parts Catalog)	

DANGER



Rotating and moving engine parts.

Risk of crushing, danger of parts of the body being caught or pulled in!

- Only run the engine at low power. Keep away from the engine's danger zone.

WARNING



Fuels are combustible.

Risk of fire and explosion!

- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

WARNING



High level of engine noise when the engine is running.

Risk of damage to hearing!

- Wear ear protectors.

NOTICE



Damage to component!

Severe material damage!

- For filter replacement with the engine running, operate the engine at low engine load.
- The filter which is to be replaced must be cut out for a brief period only.

Additional fuel filter – Replacement

1. Replace additional fuel filter with the engine stopped (→ Page 187).
2. Replace additional fuel filter with the engine running (→ Page 187).

6.7.3 Fuel filter – Replacement

Preconditions

- ☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Filter wrench	F30379104	1
Diesel fuel		
Easy-change filter	(→ Spare Parts Catalog)	
Synthetic ring	(→ Spare Parts Catalog)	

DANGER



Rotating and moving engine parts.

Risk of crushing, danger of parts of the body being caught or pulled in!

- Only run the engine at low power. Keep away from the engine's danger zone.

WARNING



Fuels are combustible.

Risk of fire and explosion!

- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

WARNING



High level of engine noise when the engine is running.

Risk of damage to hearing!

- Wear ear protectors.

NOTICE



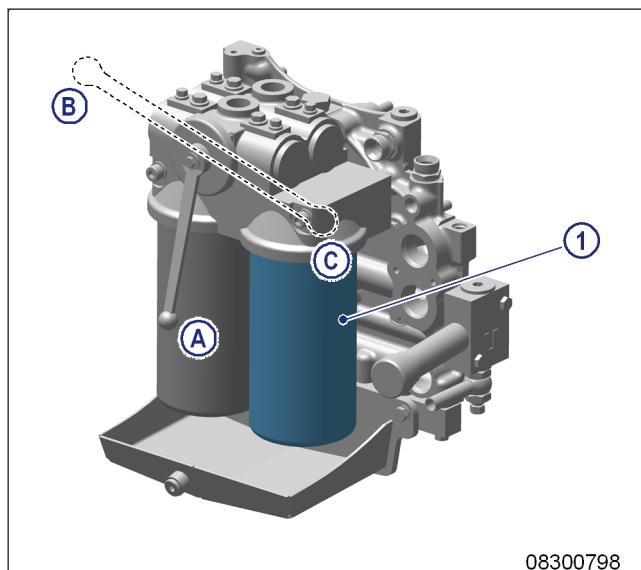
Damage to component!

Severe material damage!

- For filter replacement with the engine running, operate the engine at low engine load.
- The filter which is to be replaced must be cut out for a brief period only.

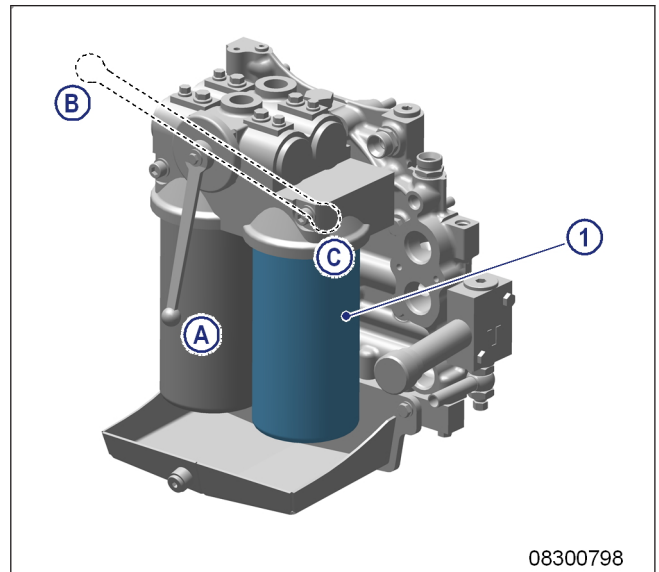
Replacing fuel filter with the engine stopped

1. Cut out the filter to be replaced (1):
 - B Left filter cut out
 - C Right filter cut out
2. Remove the cut-out oil filter (1) using an oil filter wrench.
3. Clean sealing surface on filter head.
4. Check sealing ring of new filter (1) and coat with fuel.
5. Screw on filter (1) and tighten manually.
6. Turn three-way cock into position (A) where both filters are operational.
7. Replace other fuel filters in the same way.
8. Venting fuel system (→ Page 189)



Replacing fuel filter with the engine running

1. Cut out the filter to be replaced (1):
 - B Left filter cut out
 - C Right filter cut out
2. Remove the cut-out oil filter (1) using an oil filter wrench.
3. Clean sealing surface on filter head.
4. Check sealing ring of new filter (1) and coat with fuel.
5. Screw on filter (1) and tighten manually.
6. Turn three-way cock into position (A) where both filters are operational.
7. Replace other fuel filters in the same way.



6.7.4 Fuel system - Venting

Preconditions

- ☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Diesel fuel		

WARNING



Fuels are combustible.

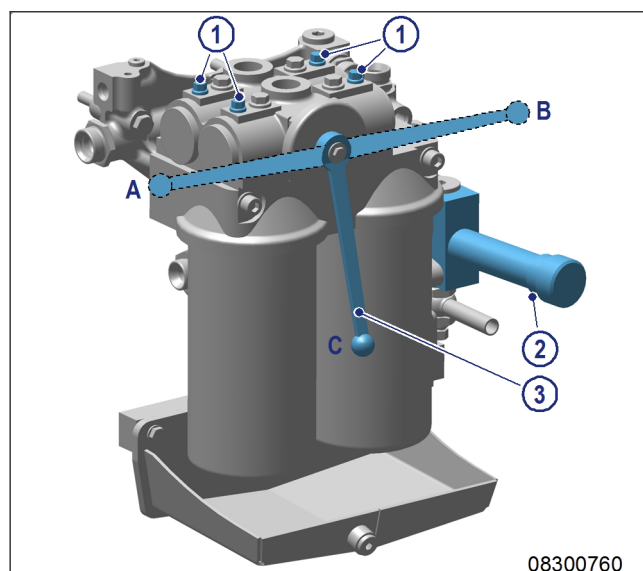
Risk of fire and explosion!

- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Venting LP fuel system

1. Turn three-way cock (3) into position (C) where both filters are operational.
2. Open threaded vent plugs (1).
3. Unlock fuel priming pump (2), screw out handle by turning it counterclockwise.
4. Operate fuel priming pump (2) until bubble-free fuel emerges from the threaded vent plugs (1).
5. Close threaded vent plugs (1).
6. Screw in handle by turning it clockwise.
7. Verify that fuel priming pump (2) is locked: Handle must be tightened.
8. Put filters back into operation:
 - A Right filter in operation
 - B Left filter in operation

Result: During operation, one filter is cut in.



6.7.5 Fuel prefilter – Differential pressure check and adjustment of gauge

DANGER



Rotating and moving engine parts.

Risk of crushing, danger of parts of the body being caught or pulled in!

- Only run the engine at low power. Keep away from the engine's danger zone.

WARNING



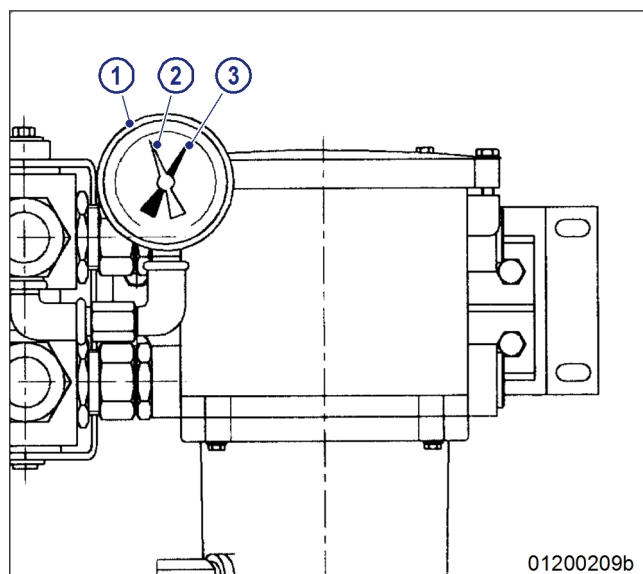
High level of engine noise when the engine is running.

Risk of damage to hearing!

- Wear ear protectors.

Setting adjustable pointer of differential pressure gauge

1. After installation of a new filter element, align adjustable pointer (2) with pressure-indicating pointer (3) of pressure gauge (1).
2. Verify that differential pressure is within the limit.



Fuel prefilter – Checking differential pressure

1. With the engine running at full load or rated power, read off pressure at gauge (1).
2. If differential pressure as indicated between position of adjustable pointer (2) and pressure-indicating pointer (3) of pressure gauge is ≥ 0.3 bar, flush filter element of the cut-in filter (→ Page 193).

6.7.6 Fuel prefilter – Draining

Preconditions

- ☑ Engine is stopped and starting disabled.

WARNING



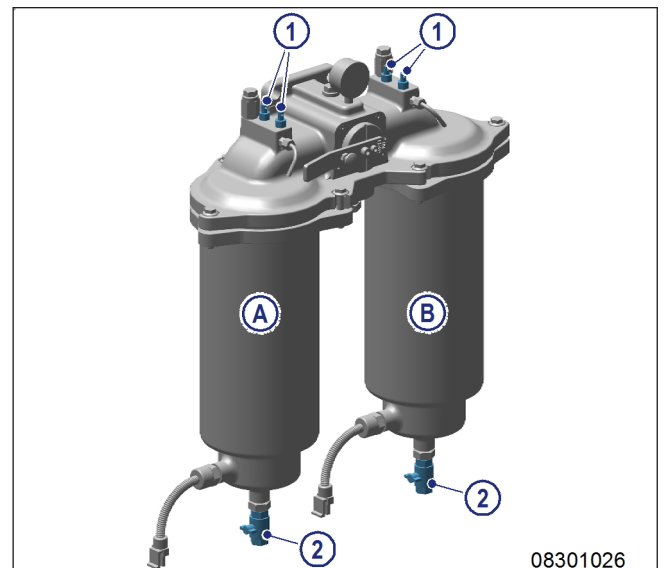
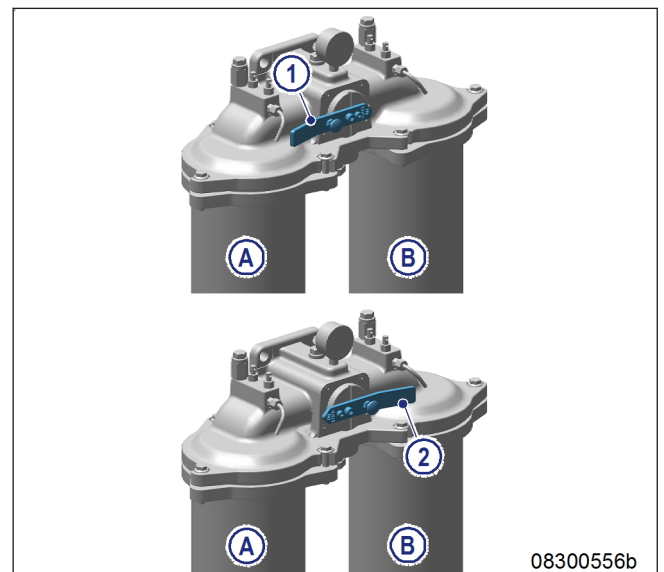
Fuels are combustible.

Risk of fire and explosion!

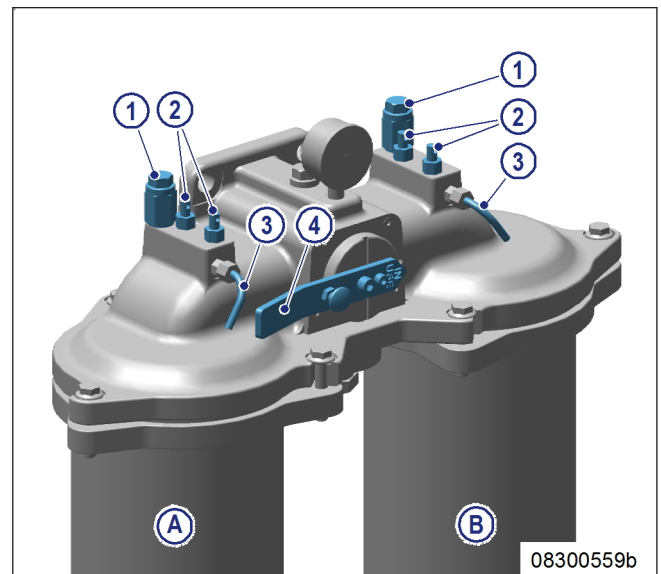
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Draining fuel prefilter

1. Cut out the filter to be replaced (A or B).
 - 1 Filter A cut out
 - 2 Filter B cut out
2. Open vent plug (1) of filter to be drained.
3. Open drain valve (2).
4. Drain water and contaminants from filter until pure fuel emerges.
5. Close drain cock (2).



6. Connect filling pump to filling connection (1) on the suction side of the filter.
7. Open vent valve (2) and fill with fuel until fuel emerges from the vent pipe (3).
8. Close vent valve (2).
9. Open rotary slide valve (4) a little (by approx. 30°) and open vent valve(s) (2), until fuel emerges from the vent pipe (3).
10. Close vent valve(s) (2).
11. Turn rotary slide valve (4) back to locked position.



6.7.7 Fuel prefilter – Flushing

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Diesel fuel		

DANGER



Rotating and moving engine parts.

Risk of crushing, danger of parts of the body being caught or pulled in!

- Only run the engine at low power. Keep away from the engine's danger zone.

WARNING



Fuels are combustible.

Risk of fire and explosion!

- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

WARNING



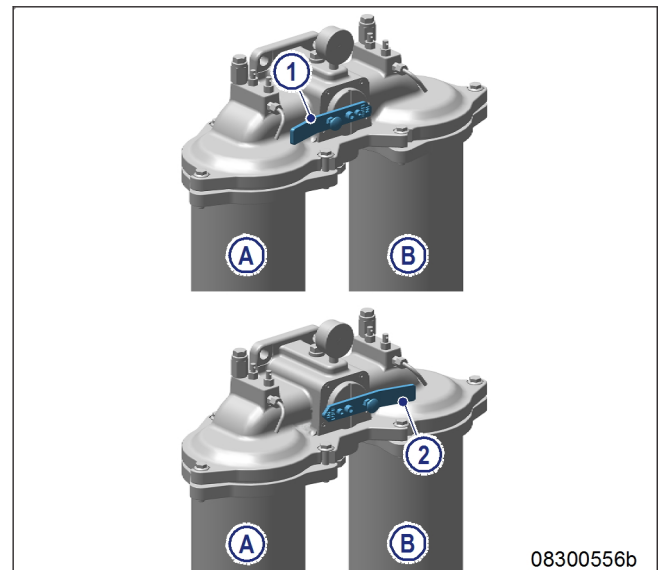
High level of engine noise when the engine is running.

Risk of damage to hearing!

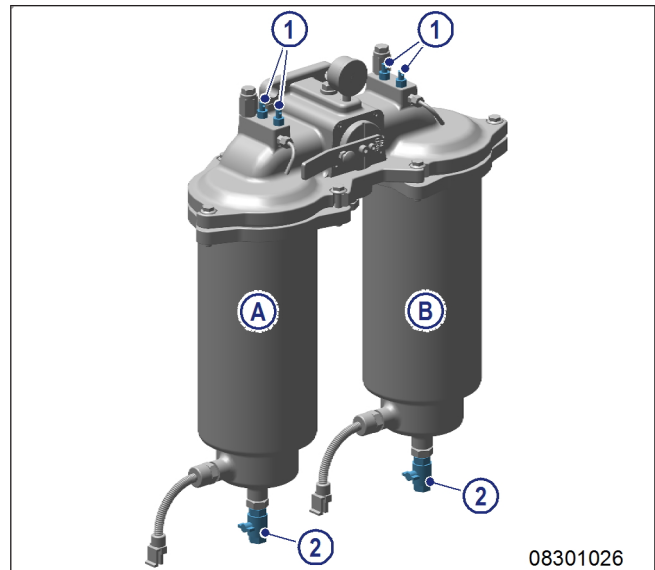
- Wear ear protectors.

Flushing fuel prefilter

1. Cut out dirty filter.
 - 1 Filter A cut out
 - 2 Filter B cut out

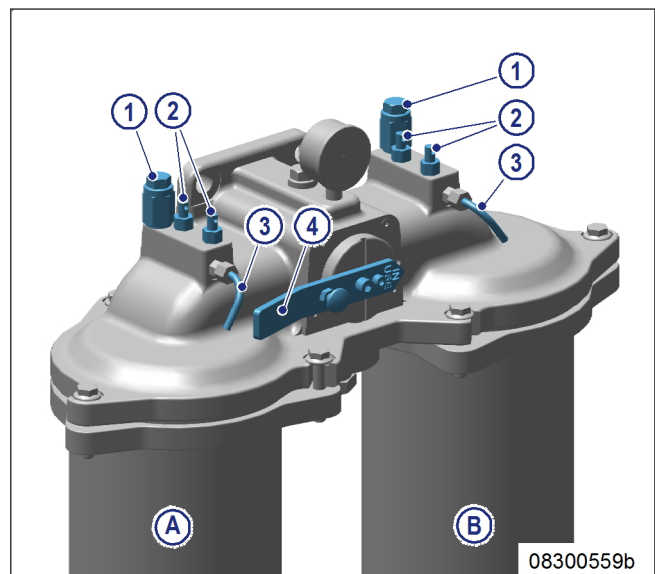


2. Open vent plug (1) of filter to be flushed.
 3. Open drain valve (2) and drain fuel.
- Result: Fuel flows from filtered side back to the un-filtered side, flushing the filter deposits downwards out of the filter.
4. Close vent plug (1) and drain valve (2).



Fuel prefilter – Filling with fuel

1. Stop engine (→ Page 86) and disable engine start.
 2. Connect filling pump to filling connection (1) on the suction side of the filter.
 3. Open vent valve (2) and fill with fuel until fuel emerges from the vent pipe (3).
 4. Close vent valve (2).
 5. Open rotary slide valve (4) a little (by approx. 30°) and open vent valve(s) (2), until fuel emerges from the vent pipe (3).
 6. Close vent valve(s) (2).
 7. Turn rotary slide valve (4) back to locked position.
 8. Check differential pressure (→ Page 190).
- Result: Replace filter element in fuel prefilter (→ Page 195) if flushing did not improve differential pressure.



6.7.8 Fuel prefilter with water separator – Filter element replacement

Preconditions

- ☑ Engine is stopped and starting disabled.
- ☑ System is at atmospheric pressure.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 10-60 Nm	F30452769	1
Ratchet adapter	F30027340	1
Filter element	(→ Spare Parts Catalog)	
O-ring	(→ Spare Parts Catalog)	

WARNING



Tank is pressurized.

Risk of eye injuries resulting from fluid escaping under high pressure!

- Open tank slowly.
- Wear goggles or safety mask.

WARNING



Fuels are combustible.

Risk of fire and explosion!

- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

WARNING



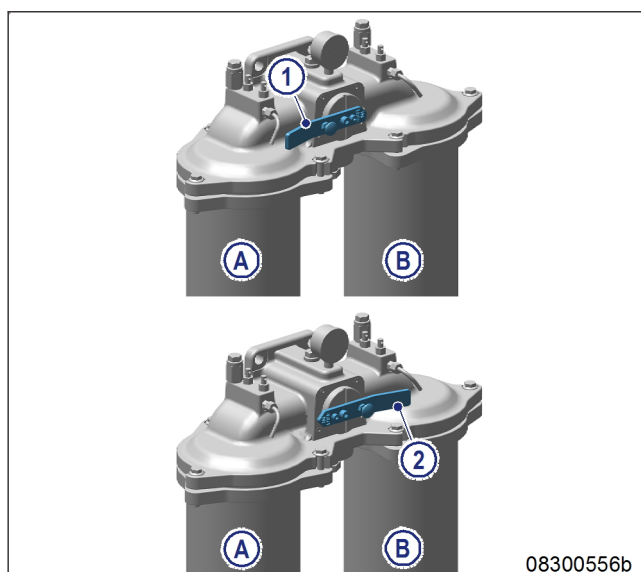
Component is hot.

Risk of burning!

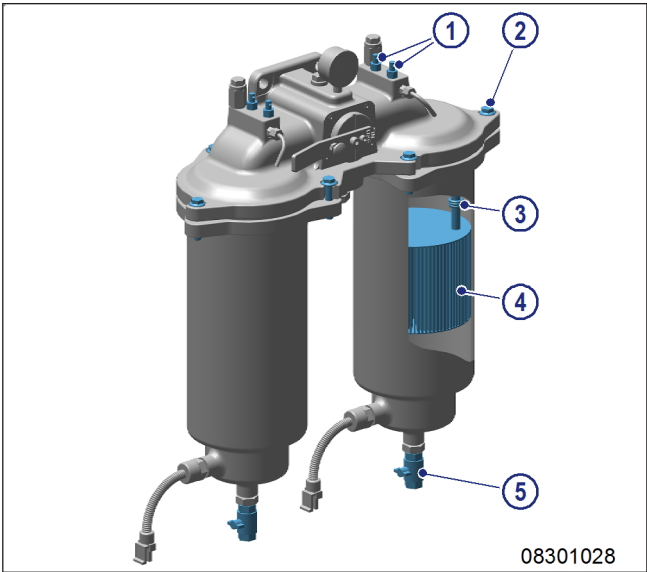
- Wear protective gloves.

Fuel prefilter with water separator – Filter element replacement

1. Cut out the filter to be replaced (A or B):
 - 1 Filter A cut out
 - 2 Filter B cut out



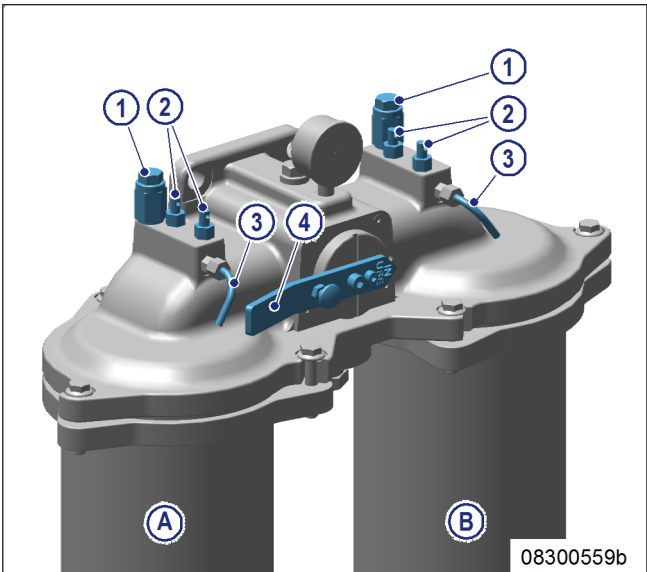
2. Open vent valve (1) of the filter to be replaced.
3. Open drain valve (5) and drain fuel.
4. Loosen screws (3) and screw out filter housing (A or B).
5. Remove filter element (4).
6. Insert new filter element in filter housing.
7. Fit O-ring.
8. Reinstall filter housing (A or B) with filter element (4).



9. Tighten screws (6 or 3) with torque wrench to the specified tightening torque (maximum half a turn per screw).

Name	Size	Type	Lubricant	Value/Standard
Screw		Tightening torque		40 Nm

10. Connect filling pump to filling connection (1) on the suction side of the filter.
11. Open vent valve (2) and fill with fuel until fuel emerges from the vent pipe (3).
12. Close vent valve (2).
13. Open rotary slide valve (4) a little (by approx. 30°) and open vent valve(s) (2), until fuel emerges from the vent pipe (3).
14. Close vent valve(s) (2).
15. Turn rotary slide valve (4) back to locked position.



6.7.9 Fuel prefilter with water separator – O-ring replacement in rotary slide valve

Preconditions

- ☑ Engine is stopped and starting disabled.
- ☑ System is at atmospheric pressure.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
O-ring	(→ Spare Parts Catalog)	

WARNING



Tank is pressurized.

Risk of eye injuries resulting from fluid escaping under high pressure!

- Open tank slowly.
- Wear goggles or safety mask.

WARNING



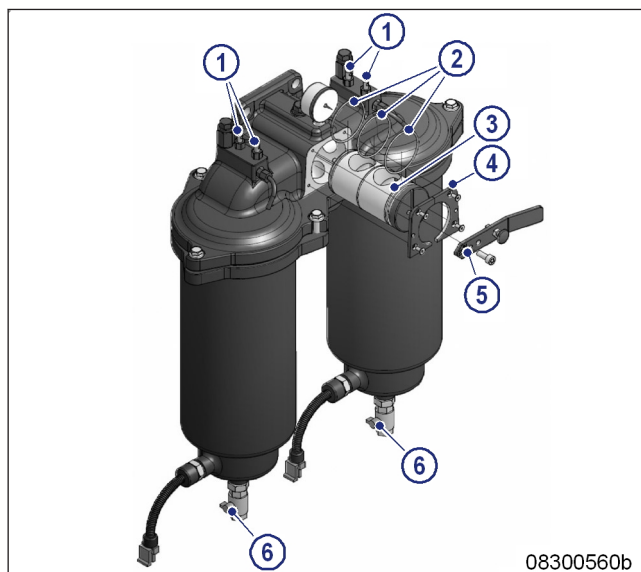
Fuels are combustible.

Risk of fire and explosion!

- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Fuel prefilter with water separator – O-ring replacement in rotary slide valve

1. Open vent valves (1) carefully to make sure that the system is not pressurized.
2. Open drain valves (6) and drain fuel.
3. Remove rotary slide valve retainer (4) with handle (5).
4. Remove rotary slide valve (3) with O-rings (2).
5. Replace O-rings (2).
6. For assembly, follow the reverse sequence of working steps as described for disassembly.

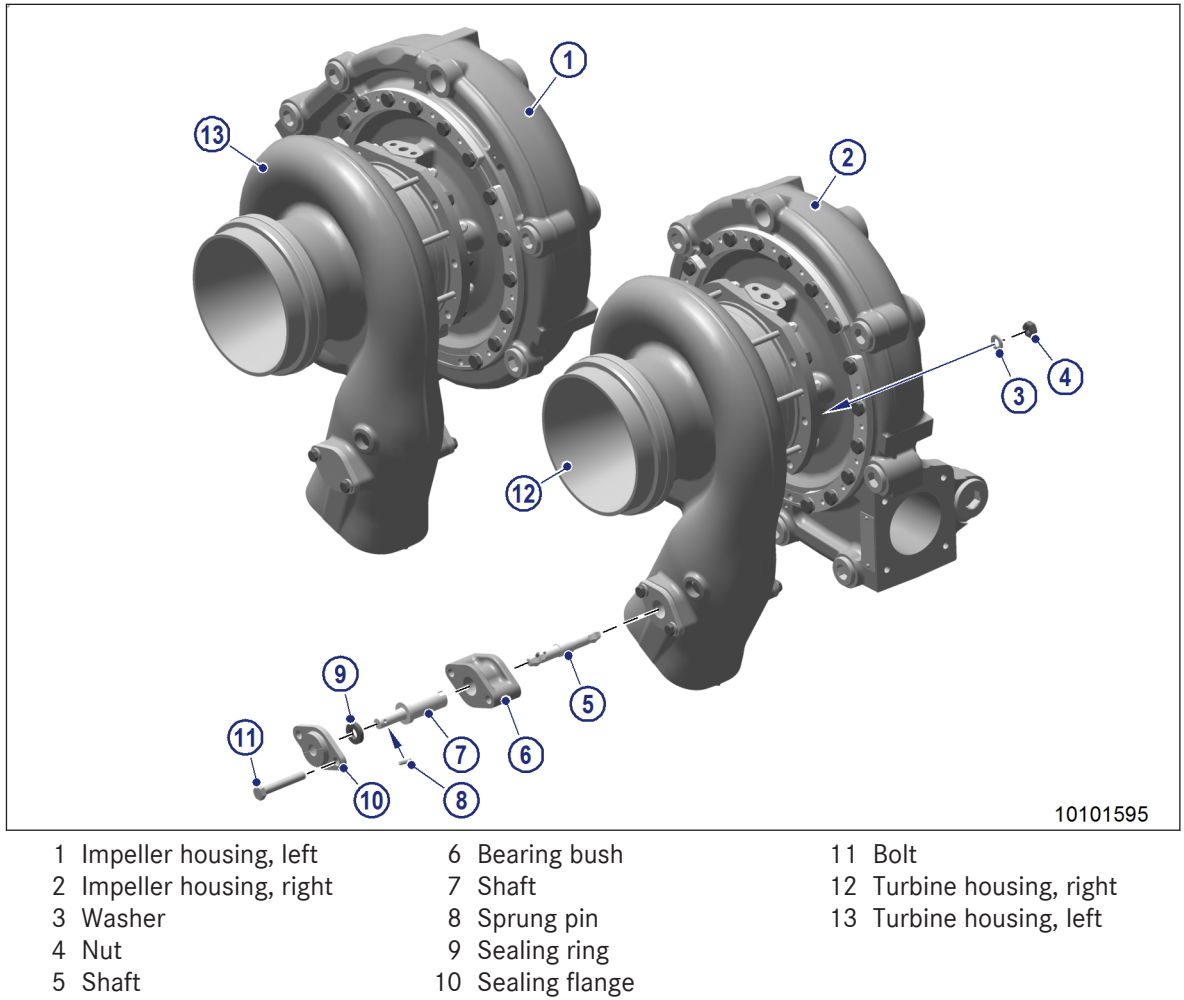


08300560b

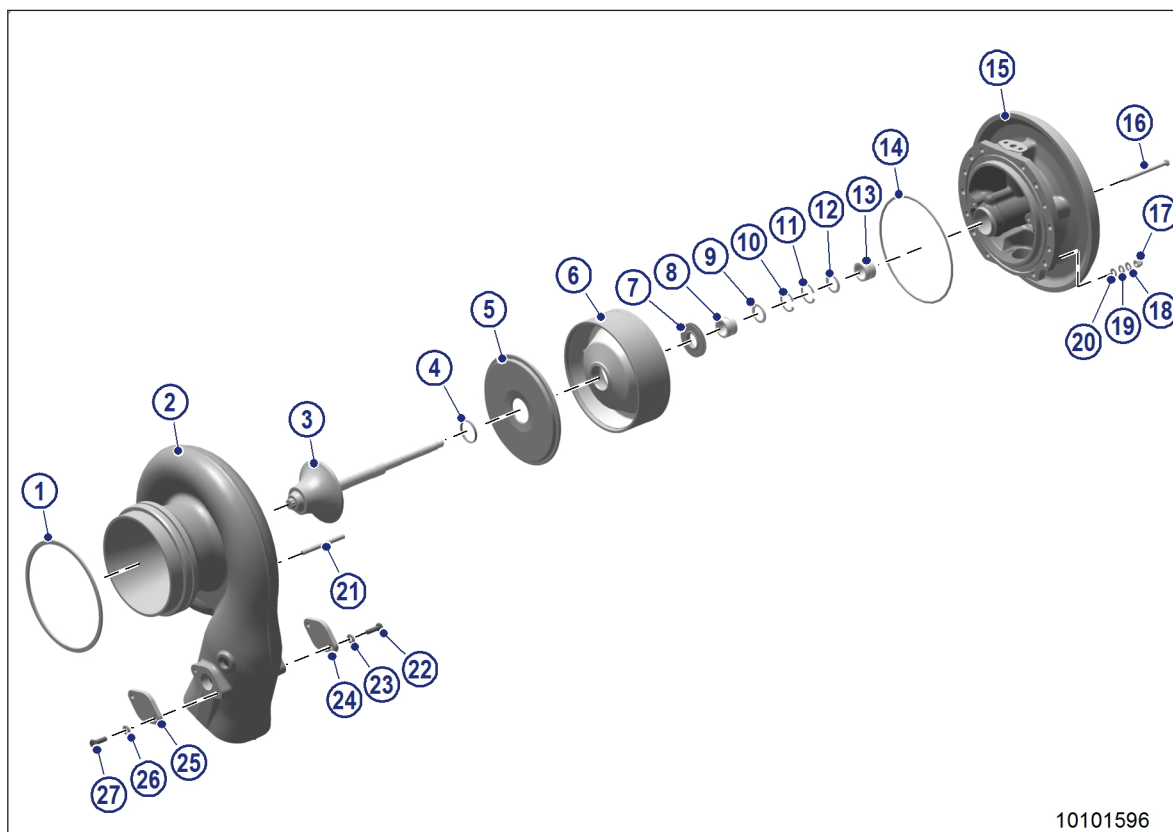
6.8 Exhaust Turbocharger

6.8.1 Overview of turbocharger

Turbocharger



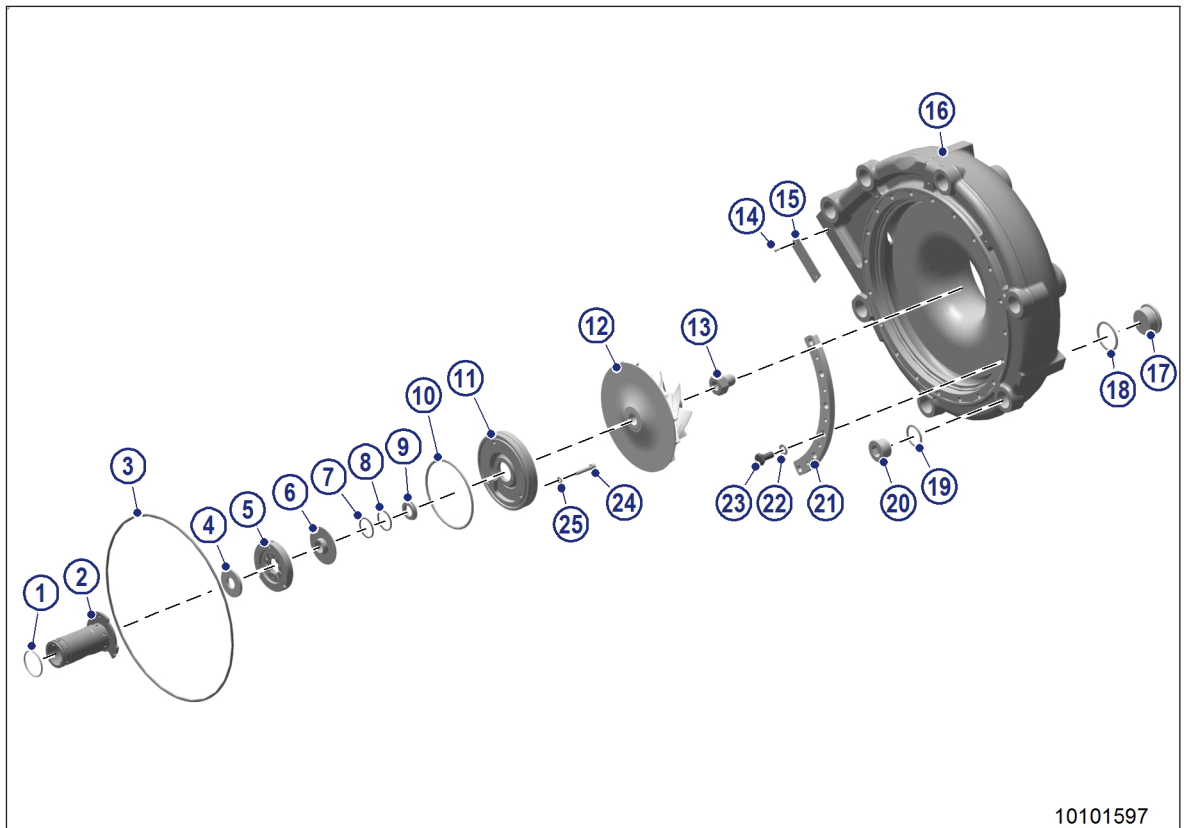
Turbine housing, left turbocharger



10101596

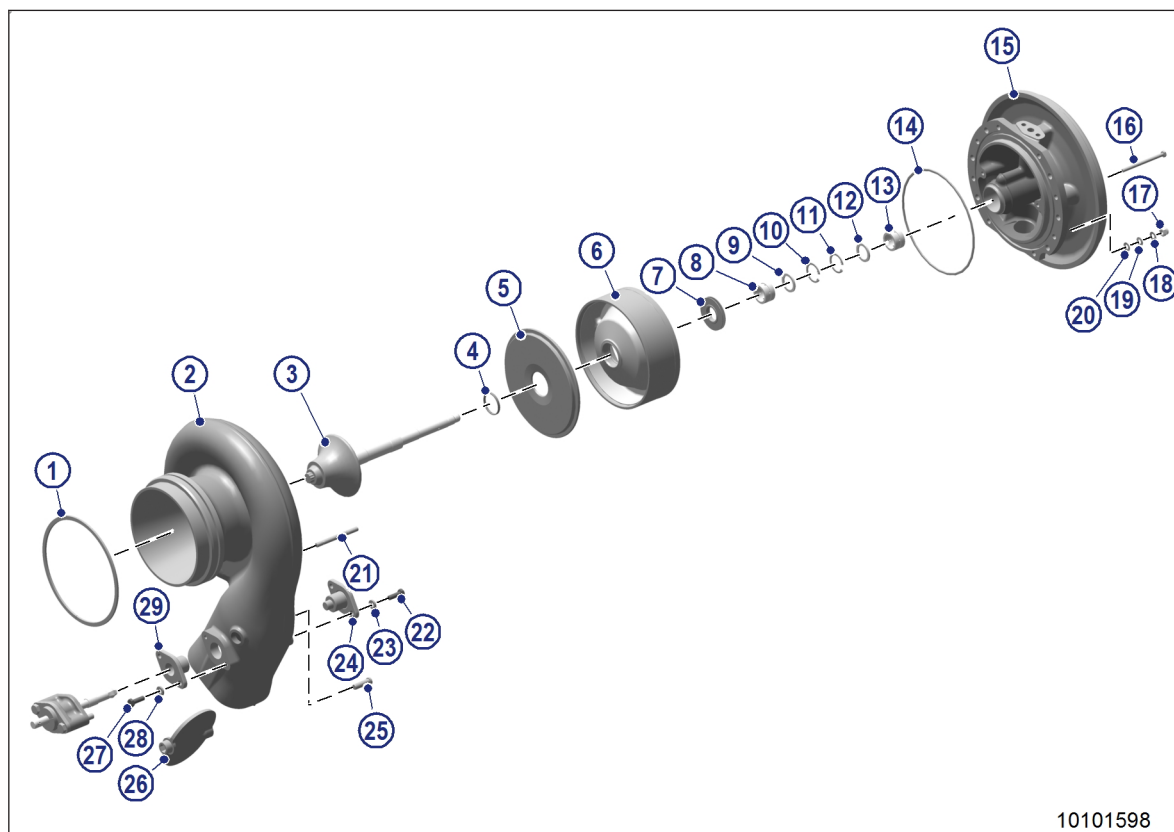
- | | | |
|-------------------|--------------------|-------------------|
| 1 R-ring | 10 Circlip | 19 Dished washer |
| 2 Turbine housing | 11 Circlip | 20 Dished washer |
| 3 Turbine | 12 Washer | 21 Stud bolt |
| 4 Piston ring | 13 Bearing bush | 22 Bolt |
| 5 Heat shield | 14 O-ring | 23 Washer |
| 6 Housing cover | 15 Bearing housing | 24 Blanking plate |
| 7 Washer | 16 Bolt | 25 Blanking plate |
| 8 Bearing bush | 17 Nut | 26 Washer |
| 9 Washer | 18 Dished washer | 27 Bolt |

Impeller housing, left



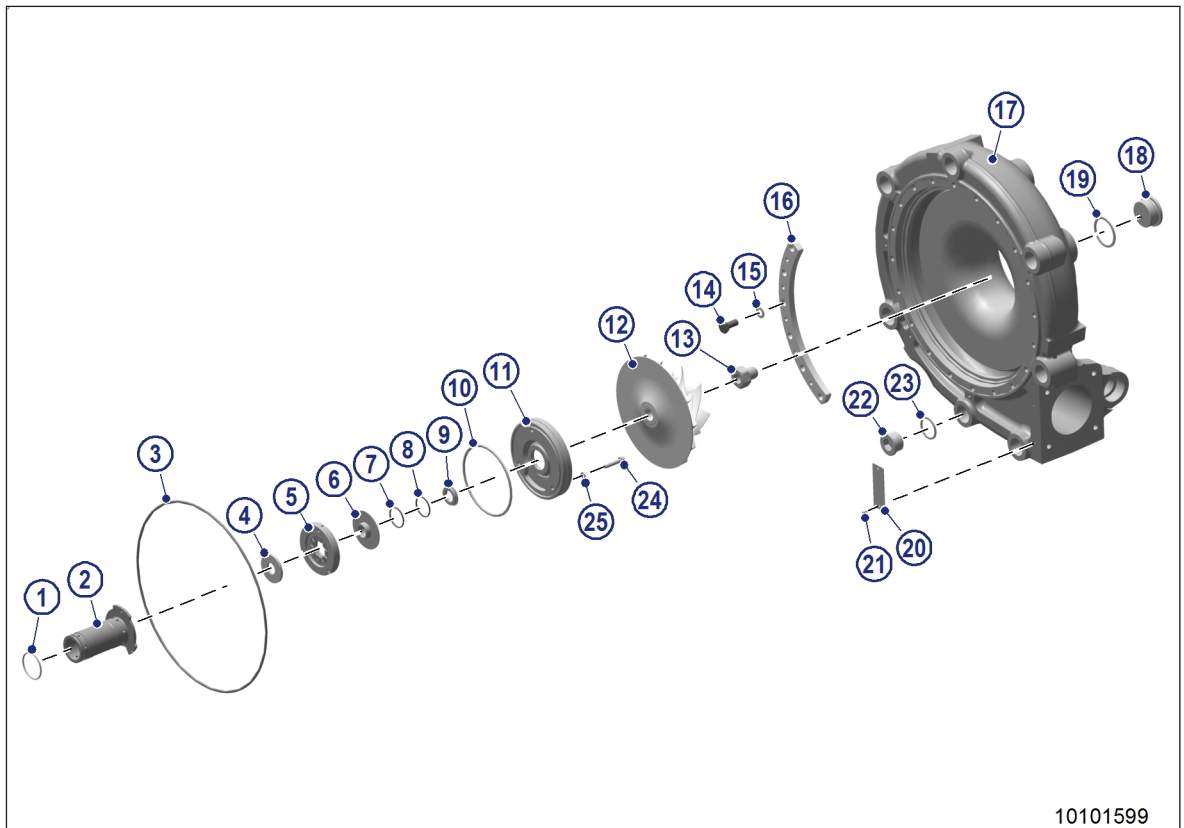
- | | | |
|------------------|-------------------------|-------------------|
| 1 O-ring | 10 O-ring | 19 Sealing ring |
| 2 Bearing body | 11 Retaining ring | 20 Plug bolt |
| 3 O-ring | 12 Impeller | 21 Clamping piece |
| 4 Washer | 13 Magnetic nut | 22 Washer |
| 5 Thrust bearing | 14 Grooved pin | 23 Bolt |
| 6 Washer | 15 Identification plate | 24 Bolt |
| 7 Piston ring | 16 Impeller housing | 25 Washer |
| 8 Piston ring | 17 Plug bolt | |
| 9 Ring retainer | 18 Sealing ring | |

Turbine housing, right turbocharger



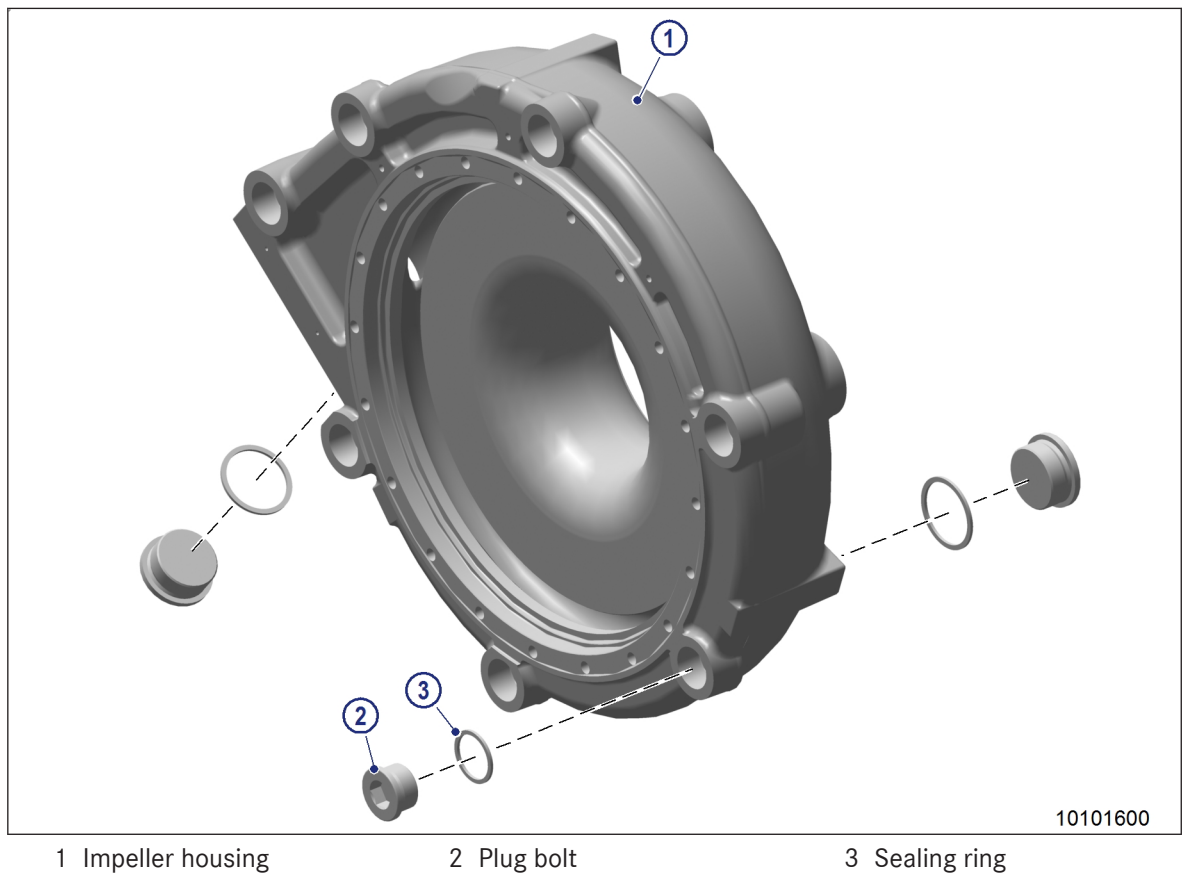
- | | | |
|-------------------|--------------------|--------------|
| 1 R-ring | 11 Circlip | 21 Stud bolt |
| 2 Turbine housing | 12 Washer | 22 Bolt |
| 3 Turbine | 13 Bearing bush | 23 Washer |
| 4 Piston ring | 14 O-ring | 24 Bush |
| 5 Heat shield | 15 Bearing housing | 25 Pin |
| 6 Housing cover | 16 Bolt | 26 Wastegate |
| 7 Washer | 17 Nut | 27 Bolt |
| 8 Bearing bush | 18 Dished washer | 28 Washer |
| 9 Washer | 19 Dished washer | 29 Bush |
| 10 Circlip | 20 Dished washer | |

Impeller housing, right turbocharger

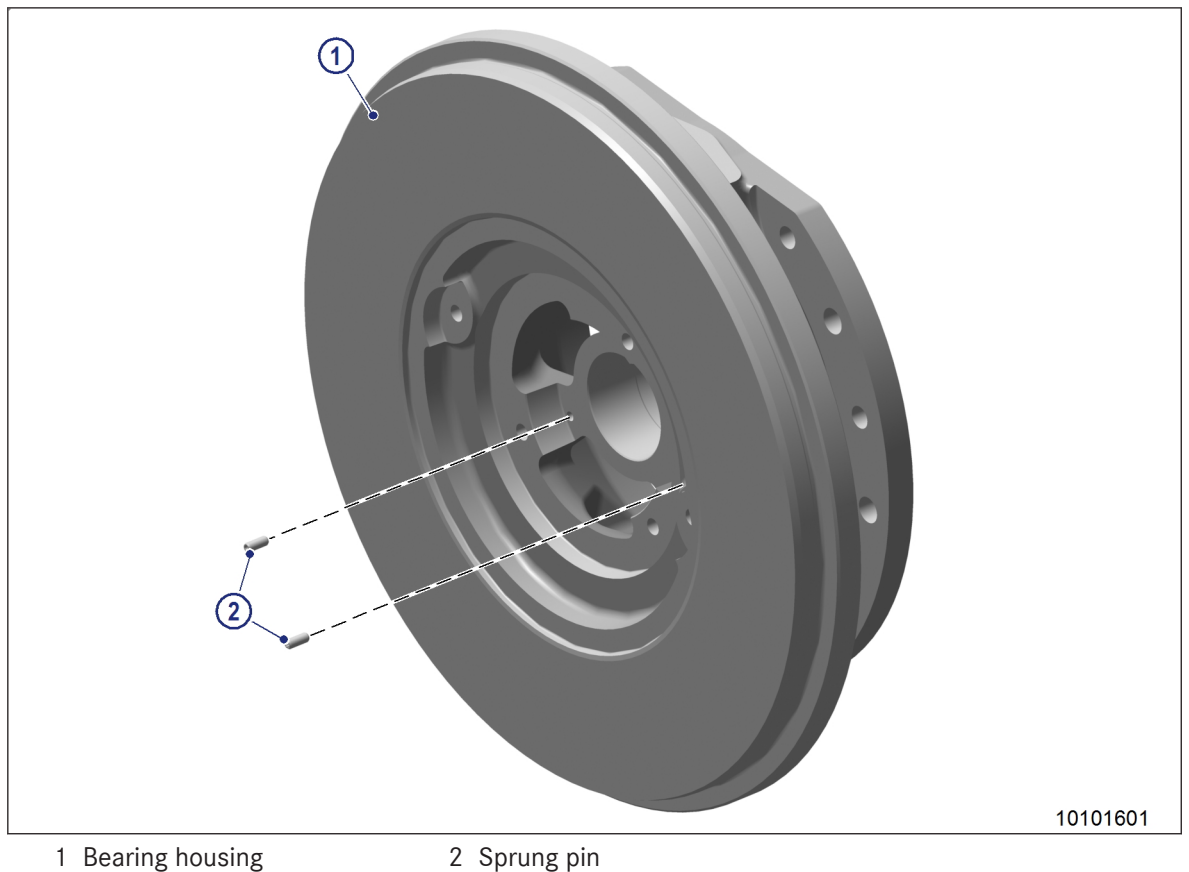


- | | | |
|------------------|---------------------|-------------------------|
| 1 O-ring | 10 O-ring | 19 Sealing ring |
| 2 Bearing body | 11 Retaining ring | 20 Identification plate |
| 3 O-ring | 12 Impeller | 21 Grooved pin |
| 4 Washer | 13 Magnetic nut | 22 Plug bolt |
| 5 Thrust bearing | 14 Bolt | 23 Sealing ring |
| 6 Washer | 15 Washer | 24 Bolt |
| 7 Piston ring | 16 Clamping piece | 25 Washer |
| 8 Piston ring | 17 Impeller housing | |
| 9 Ring retainer | 18 Plug bolt | |

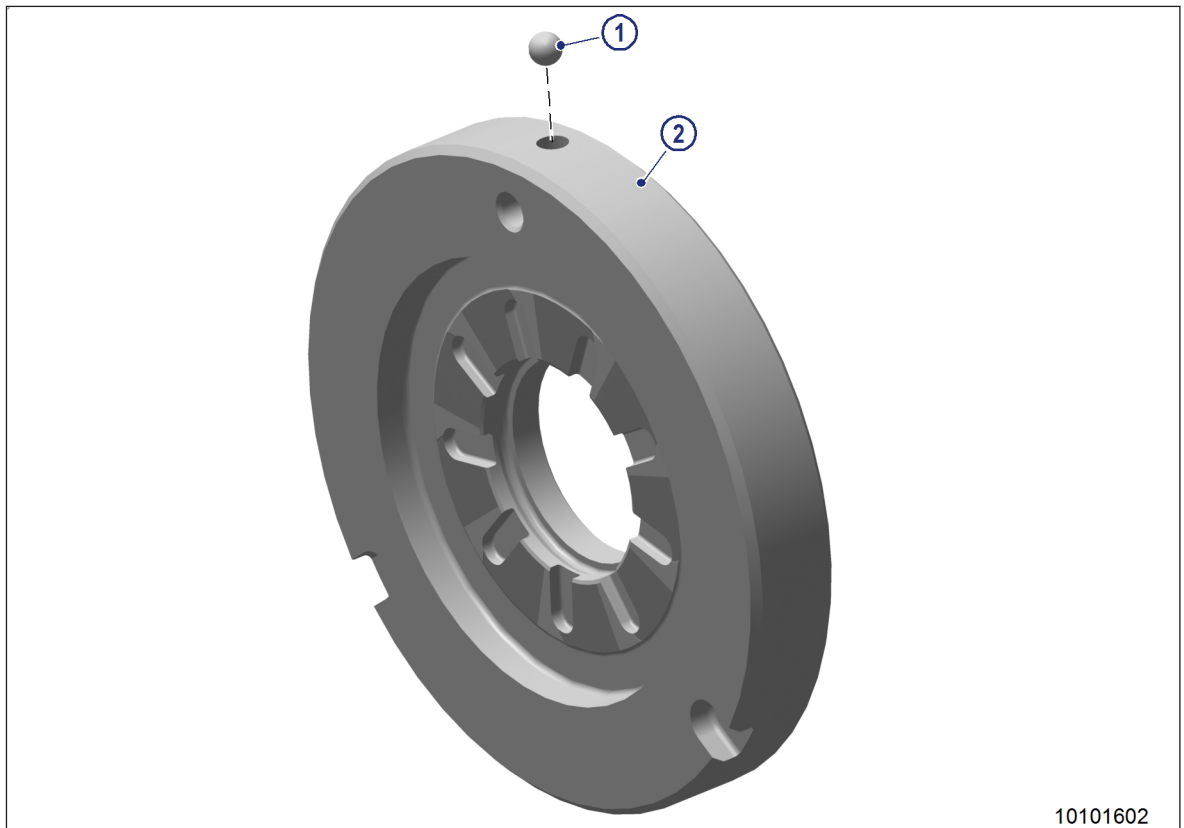
Impeller housing



Bearing housing



Thrust bearing

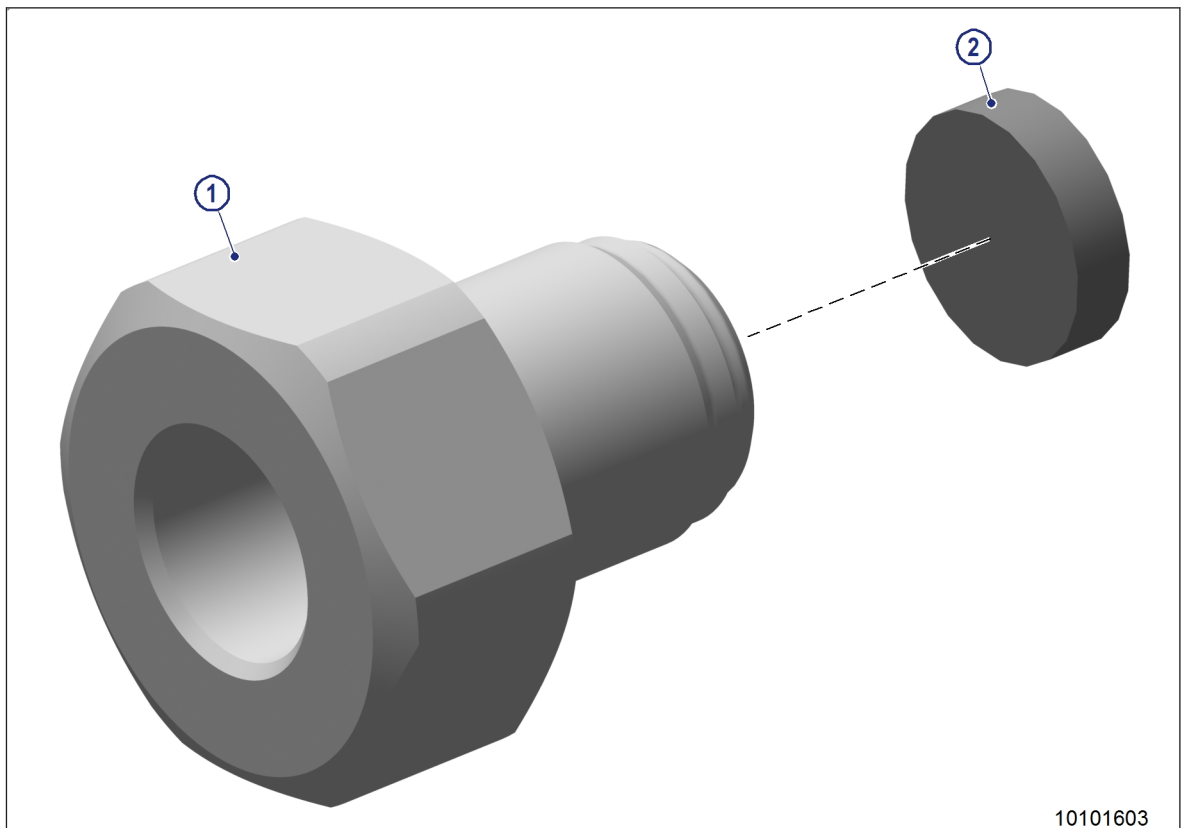


10101602

1 Ball

2 Thrust bearing

Magnetic nut



10101603

1 Magnetic nut

2 Magnet

TIM-ID: 0000037654 - 001

6.8.2 Compressor wheel – Cleaning

Preconditions

- ☒ Engine is stopped and starting disabled

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 10-60 Nm	F30452769	1
Ratchet adapter	F30027340	1
Cleaner	40377	1
Engine oil		
Engine coolant		
Sealing rings	(→ Spare Parts Catalog)	3
Sealing rings	(→ Spare Parts Catalog)	4

WARNING



Chemical substances.

Risk of irritation and chemical burns!

- Observe the instructions of the cleaning agent manufacturer.

NOTICE



Inappropriate cleaning tool.

Risk of damage to component!

- Observe manufacturer's instructions.
- Use appropriate cleaning tool.

NOTICE



Incorrect installation of components and lines.

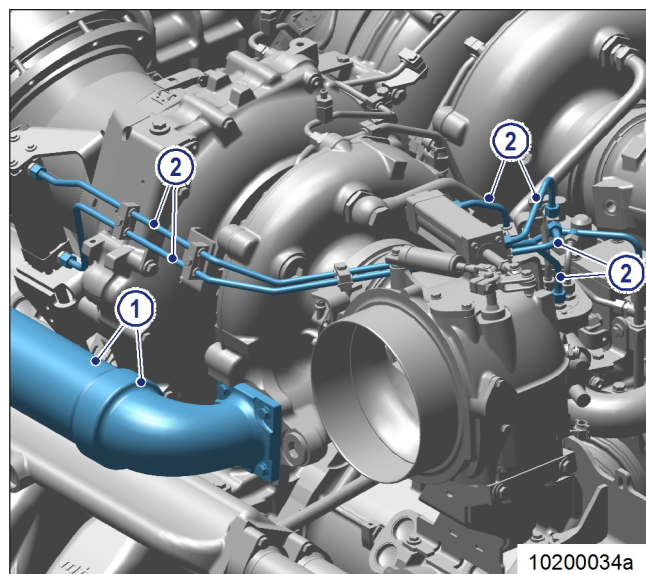
Damage to component!

- Ensure that components/lines are installed so that they are never under tension or strain.
- Ensure correct installation position of components.

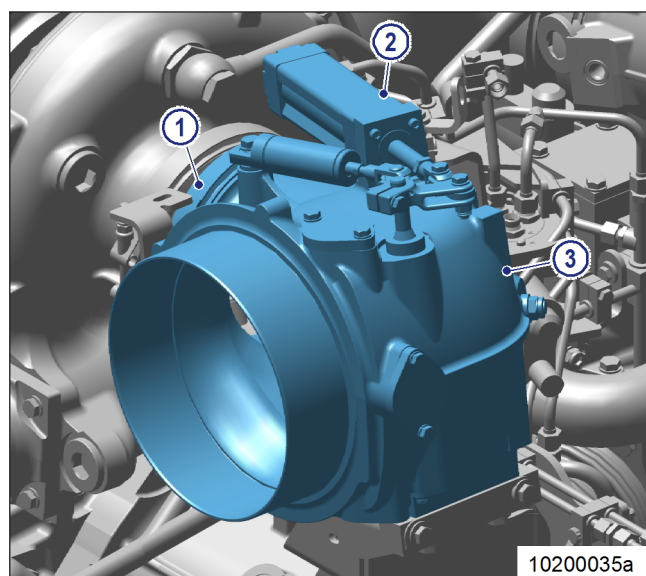
Preparatory steps – Horizontal air intake

1. Drain engine coolant (→ Page 236).
2. Remove air filter (→ Page 215).
3. Seal all openings with suitable covers.

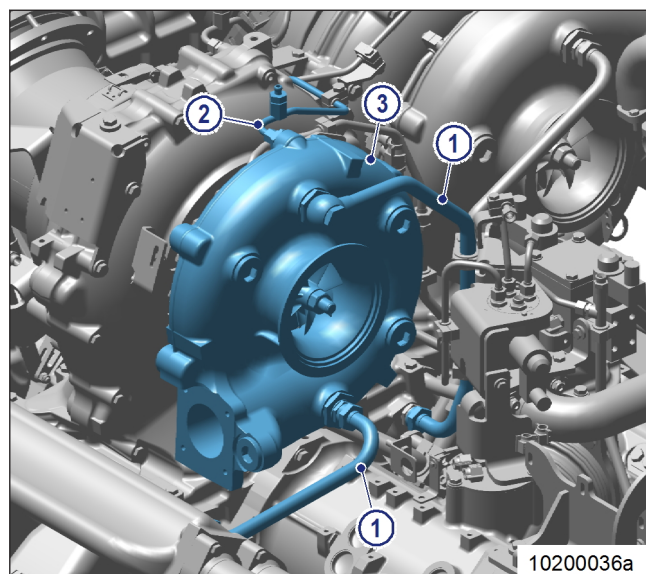
4. Remove charge-air pipework (1) from exhaust turbocharger to intercooler.
5. Remove oil lines (2).



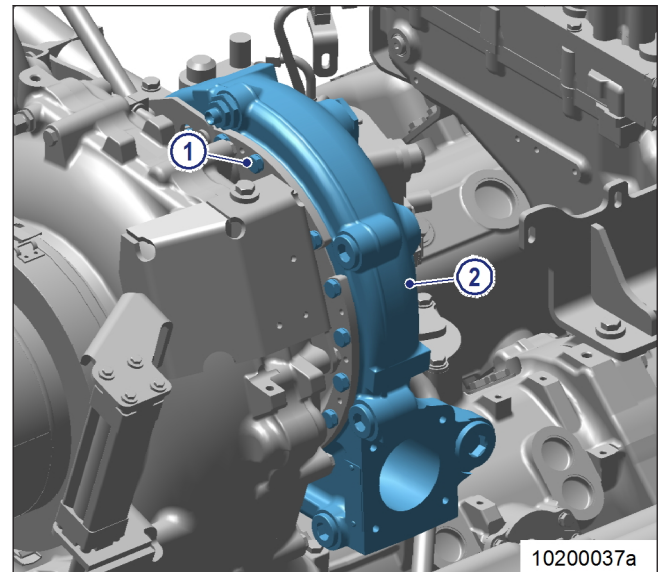
6. Loosen clamp (1).
7. Remove intake housing (3) with actuating cylinder (2).



8. Remove coolant lines (1) from compressor housing (3).
9. Remove coolant ventilation line (2) from compressor housing (3).

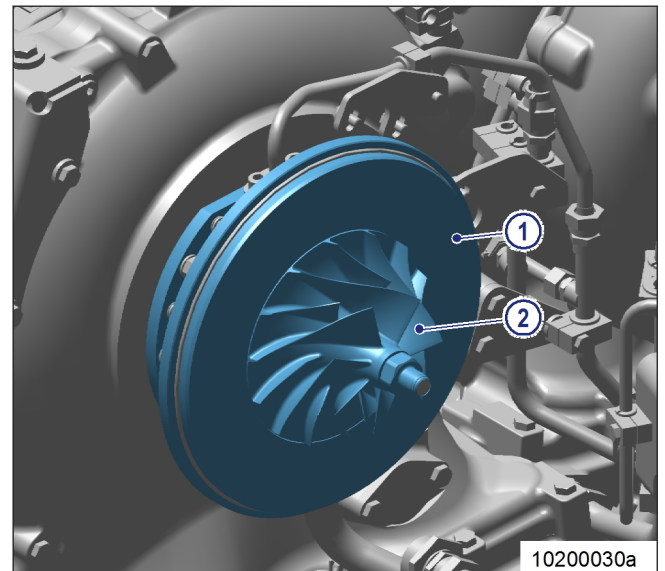


10. Undo screws (1).
11. Remove compressor housing (2).



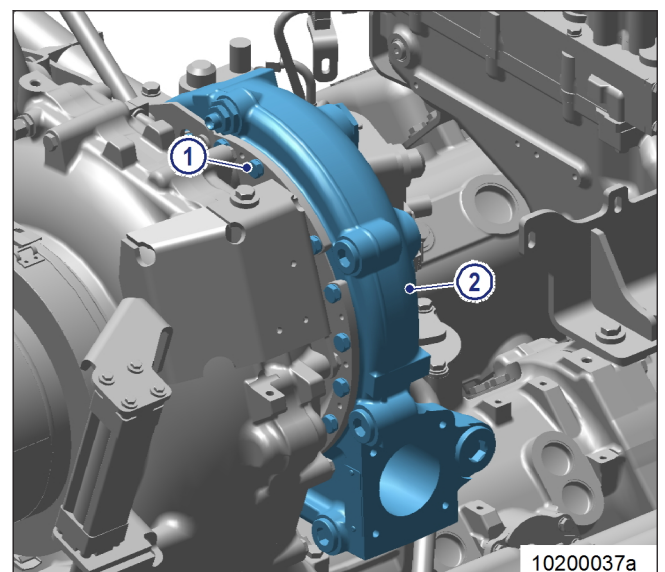
Cleaning compressor wheel

- Note: Do not use wire brushes, scrapers or similar tools for cleaning!
1. Clean compressor housing with a smooth paint brush or brush.
 2. Clean compressor wheel (2) and bearing housing (1).
 3. Thoroughly remove cleaner from all components.
 4. Fit new sealing rings between bearing housing/compressor housing and plug-in sleeves if necessary.



Final steps – Horizontal air intake

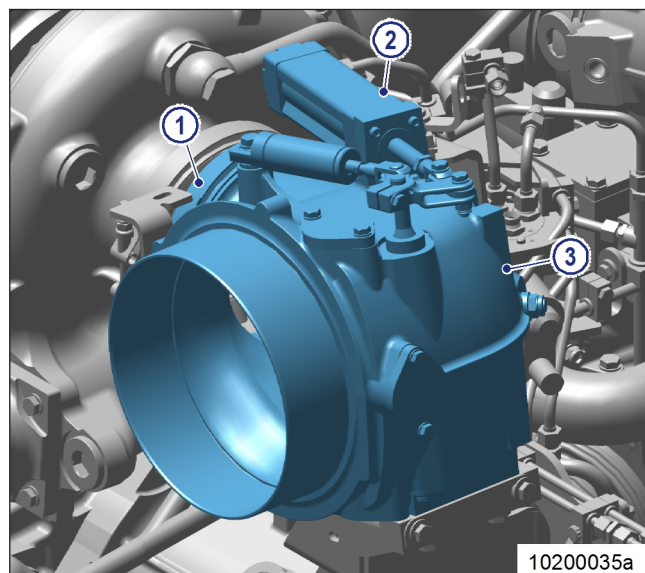
1. Install compressor housing (2).



2. Tighten screws (1) to specified torque using a torque wrench.

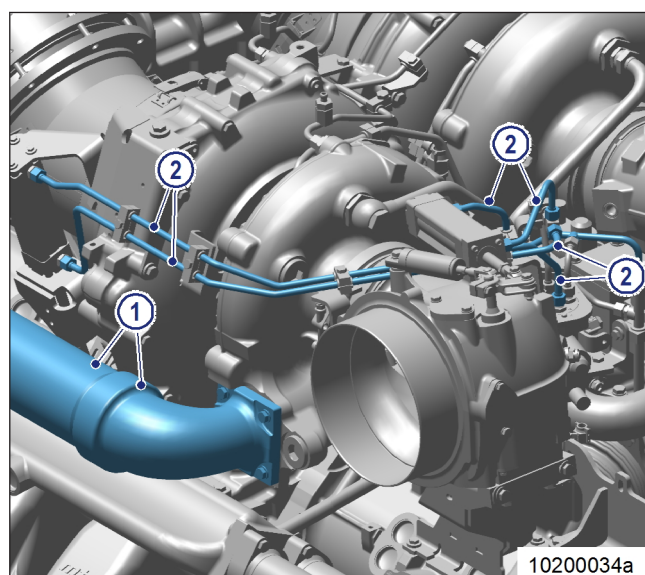
Name	Size	Type	Lubricant	Value/Standard
Screw		Tightening torque	(Engine oil)	20 Nm + 2.5 Nm

3. Install coolant ventilation line and coolant lines on compressor housing.
4. Install intake housing (3) with actuating cylinder (2).



5. Align clamp (1) and tighten to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Clamp		Tightening torque		15 Nm + 2 Nm



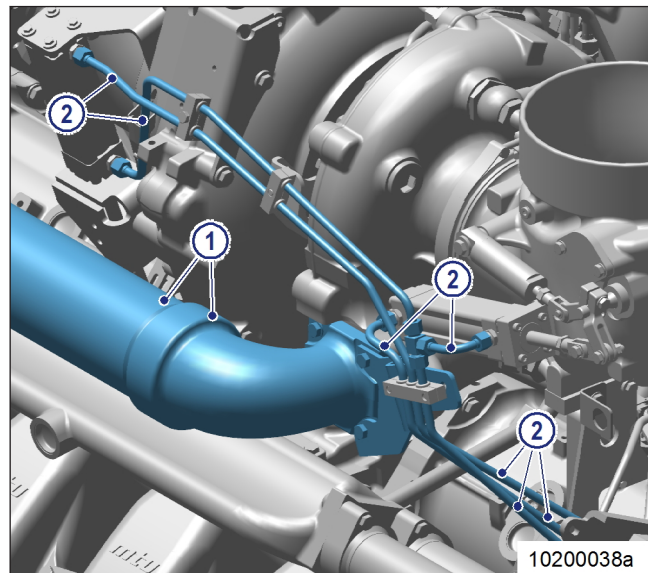
6. Install oil lines (2). Tighten threaded adapter at actuating cylinder to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Threaded adapter	10 G 1/4 A	Tightening torque	(Engine oil)	40 Nm + 4 Nm

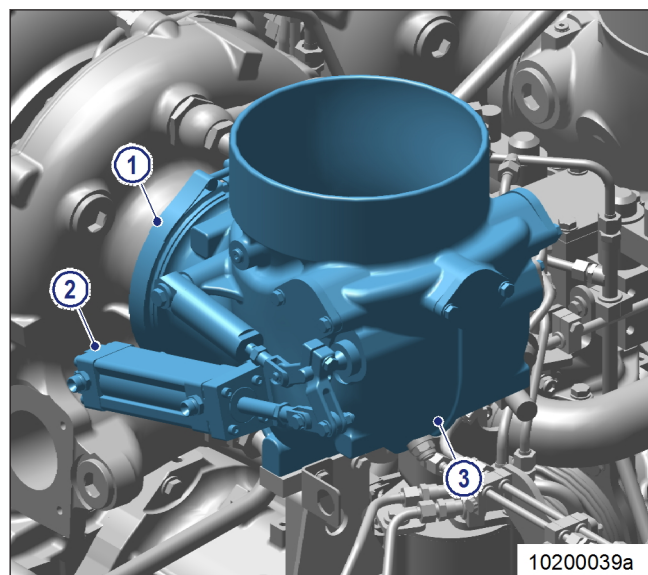
7. Install charge-air pipework (1) between exhaust turbocharger and intercooler.
8. Install air filter (→ Page 215).
9. Fill with engine coolant (→ Page 239).

Preparatory steps – Vertical air intake

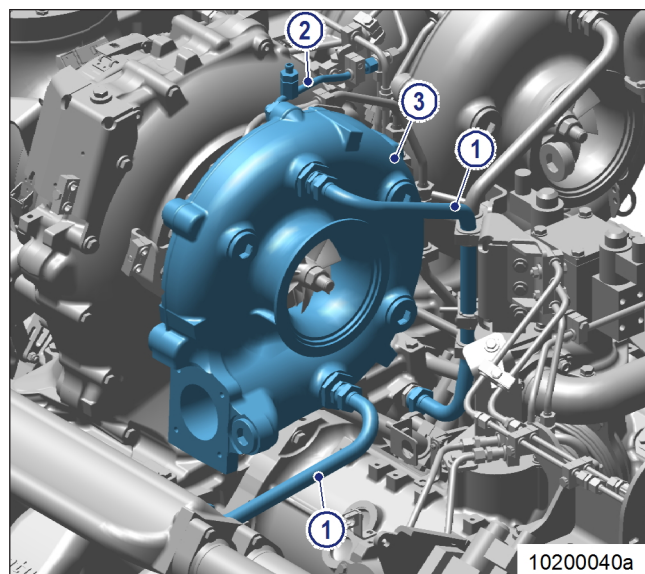
1. Drain engine coolant (→ Page 236).
2. Remove air filter (→ Page 215).
3. Seal all openings with suitable covers.
4. Remove charge-air pipework (1) from exhaust turbocharger to intercooler.
5. Remove oil lines (2).



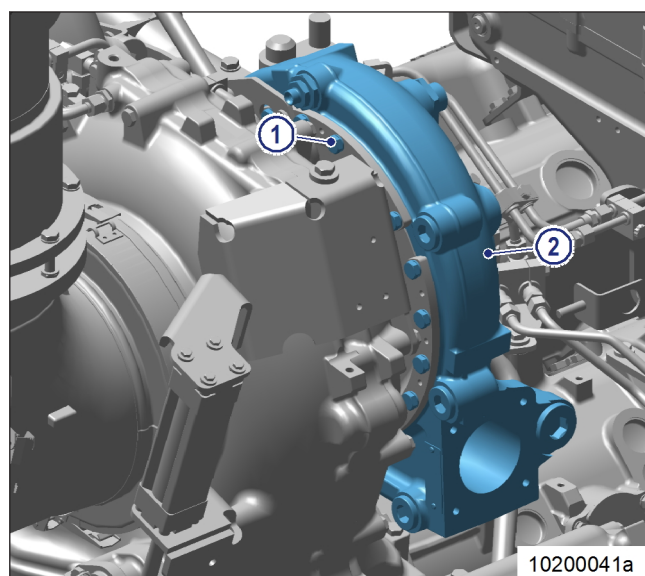
6. Loosen clamp (1).
7. Remove intake housing (3) with actuating cylinder (2).



8. Remove coolant lines (1) from compressor housing (3).
9. Remove coolant ventilation line (2) from compressor housing (3).



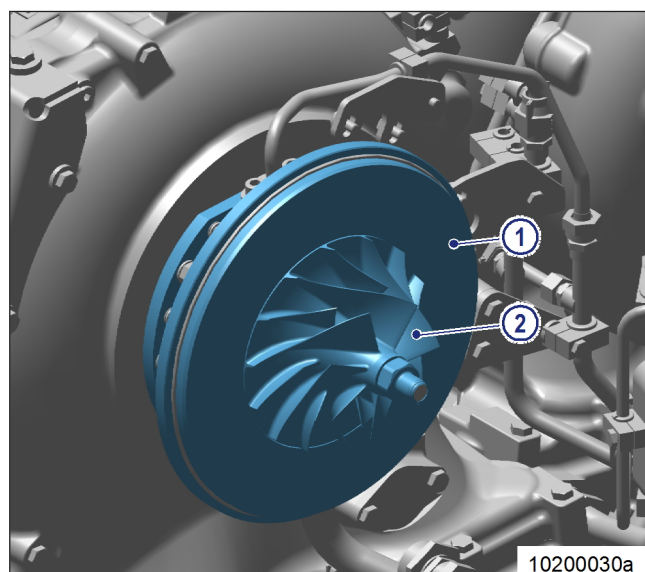
10. Undo screws (1).
11. Remove compressor housing (2).



Cleaning compressor wheel

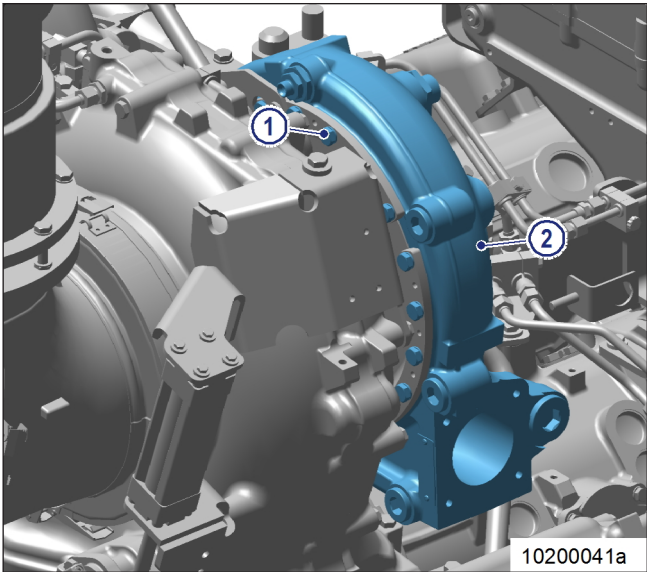
Note: Do not use wire brushes, scrapers or similar tools for cleaning!

1. Clean compressor housing with a smooth paint brush or brush.
2. Clean compressor wheel (2) and bearing housing (1).
3. Thoroughly remove cleaner from all components.
4. Fit new sealing rings between bearing housing/compressor housing and plug-in sleeves if necessary.



Final steps – Vertical air intake

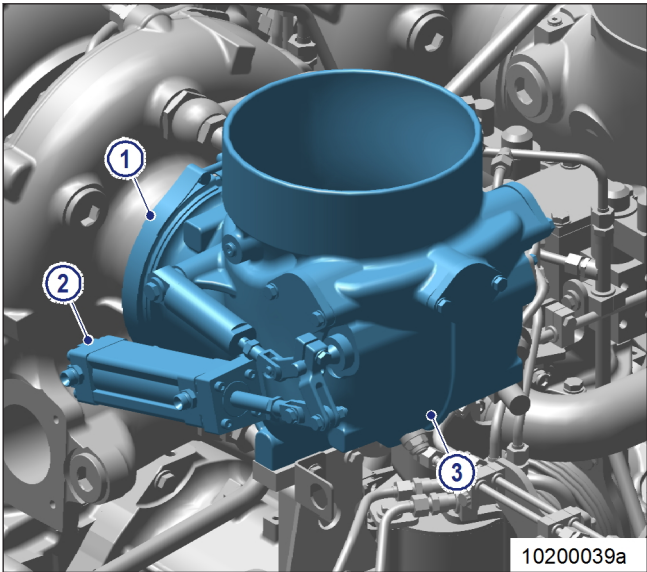
1. Install compressor casing (2).



2. Tighten screws (1) to specified torque using a torque wrench.

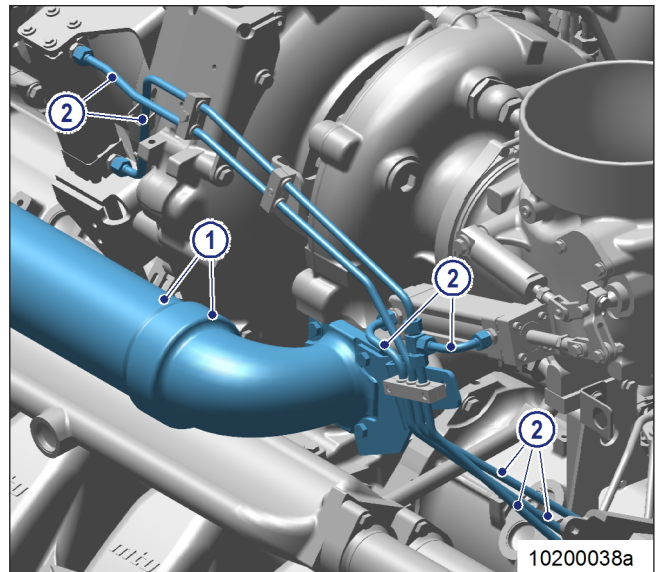
Name	Size	Type	Lubricant	Value/Standard
Screw		Tightening torque	(Engine oil)	20 Nm + 2.5 Nm

3. Install coolant ventilation line and coolant lines on compressor housing.
4. Install intake housing (3) with actuating cylinder (2).



5. Align clamp (1) and tighten to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Clamp		Tightening torque		15 Nm + 2 Nm



6. Install oil lines (2). Tighten threaded adapter at actuating cylinder to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Threaded adapter	10 G 1/4 A	Tightening torque	(Engine oil)	40 Nm +4 Nm

7. Install charge-air pipework (1) between exhaust turbocharger and intercooler.
8. Install air filter (→ Page 215).
9. Fill with engine coolant (→ Page 239).

6.9 Charge-Air Cooling

6.9.1 Intercooler – Checking condensate drain for water discharge and obstruction

DANGER



Rotating and moving engine parts.

Risk of crushing, danger of parts of the body being caught or pulled in!

- Only run the engine at low power. Keep away from the engine's danger zone.

WARNING



High level of engine noise when the engine is running.

Risk of damage to hearing!

- Wear ear protectors.

WARNING



Compressed air gun ejects a jet of pressurized air.

Risk of injury to eyes and damage to hearing, risk of rupturing internal organs!

- Never direct air jet at people.
- Always wear safety goggles/face mask and ear defenders.

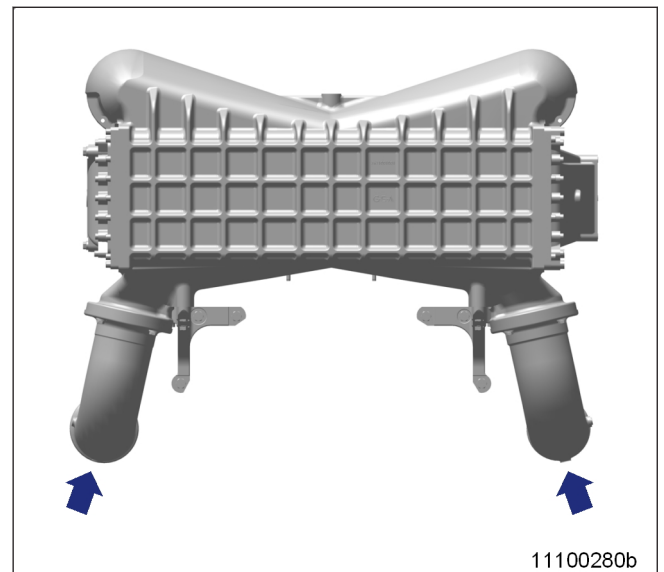
Intercooler – Checking condensate drain for water discharge and obstruction

1. With the engine running, check if air emerges from drain bore(s) on the left and right sides on engine driving end.

Result: If no air emerges:

- Clean condensate drain bore(s).
- Blow out with compressed air.

2. If a large amount of coolant is continuously discharged, the intercooler is leaking. Contact Service.



11100280b

Emergency measures prior to engine start with a leaking intercooler

1. Remove injectors (→ Page 180).
2. Bar engine manually (→ Page 162).
3. Bar engine with starting system to blow out combustion chambers (→ Page 162).
4. Install injectors (→ Page 180).

6.10 Air Filter

6.10.1 Air filter – Replacement

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Air filter	(→ Spare Parts Catalog)	

Replacing the air filter

1. Remove old air filter and install new air filter (→ Page 215).
2. Reset signal ring of contamination indicator (→ Page 216).

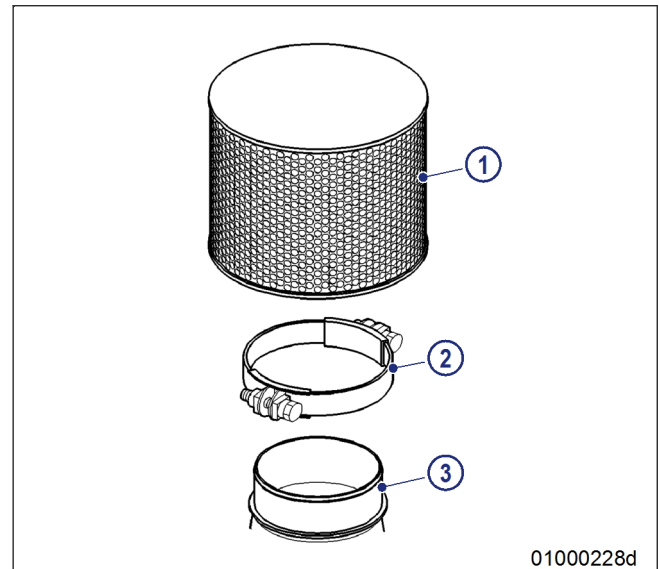
6.10.2 Air filter - Removal and installation

Preconditions

- ☑ Engine is stopped and starting disabled.

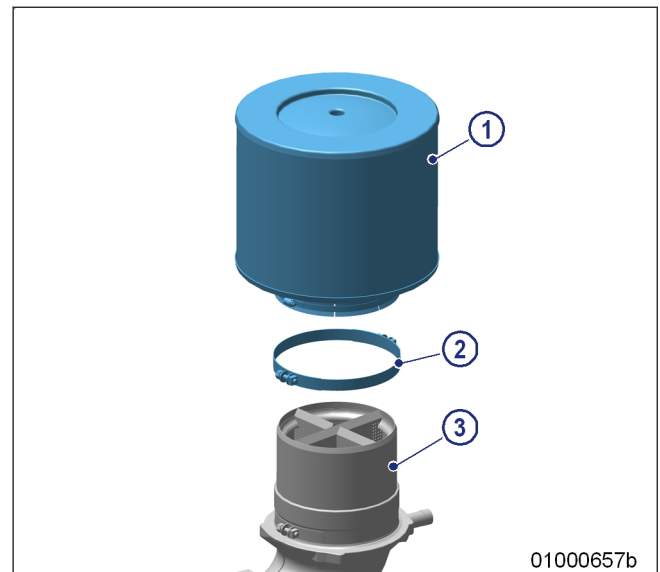
Air filter

1. Loosen clamp (2).
2. Remove air filter (1) and clamp (2) from connecting flange of housing (3).
3. Verify that there are no objects in the flange of the intake housing (3) and clean it.
4. Attach air filter (1) with clamp (2) onto intake housing (3).
5. Tighten clamp (2).



Air filter with intake silencer

1. Loosen clamp (2).
2. Remove air filter (1) and clamp (2) from intake silencer (3).
3. Clean intake silencer (3) and check for obstructions.
4. Attach air filter (1) with clamp (2) onto intake silencer (1).
5. Tighten clamp (2).



6.11 Air Intake

6.11.1 Service indicator – Signal ring position check (optional)

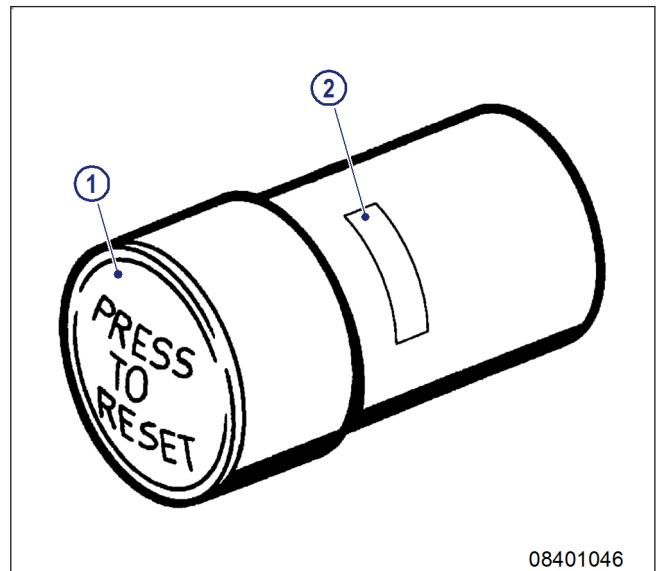
Preconditions

- ☑ Engine is stopped and starting disabled.

Checking signal ring position

1. If the signal ring is completely visible in the control window (2), replace air filter (→ Page 214).
2. After installation of new filter, press reset button (1).

Result: Engaged piston with signal ring moves back to initial position.



6.12 Starting Equipment

6.12.1 Starter - Condition check

Preconditions

- ☒ Engine is stopped and starting disabled.

Checking starter condition

1. Check securing screws of starter for secure seating and tighten if required.
2. Check wiring (→ Page 265).

6.13 Lube Oil System, Lube Oil Circuit

6.13.1 Engine oil - Level check

Preconditions

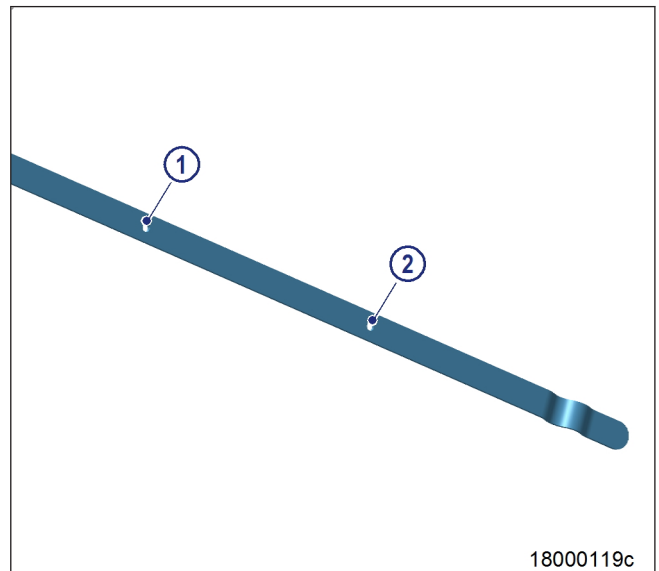
☑ Engine is stopped and starting disabled.

Oil level check prior to engine start

1. Withdraw dipstick from guide tube and wipe it.
2. Insert dipstick into guide tube to stop, withdraw after approx. 10 seconds and check oil level.

Note: After extended standstill, the oil level may be up to 2 cm above mark (1). This may be caused e.g. by oil from oil filters and heat exchanger flowing back into the oil pan.

3. The oil level must reach mark (1) or exceed mark (1) by up to 2 cm.
4. Top up with oil to mark (1) as necessary (→ Page 219).
5. Insert dipstick into guide tube up to the stop.



Oil level check after the engine is stopped

1. 5 minutes after stopping the engine, remove oil dipstick from the guide tube and wipe it.
2. Insert dipstick into guide tube to stop, withdraw after approx. 10 seconds and check oil level.
3. Oil level must be between marks (1) and (2).
4. Top up with oil to mark (1) as necessary (→ Page 219).
5. Insert dipstick into guide tube up to the stop.

6.13.2 Engine oil – Change

Preconditions

- ☑ Engine is stopped and starting disabled.
- ☑ Engine is at operating temperature.
- ☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 40-200 Nm	F30027337	1
Ratchet adapter	F30027341	1
Engine oil		
Sealing ring	(→ Spare Parts Catalog)	

WARNING



- Hot oil.
Oil can contain combustion residues which are harmful to health.
- Risk of injury and poisoning!**
- Wear protective clothing, gloves, and goggles / safety mask.
 - Avoid contact with skin.
 - Do not inhale oil vapor.

Oil change without semirotary hand pump: Draining oil via drain plug(s) on oil pan

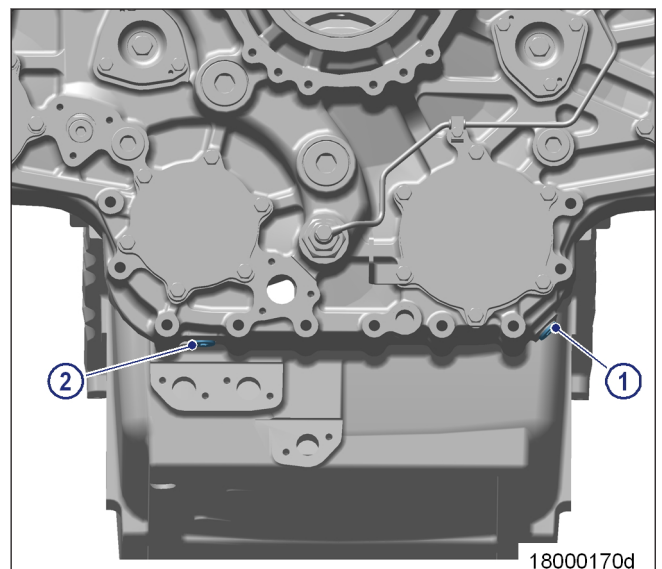
1. Provide a suitable container to collect the oil.
2. Remove drain plug(s) and drain oil.
3. Install drain plug(s) with new sealing ring.

Oil change with semirotary hand pump: Oil extraction

1. Provide a suitable container to collect the oil.
2. Draw all oil from oil pan using the semirotary hand pump.

Draining residual oil at gearcase

1. Provide a suitable container to collect the oil.
2. Remove drain plugs (1) and (2) and drain oil:
 - Approx. 12 liters at (1)
 - Approx. 5 liters at (2)
3. Install drain plug(s) with new sealing ring.

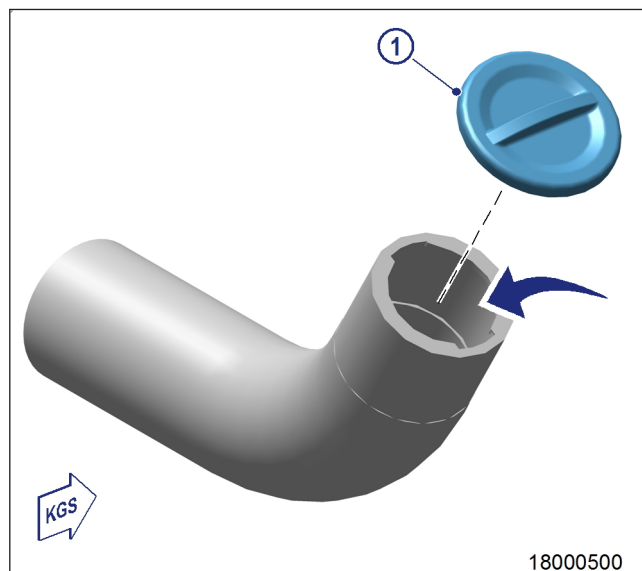


4. Tighten drain plugs (1) and (2) to specified torque using a torque wrench:

Name	Size	Type	Lubricant	Value/Standard
Screw	M26x1.5	Tightening torque	(Engine oil)	100 Nm+10 Nm

Filling with new oil

1. Open cap on filler neck.
2. Pour oil in at filler neck up to 'max.' mark at oil dipstick.
3. Close cap on filler neck.
4. Check engine oil level (→ Page 218).
5. Turn engine with starting system after oil change (→ Page 164).



6.13.3 Engine oil – Sample extraction and analysis

Preconditions

- ☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
MTU test kit	5605892099/00	1

DANGER



Rotating and moving engine parts.

Risk of crushing, danger of parts of the body being caught or pulled in!

- Only run the engine at low power. Keep away from the engine's danger zone.

WARNING



Hot oil.

Oil can contain combustion residues which are harmful to health.

Risk of injury and poisoning!

- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

WARNING



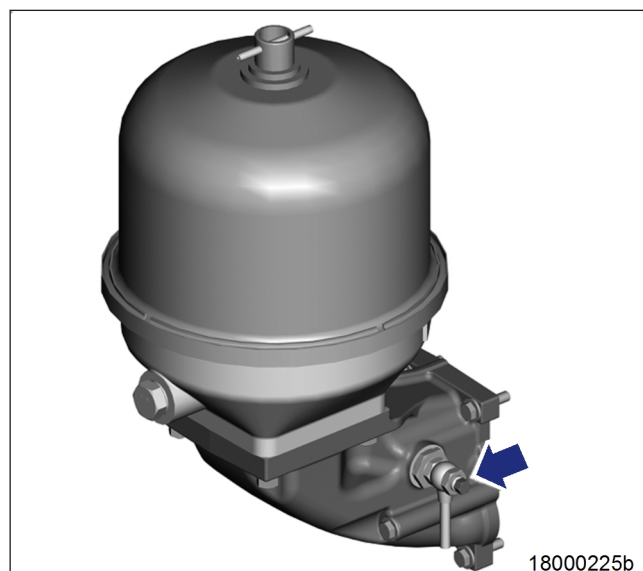
High level of engine noise when the engine is running.

Risk of damage to hearing!

- Wear ear protectors.

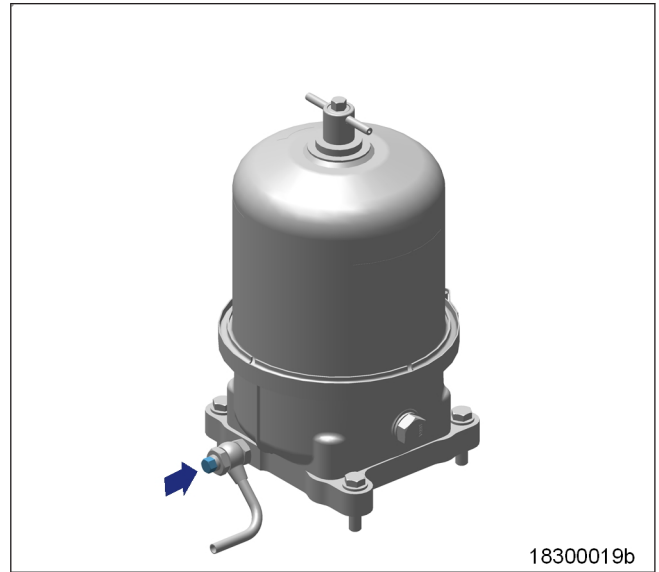
Engine oil – Sample extraction and analysis

1. With the engine running at operating temperature, open screw on centrifugal oil filter carrier by 1 to 2 rotations.
2. Drain approx. 2 liters engine oil to flush out the oil sludge.
3. Drain approx. 1 liter engine oil into a clean container.
4. Close screw.
5. Using the equipment and chemicals in the MTU test kit, analyze the engine oil for:
 - Dispersion capability (spot test);
 - Water content;
 - Dilution by fuel.



Engine oil – Sample extraction and analysis (engines with switchable oil filter)

1. With the engine running at operating temperature, open screw on flange of centrifugal oil filter by 1 to 2 rotations.
2. Drain approx. 2 liters engine oil to flush out the oil sludge.
3. Drain approx. 1 liter engine oil into a clean container.
4. Close screw.
5. Using the equipment and chemicals in the MTU test kit, analyze the engine oil for:
 - Dispersion capability (spot test);
 - Water content;
 - Dilution by fuel.



6.14 Oil Filtration / Cooling

6.14.1 Engine oil filter – Replacement

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Filter wrench	F30379104	
Engine oil		
Oil filter	(→ Spare Parts Catalog)	

DANGER



Rotating and moving engine parts.

Risk of crushing, danger of parts of the body being caught or pulled in!

- Only run the engine at low power. Keep away from the engine's danger zone.

WARNING



High level of engine noise when the engine is running.

Risk of damage to hearing!

- Wear ear protectors.

WARNING



Hot oil.

Oil can contain combustion residues which are harmful to health.

Risk of injury and poisoning!

- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

NOTICE



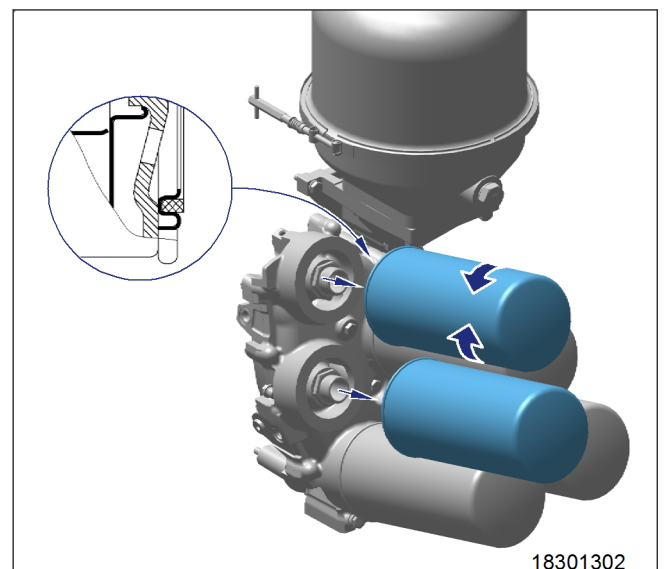
Damage to component!

Severe material damage!

- For filter replacement with the engine running, operate the engine at low engine load.
- The filter which is to be replaced must be cut out for a brief period only.

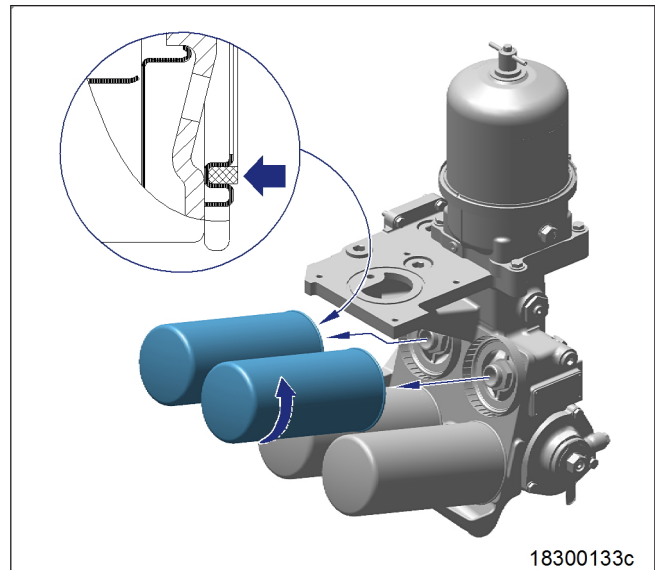
Engine oil filter – Replacement

1. Stop engine (→ Page 86) and disable engine start.
2. Unscrew oil filter using filter wrench.
3. Clean sealing surface on connecting piece.
4. Check condition of new oil filter sealing ring and moisten it with oil.
5. Screw on and tighten new oil filter by hand.
6. Replace other oil filters in the same way.
7. Turn engine with starting system after every oil change and filter replacement (→ Page 164).
8. Check oil level (→ Page 218).



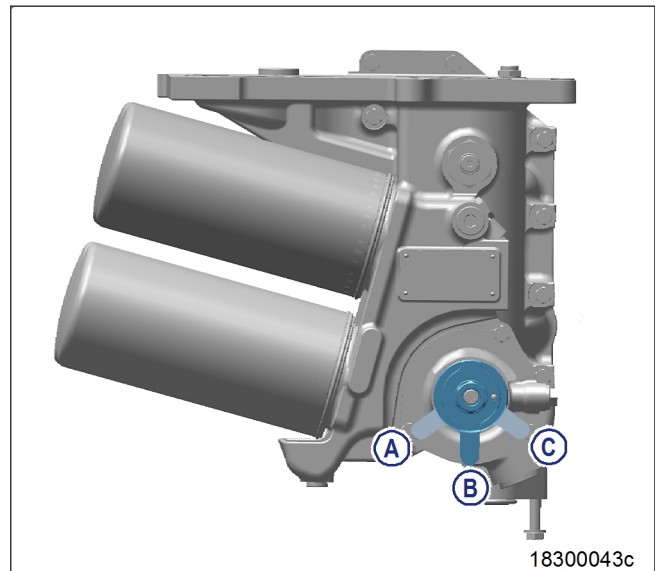
Oil filter with diverter (option): Oil filter replacement with the engine stopped

1. Stop engine (→ Page 86) and disable engine start.
2. Unscrew oil filter using oil filter wrench.
3. Clean sealing surface on connecting piece.
4. Check condition of new oil filter sealing ring and moisten it with oil.
5. Fit SOLAS shield (→ Page 16).
6. Screw on and tighten new oil filter by hand.
7. Replace other oil filters in the same way.
8. Turn engine with starting system after every oil change and filter replacement (→ Page 164).
9. Check oil level (→ Page 218).

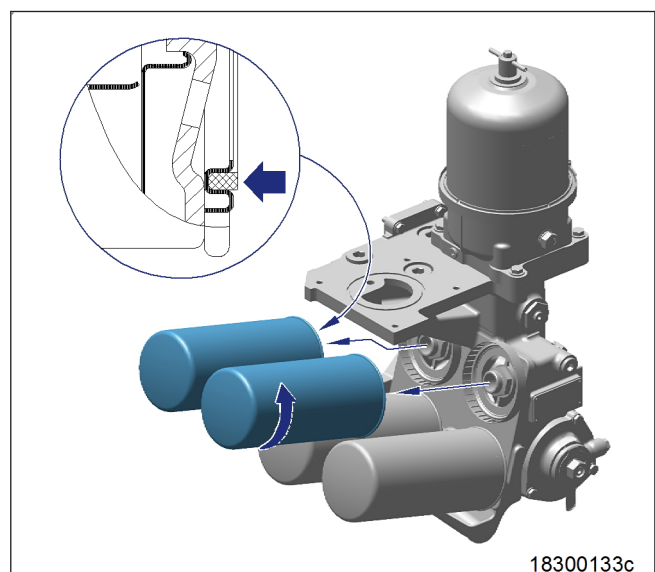


Oil filter with diverter (option): Oil filter replacement with the engine running

1. To cut out the filter to be replaced, set the three-way cock to the corresponding position.
 - Position A: Lower filters cut out
 - Position B: Both filters cut in (normal operating position)
 - Position C: Upper filters cut out.



2. Unscrew oil filter using oil filter wrench.
3. Clean sealing surface on connecting piece.
4. Check condition of new oil filter sealing ring and moisten it with oil.
5. Fit SOLAS shield (→ Page 16).
6. Screw on and tighten new oil filter by hand.
7. Replace other oil filters in the same way.
8. Check oil level (→ Page 218).



6.14.2 Oil indicator filter – Cleaning and check

Preconditions

- ☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Cleaning agent (Snow-White 11-0)	40460	1
Cleaning agent (Hakupur 312)	30390	1
Engine oil		
Strainer	(→ Spare Parts Catalog)	
Square-section ring	(→ Spare Parts Catalog)	
O-ring	(→ Spare Parts Catalog)	

WARNING



- Hot oil.
Oil can contain combustion residues which are harmful to health.
Risk of injury and poisoning!
- Wear protective clothing, gloves, and goggles / safety mask.
 - Avoid contact with skin.
 - Do not inhale oil vapor.

WARNING



- Compressed air gun ejects a jet of pressurized air.
Risk of injury to eyes and damage to hearing, risk of rupturing internal organs!
- Never direct air jet at people.
 - Always wear safety goggles/face mask and ear defenders.

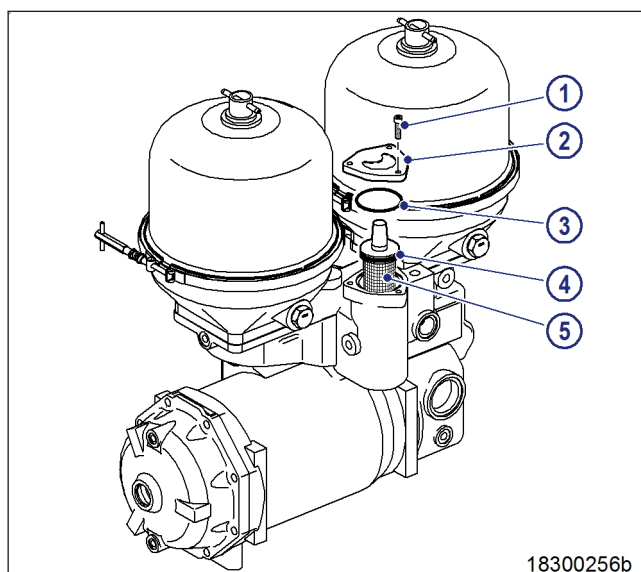
NOTICE



- Inappropriate cleaning tool.
Risk of damage to component!
- Observe manufacturer's instructions.
 - Use appropriate cleaning tool.

Removing strainer

1. Clean oil indicator filter before disassembling it.
2. Remove screws (1).
3. Take off cover (2) with O-ring (3).
4. Take strainer (5) from filter housing.



Checking strainer

Item	Findings	Action
Strainer	Metallic residues	• Clean • Monitor engine operation • Check strainer daily • Contact Service
Strainer	Damaged	Fit new part
Square-section ring	Damaged	Fit new part
O-ring	Damaged	Fit new part

Cleaning strainer

1. Wash strainer (5) with cleaner.
2. Remove stubborn deposits with soft brush.
3. Blow out strainer (5) with compressed air from inside.

Installing strainer

1. Coat square-section ring (4) on strainer (5) with engine oil and install strainer (5).
2. Coat O-ring (3) with engine oil and fit in filter housing.
3. Fit cover (2) and secure with screws (1) and washers.

6.14.3 Centrifugal oil filter – Cleaning and filter sleeve replacement

Preconditions

- ☒ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 6-50 Nm	F30027336	1
Filter wrench	F30379104	1
Cleaner Hakutex 60		
Grease (Kluthe Hakuform 30-10/emulsifier)	X00029933	1
Filter sleeve	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	

WARNING



- Hot oil.
Oil can contain combustion residues which are harmful to health.
- Risk of injury and poisoning!**
- Wear protective clothing, gloves, and goggles / safety mask.
 - Avoid contact with skin.
 - Do not inhale oil vapor.

WARNING



- Compressed air gun ejects a jet of pressurized air.
- Risk of injury to eyes and damage to hearing, risk of rupturing internal organs!**
- Never direct air jet at people.
 - Always wear safety goggles/face mask and ear defenders.

Centrifugal oil filter – Cleaning and filter sleeve replacement

1. Remove clamp (14).
2. Release Tommy nut (2) and take off cover (1).
3. Carefully lift rotor (11), allow oil to drain and remove from housing.
4. Holding the rotor (11) firmly, release rotor cover nut (3).
5. Take off rotor cover (4).
6. Remove filter sleeve (6).
7. Measure layer thickness of oil residues on filter sleeve (6).

Result: If the oil residues exceed the maximum layer thickness of 45 mm, shorten the maintenance interval.

8. Disassemble rotor tube (7), conical disk (8) and rotor base (10).
9. Wash rotor cover (4), rotor tube (7), conical disk (8) and rotor base (10) with cold cleaner.
10. Blow out with compressed air.
11. Check sealing ring (9), fit new one if necessary.
12. Assemble rotor tube (7), conical disk (8) and rotor base (10) with sealing ring (9).
13. Insert new filter sleeve (6) in rotor tube (7) with the smooth paper surface facing the outer wall.
14. Check sealing ring (5), fit new one if necessary.
15. Mount rotor cover (4) with sealing ring (5).
16. Tighten rotor cover nut (3) with torque wrench to the specified torque.

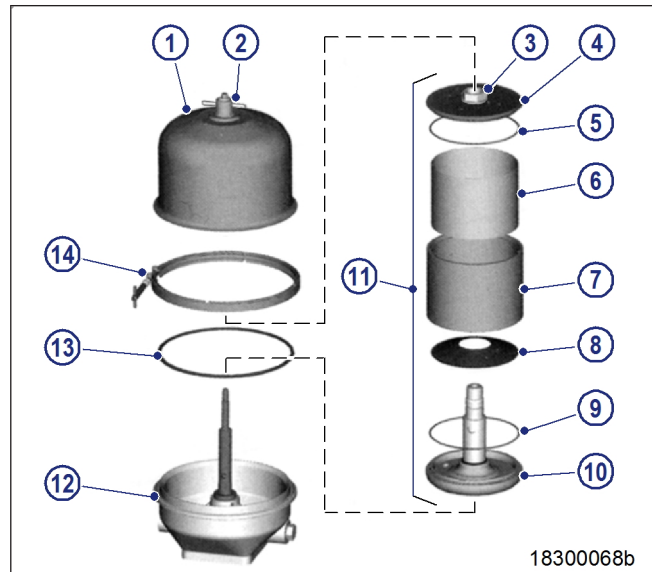
Name	Size	Type	Lubricant	Value/Standard
Nut		Tightening torque		35 Nm to 45 Nm

17. Place rotor (11) in housing (12) and check for ease of movement.
18. Check sealing ring (13), fit new one if necessary.
19. Fit sealing ring (13) on housing (12).
20. Fit hood (1).
21. Tighten Tommy nut (2) by hand.
22. Install clamp (14) and tighten with torque wrench to the specified torque.

Name	Size	Type	Lubricant	Value/Standard
Clamp		Tightening torque		8 Nm to 10 Nm

23. Tighten cover nut (2) with torque wrench to the specified torque.

Name	Size	Type	Lubricant	Value/Standard
Screw		Tightening torque		5 Nm to 7 Nm



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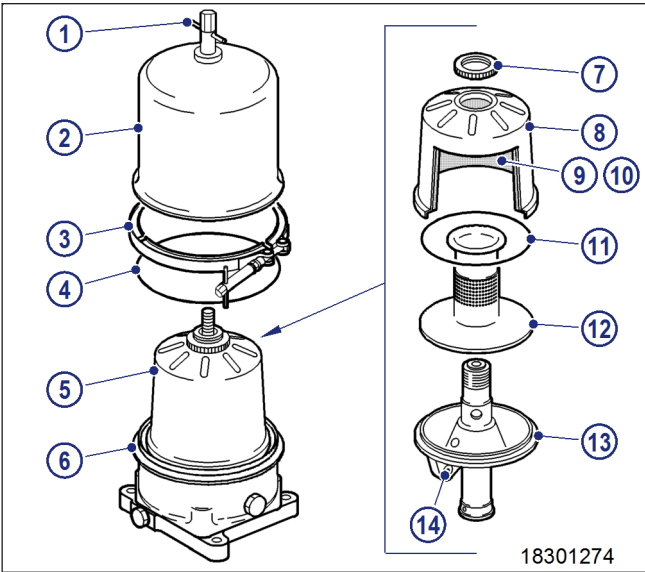
Cleaning centrifugal oil filter and replacing filter sleeve (engines with switchable oil filter)

1. Undo and remove screw (1).
2. Remove clamp (3) and take off hood (2).
3. Carefully remove rotor (5) from housing.
4. Hold rotor assembly (5) firmly in position with filter wrench and undo knurled nut (7).
5. Take off rotor cap (8).
6. Remove filter sleeve (9), stiffener plate (10) and sealing ring (11).
7. Measure thickness of oil residues on filter sleeve.
8. If maximum layer thickness of oil residues exceeds 30 mm, shorten maintenance interval.
9. Remove standpipe (12) from lower rotor section (13).
10. Wash hood (2), rotor cap (8), stiffener plate (10), standpipe (12), lower rotor section (13) and nozzles (14) with cleaner and blow out with compressed air. Do not use sharp objects for cleaning.
11. Check nozzles (14) for obstructions.
12. Push standpipe (12) onto rotor lower section (13).
13. Insert new filter sleeve (9) with stiffener plate (10) into rotor cap (8), ensuring that the smooth surface of the filter sleeve (9) faces the rotor cap (8).
14. Check sealing ring (11), replace if necessary. Coat sealing ring with grease and insert in groove of rotor cap (8).
15. Place rotor cap (8) onto standpipe (12).
16. Hold rotor assembly (5) firmly in position with filter wrench and tighten knurled nut (7).
17. Lubricate bearings of rotor (5), insert in housing (6) and check for ease of movement.
18. Check sealing ring (4), replace if necessary. Fit sealing ring on housing (6).
19. Fit hood (2).
20. Tighten screw (1) by hand.
21. Install clamp (3) and tighten to specified torque using a torque wrench:

Name	Size	Type	Lubricant	Value/Standard
Clamp		Tightening torque		6 Nm + 1 Nm

22. Tighten screw (1) to specified torque using a torque wrench:

Name	Size	Type	Lubricant	Value/Standard
Screw		Tightening torque		6 Nm + 1 Nm

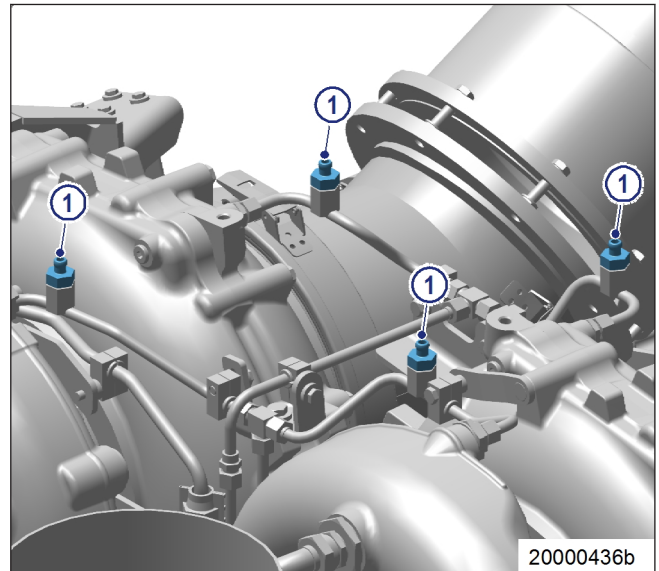


6.15 Coolant Circuit, General, High-Temperature Circuit

6.15.1 Drain and vent points

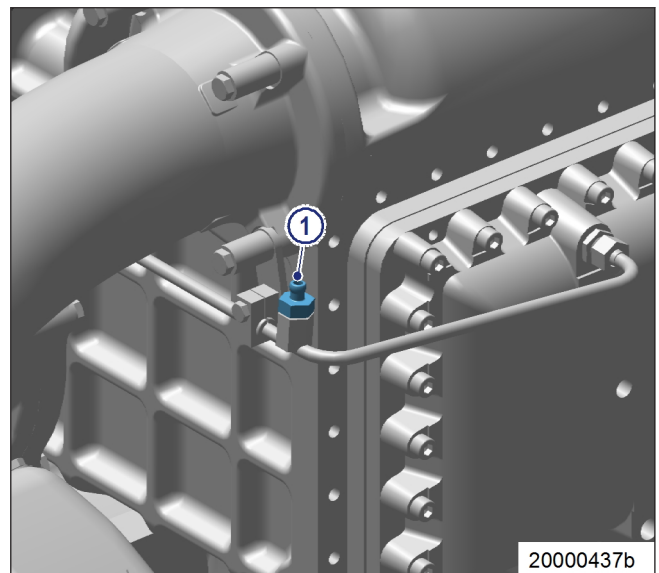
Coolant lines on ETC

1 Vent point

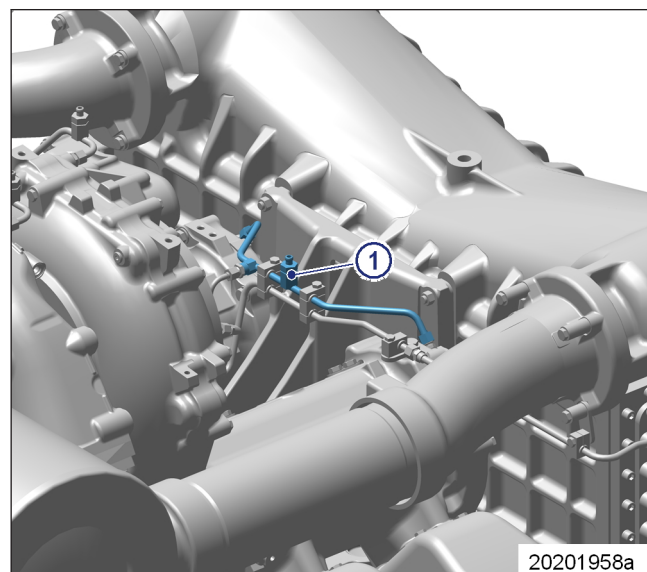


Coolant line to intercooler

1 Vent point

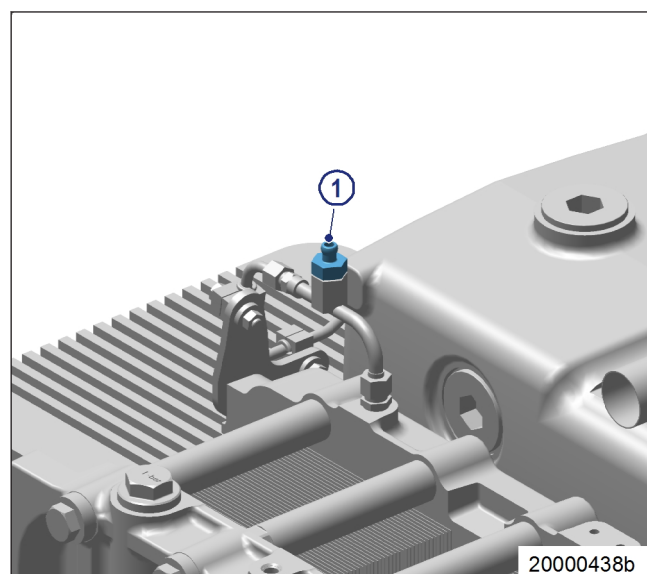


1 Vent point



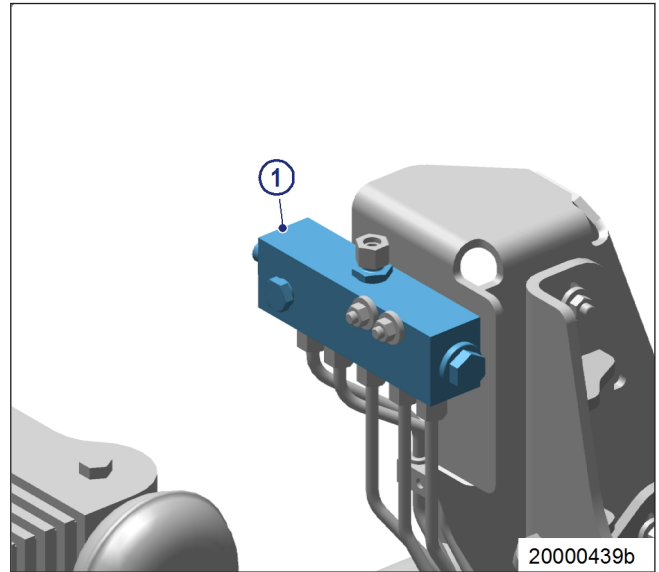
Coolant line to raw water cooler

1 Vent point



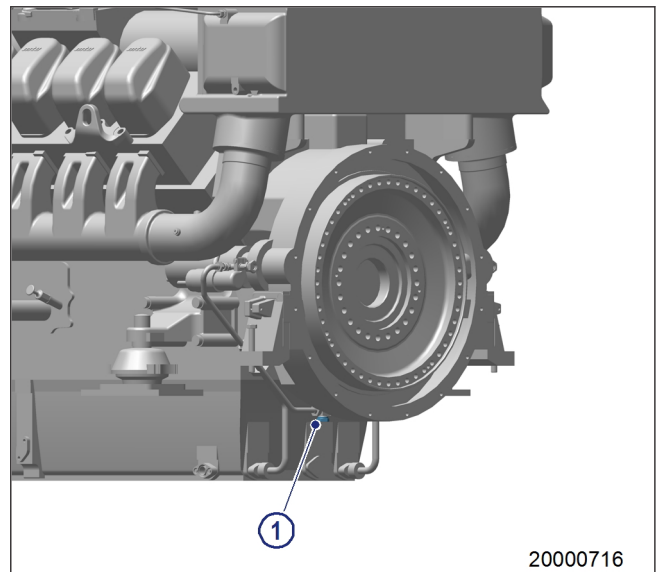
Vent line – Distribution cross

- 1 Vent point



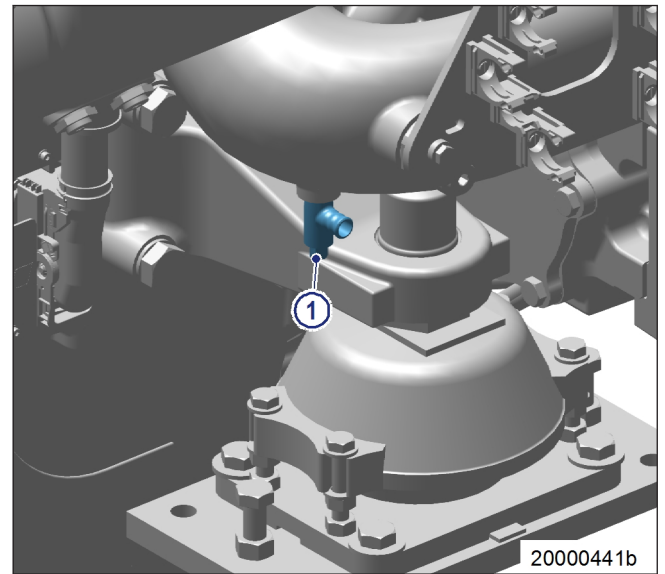
Coolant drain point, engine driving end

- 1 Drain point



Coolant drain point, engine free end

- 1 Drain point



6.15.2 Engine coolant level – Check

Preconditions

- ☑ Engine is stopped and starting disabled.
- ☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

WARNING



Coolant is hot and under pressure.

Risk of injury and scalding!

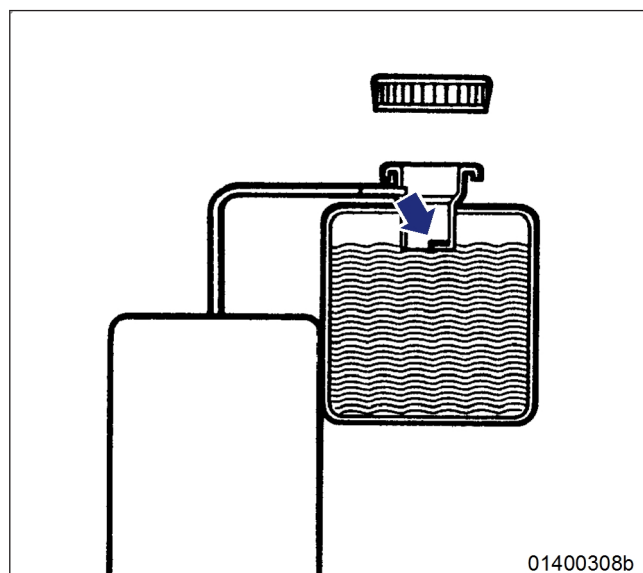
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Checking engine coolant level at filler neck:

1. Turn breather valve on coolant expansion tank (for engines with remote heat exchanger: the expansion tank is part of the remote cooling system) counterclockwise up to the first stop and allow pressure to escape.
2. Continue to turn breather valve counterclockwise and remove.
3. Check coolant level (coolant must be visible at the bottom edge of the cast-in eye in the filler neck).

Checking engine coolant level at external cooler:

1. Check coolant level (coolant must be visible at marker plate).
2. Top up with treated coolant as necessary (→ Page 239).
3. Check and clean breather valve.
4. Set breather valve onto filler neck and close it.



Checking engine coolant level by means of level sensor:

1. Switch on engine control system and check readings on the display.
2. Top up with treated coolant as necessary (→ Page 239).

6.15.3 Engine coolant – Change

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Coolant		

Engine coolant change

- 1. Drain engine coolant (→ Page 236).
- 2. Fill with engine coolant (→ Page 239).

6.15.4 Engine coolant – Draining

Preconditions

- ☑ Engine is stopped and starting disabled.

WARNING



Coolant is hot and under pressure.

Risk of injury and scalding!

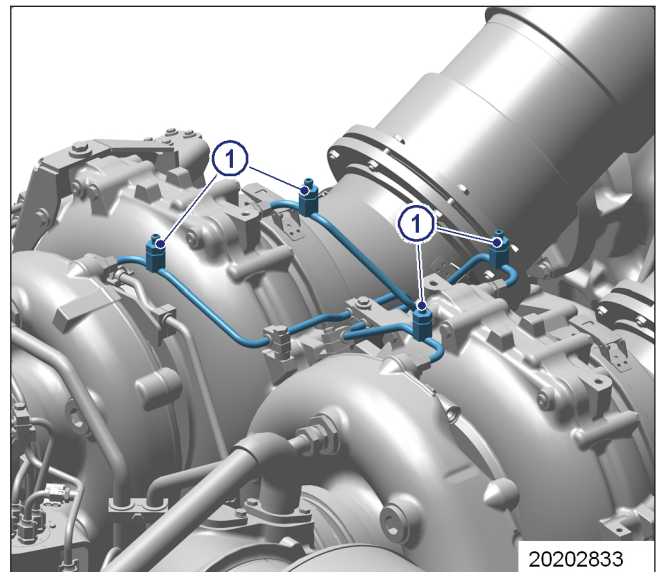
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Preparatory steps

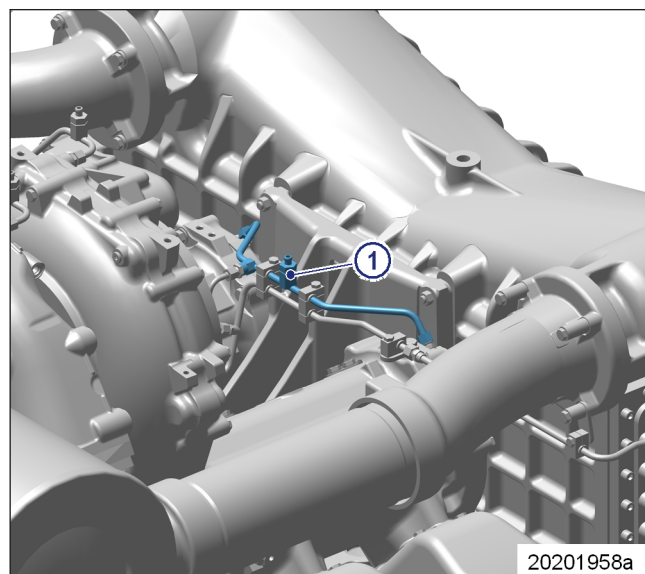
1. Provide an appropriate container to drain the coolant into.
2. Switch off preheating unit.

Engine coolant – Draining

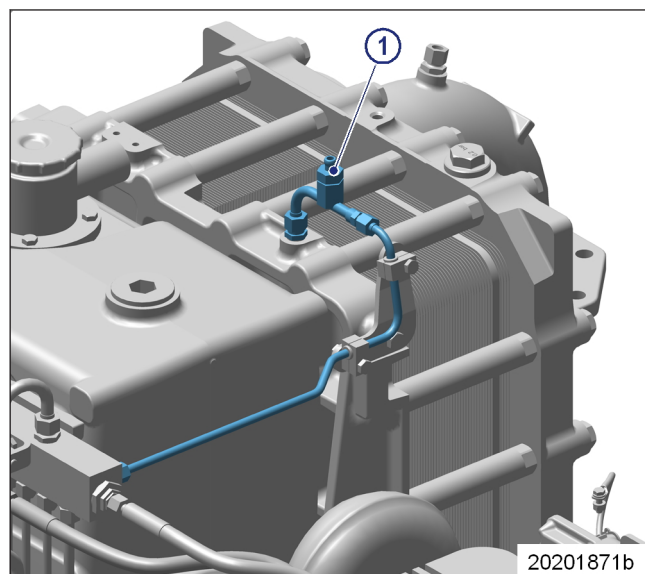
1. Turn breather valve on expansion tank (for engines with remote heat exchanger: the expansion tank is part of the remote cooling system) counterclockwise up to the first stop and allow pressure to escape.
2. Continue to turn breather valve counterclockwise and remove.
3. Draw off precipitated corrosion inhibitor oil from the expansion tank through filler neck.
4. Open vent valves on carrier housing (1).



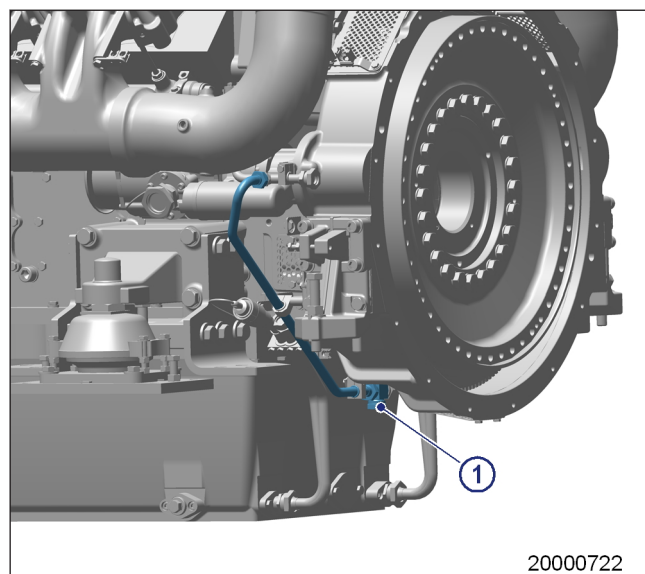
5. Open vent valve on exhaust pipework (driving end) (1).



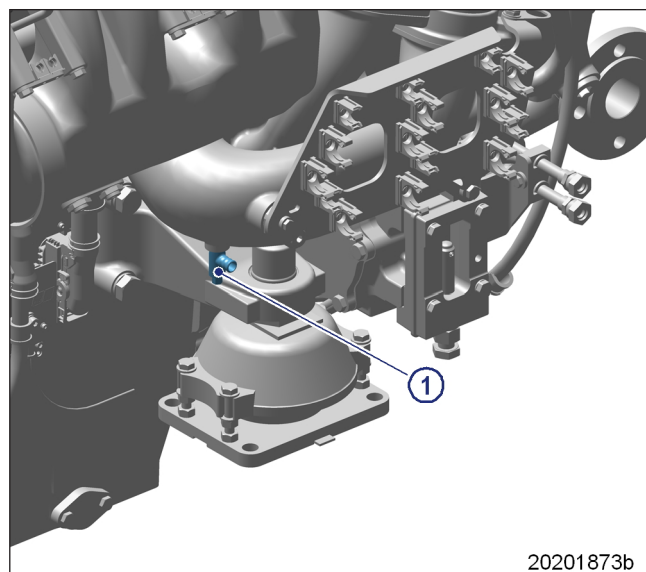
6. Open vent valve on seawater cooler (1) (or remote heat exchanger).



7. Open drain plug (1) and drain coolant at crankcase.



8. Open drain screw (1) and drain coolant on coolant pump elbow.



Final steps

1. Seal all open vent and drain points.
2. Set breather valve onto filler neck and close it.

6.15.5 Engine coolant – Filling

Preconditions

- ☑ Engine is stopped and starting disabled.
- ☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Engine coolant		

WARNING



Coolant is hot and under pressure.

Risk of injury and scalding!

- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

NOTICE



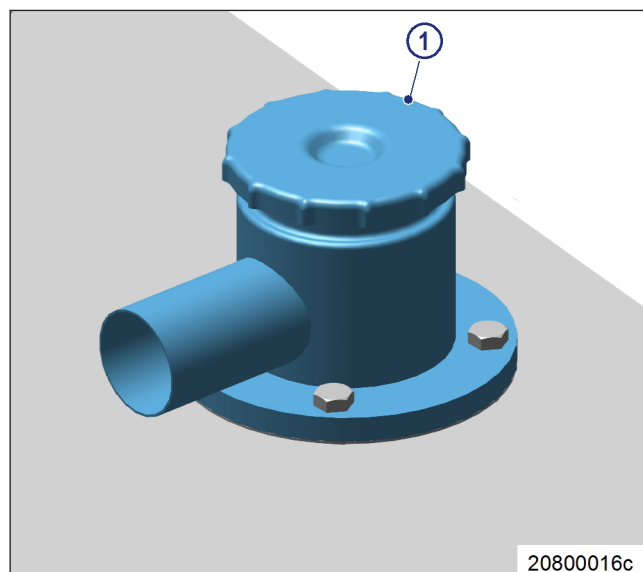
Cold coolant in hot engine can cause thermal stress.

Possible formation of cracks in the engine!

- Fill / top up coolant only into cold engine.

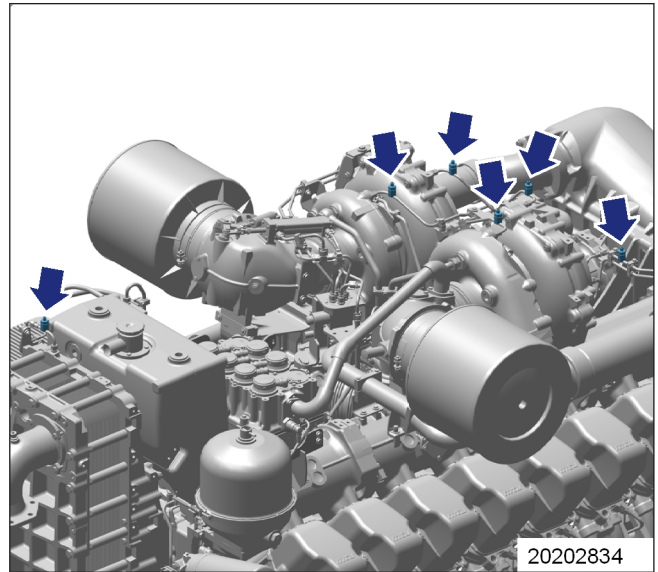
Preparatory steps

1. Turn breather valve on expansion tank (for engines with remote heat exchanger: the expansion tank is part of the remote cooling system) counterclockwise up to the first stop and allow pressure to escape.
2. Continue to turn breather valve counterclockwise and remove.



Filling coolant through filler neck

1. Open vent points on charge-air cooler, exhaust turbochargers and on plate-core heat exchanger (arrows).
2. Fill coolant through the filler neck of the expansion tank (for engines with remote heat exchanger: the expansion tank is part of the remote cooling system) until the coolant level at the top edge of the filler neck remains constant.
3. When coolant emerges from the vent points, close vent points one by one, proceeding from the lowest point upwards.
4. Check proper condition of breather valve and clean sealing faces if required.
5. Set breather valve onto filler neck and turn until the first stop.
6. Start engine (→ Page 77).
7. After 10 seconds of running the engine without load, shut down the engine (→ Page 86).
8. Turn breather valve counterclockwise and remove.
9. Check coolant level (→ Page 234) and top up engine coolant as required:
 - a) Repeat the steps from starting the engine (→ Step 6) until no coolant needs to be topped up any more.
 - b) Check proper condition of breather valve and clean sealing faces if required.
 - c) Set breather valve onto filler neck and close it.



Final steps

1. Start the engine and run it without load for some minutes.
2. Check coolant level (→ Page 234) and top up engine coolant as required.

6.15.6 HT coolant pump – Relief bore check

DANGER



Rotating and moving engine parts.

Risk of crushing, danger of parts of the body being caught or pulled in!

- Only run the engine at low power. Keep away from the engine's danger zone.

WARNING



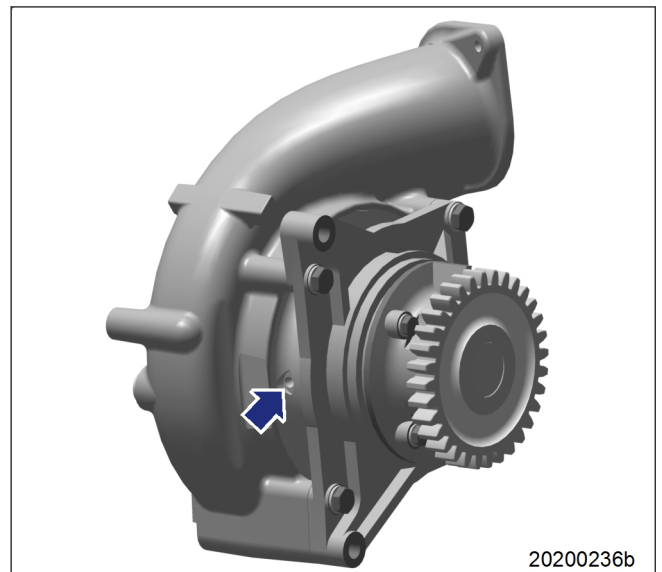
High level of engine noise when the engine is running.

Risk of damage to hearing!

- Wear ear protectors.

HT coolant pump – Relief bore check

1. Check relief bore for oil and coolant discharge.
2. Stop engine (→ Operating instructions electronic system) and disable engine start.
3. Clean the relief bore with a wire if it is dirty.
 - Permissible engine coolant discharge: up to 10 drops per hour;
 - Permissible oil discharge: up to 5 drops per hour.
4. If discharge exceeds the specified limits, contact Service.



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6.15.7 Engine coolant – Sample extraction and analysis

Preconditions

- ☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
MTU test kit	5605892099/00	1

DANGER



Rotating and moving engine parts.

Risk of crushing, danger of parts of the body being caught or pulled in!

- Only run the engine at low power. Keep away from the engine's danger zone.

WARNING



Coolant is hot and under pressure.

Risk of injury and scalding!

- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

WARNING



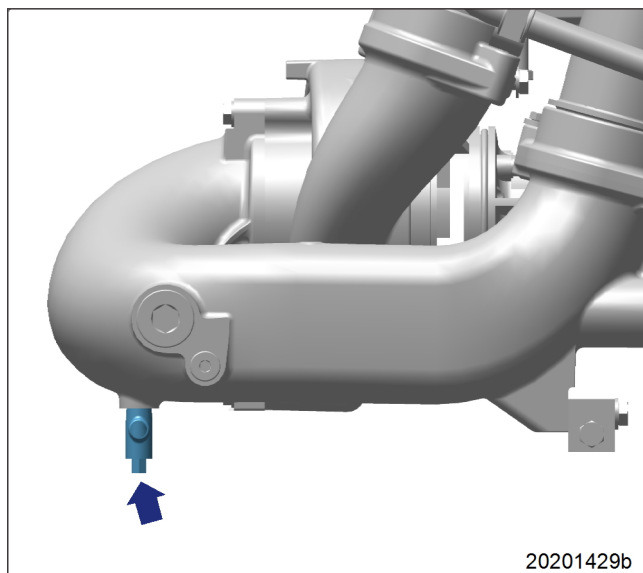
High level of engine noise when the engine is running.

Risk of damage to hearing!

- Wear ear protectors.

Engine coolant – Sample extraction and analysis

1. Open drain valve (arrow) with the engine running.
2. Flush sampling point by draining approx. 1 liter coolant.
3. Drain approx. 1 liter of engine coolant into a clean container.
4. Close drain valve (arrow).
5. Use the equipment and chemicals of the MTU test kit to check the coolant for:
 - Antifreeze concentration
 - Corrosion inhibitor concentration
 - pH value
6. Engine coolant change intervals (→ MTU Fluids and Lubricants Specifications).



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6.15.8 Engine coolant filter – Replacement

Preconditions

- ☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Filter wrench	F30379104	1
Engine oil		
Engine coolant filter	(→ Spare Parts Catalog)	

WARNING



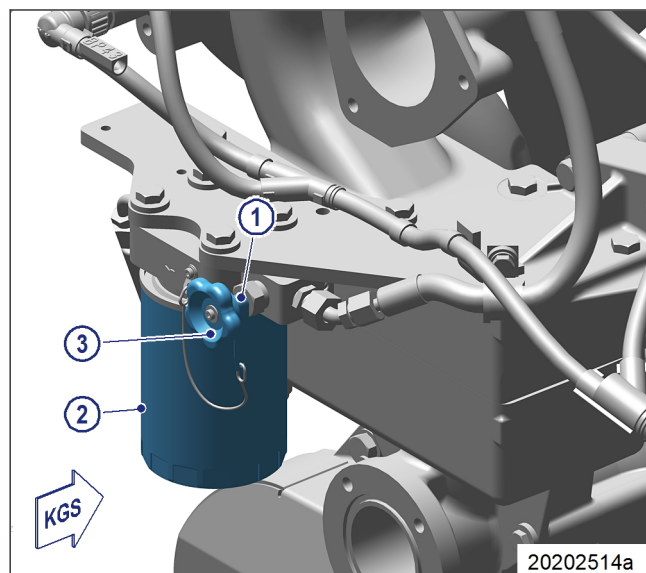
Coolant is hot and under pressure.

Risk of injury and scalding!

- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

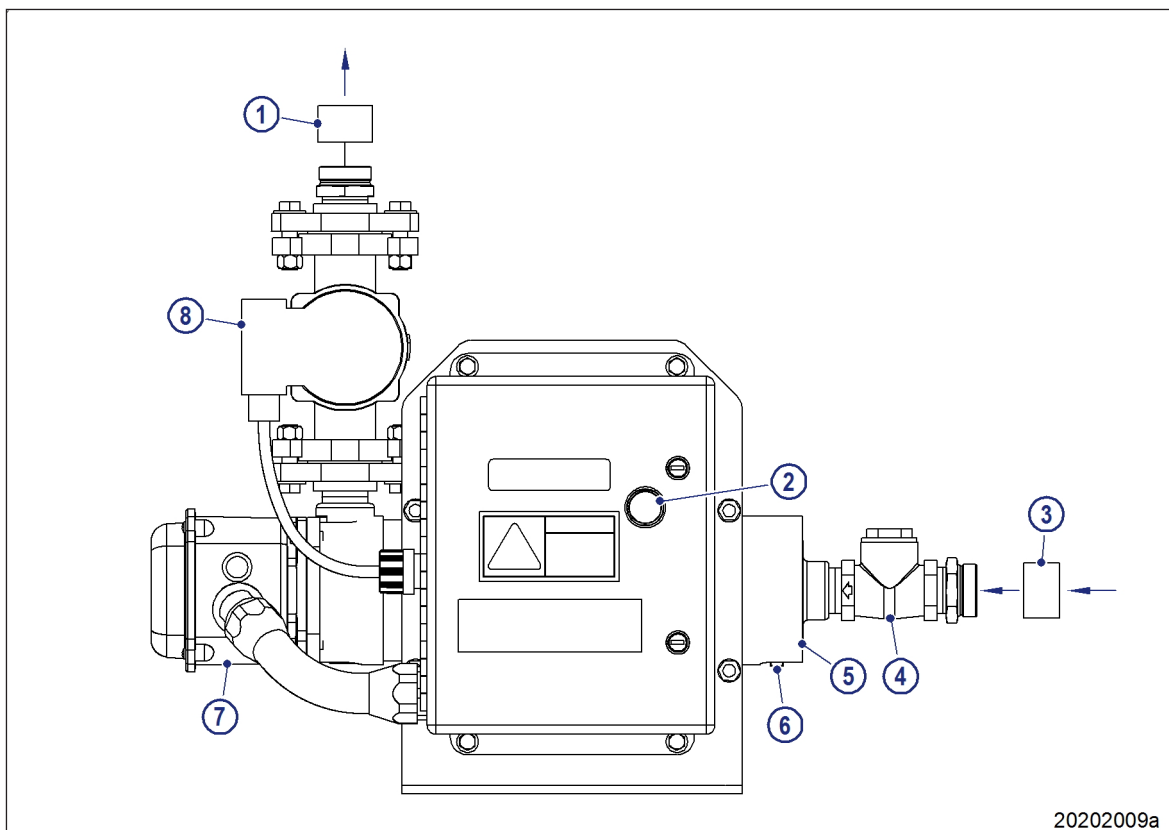
Engine coolant filter – Replacement

1. Remove locking device (1).
2. Close shut-off cock (3).
3. Remove engine coolant filter (2) with filter wrench.
4. Clean sealing surface on connecting piece.
5. Coat seal on new engine coolant filter (2) with engine oil.
6. Screw on engine coolant filter (2) and tighten hand-tight.
7. Open shut-off cock (3).
8. Install locking device (1).



6.15.9 Preheating unit

Hotstart preheating unit



- | | | |
|-----------------------------|--------------------------|--------------------|
| 1 Plastic cap (drain) | 4 Shutoff valve | 7 Thermostat |
| 2 On/Off switch | 5 Continuous flow heater | 8 Circulation pump |
| 3 Plastic cap (supply line) | 6 Vent valve | |

Cylinders	Nominal voltage / frequency	Heating power kW
12 V	230 V / 50 Hz	9
	400 V / 50 Hz	9
	230 V / 60 Hz	9
	440 V / 60 Hz	9
16 V	230 V / 50 Hz	12
	400 V / 50 Hz	12
	230 V / 60 Hz	12
	440 V / 60 Hz	12

Function

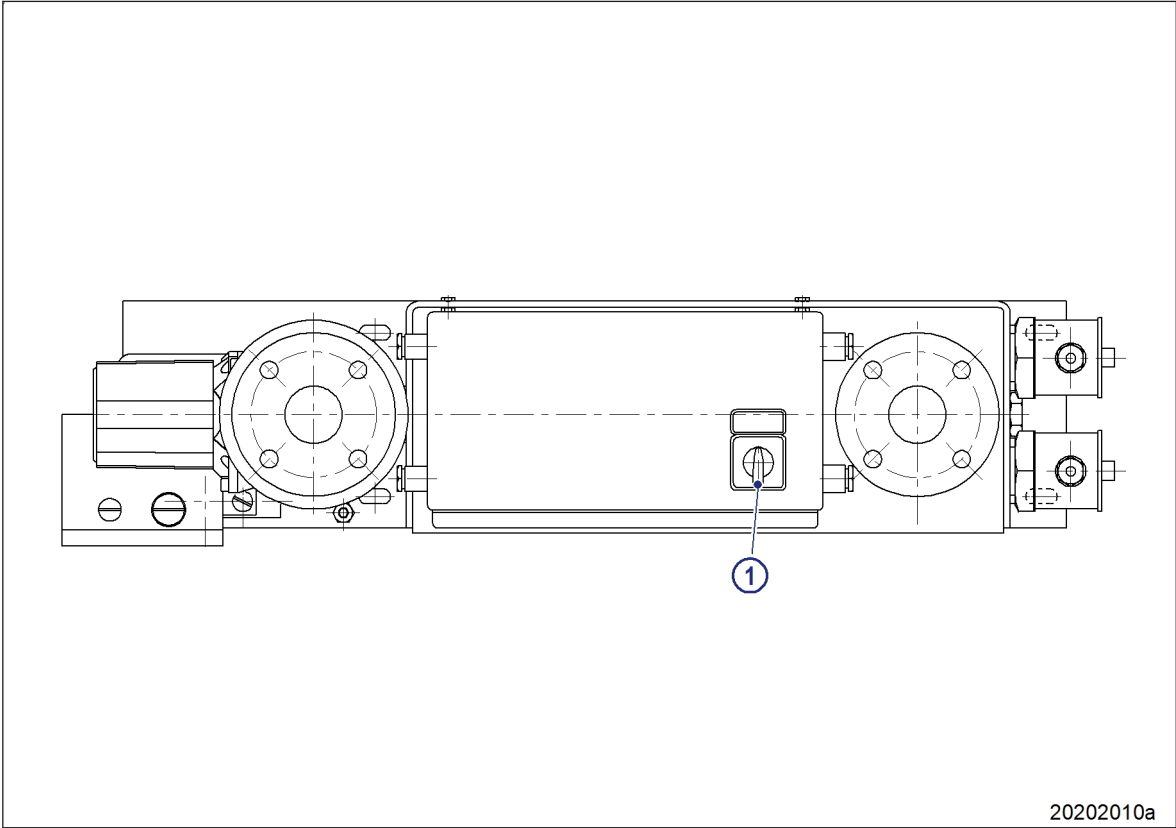
The preheating unit is intended to warm up the engine coolant. The circulating pump (8) ensures the circulation of the preheated engine coolant through the engine.

The continuous flow heater (5) comprises a heating element. The thermostat (7) switches off the preheating unit via contactors when the engine coolant temperature has reached the setting of the thermostat (7).

In the event of excessive coolant temperature, the temperature limiter of the thermostat (7) opens the control loop. The preheating unit is switched off.

The unit must be reset manually after the fault has been rectified.

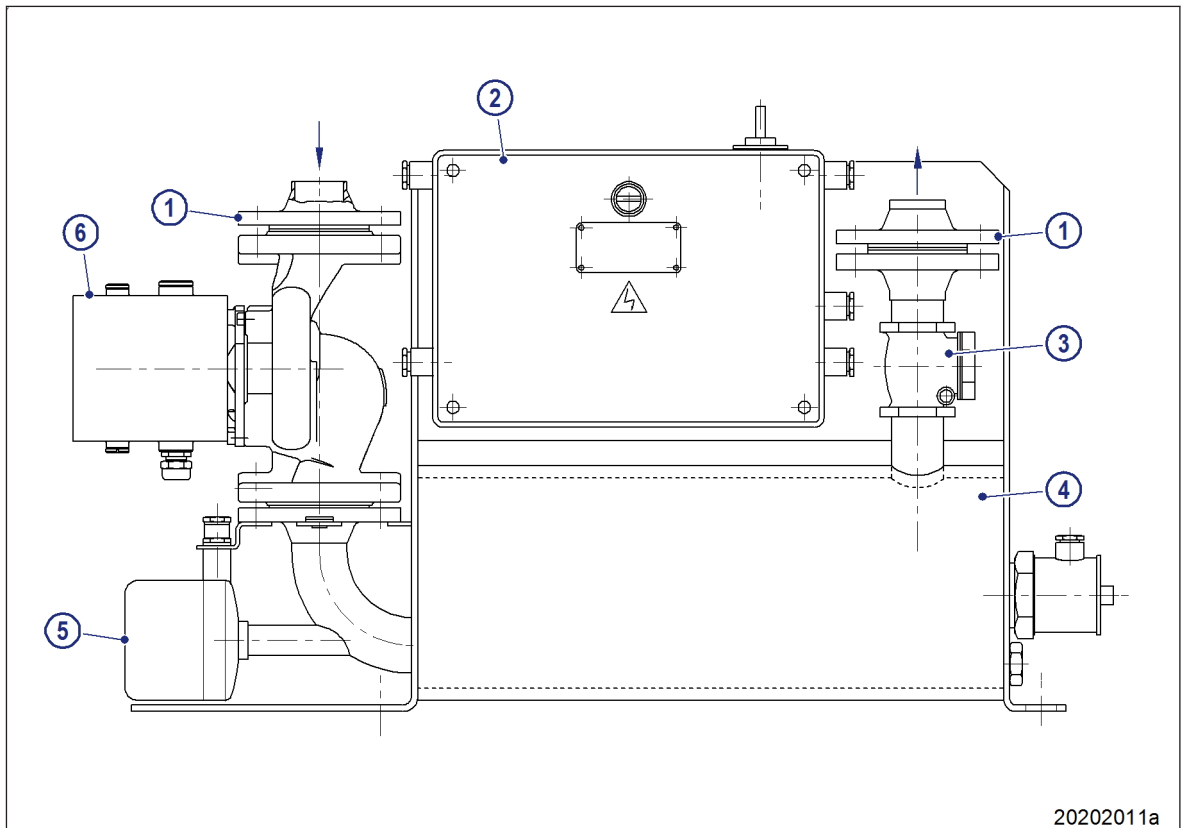
Hilzinger preheating unit



1 On/Off switch

Cylinders	Nominal voltage / frequency	Heating power kW
12 V and 16 V	230 V / 50 Hz	9
	400 V / 50 Hz	9
	230 V / 60 Hz	9
	440 V / 60 Hz	9

Hilzinger preheating unit, side view



- | | | |
|------------------------------|--------------------------|--------------------|
| 1 Flange (supply and return) | 3 Non-return flap | 5 Thermostat |
| 2 Junction box | 4 Continuous flow heater | 6 Circulation pump |

Function

The preheating unit is intended to warm up the engine coolant. The circulation pump (6) ensures the circulation of the preheated coolant through the engine.

The continuous flow heater (4) comprises a heating element. A non-return flap (3) prevents coolant from flowing through the preheating unit when the engine is running.

When the coolant temperature has reached the value of the thermostat setting (5), the thermostat (5) switches off the preheating unit via contactors.

In the event of excessive coolant temperature, the temperature limiter of the thermostat (5) opens the control loop. The preheater is switched off.

The unit must be reset manually after the fault has been rectified.

6.15.10 Preheater – Overhaul

Preconditions

- ☑ Engine is stopped and starting disabled.

DANGER



Electric voltage supply for operation.

Danger of burns and fatal electric shock!

- Make certain that the power supply to the product is switched off before starting work. Secure against unintentional switching on!

WARNING



Coolant is hot and under pressure.

Risk of injury and scalding!

- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Overhauling preheater

1. Disconnect power supply to heating element.
2. Close shut-off valve in coolant line before and after preheater.
3. Drain coolant at drain valve into a clean container.
4. Clean and flush coolant circuit.
5. Check hoses for cracks and other damage. Replace as necessary.
6. Check wiring for damage and overheating.
7. Remove heating element.
8. Clean heating element and tank.
9. Remove pump from volute (if applicable) and check for residues in impeller and lines.
10. Install heating element.
11. Connect heating element to power supply.
12. Connect hoses and open shut-off valves.
13. Check preheater for leakage and correct operation (→ Page 248).
14. Check coolant level (→ Page 234).

6.15.11 Preheater – Function and leak-tightness check

Preconditions

- ☒ Preheater is switched on.

WARNING



Coolant is hot and highly pressurized.

Risk of injury! Risk of scalding!

- Allow engine to cool down.
- Wear protective clothing, protective gloves, and safety glasses / facial protection.

Checking operation

Note: The coolant temperature must correlate to the control range of the thermostat when the preheater is ready for operation.

1. Check coolant preheating temperature.
2. Set the thermostat accordingly if the temperatures are not in the control range.

Checking for leaks

1. Check leak-tightness at coolant inlet and outlet.
2. Tighten any leaking unions.

6.16 Raw Water Pump with Connections

6.16.1 Raw water pump – Relief bore check

DANGER



Rotating and moving engine parts.

Risk of crushing, danger of parts of the body being caught or pulled in!

- Only run the engine at low power. Keep away from the engine's danger zone.

WARNING



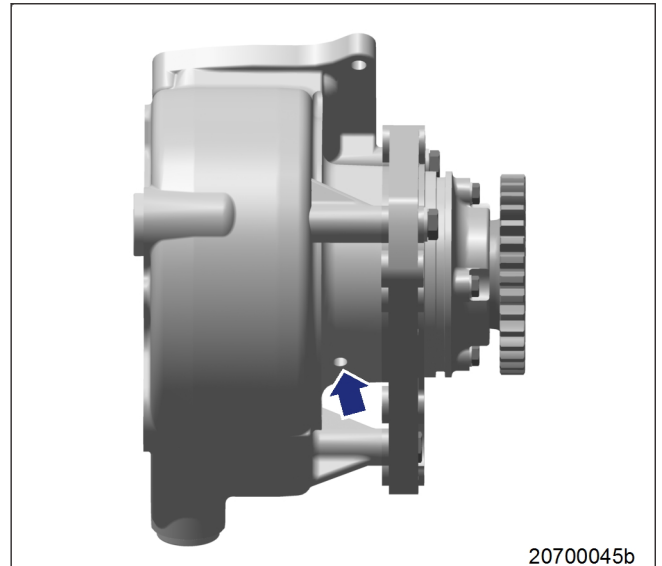
High level of engine noise when the engine is running.

Risk of damage to hearing!

- Wear ear protectors.

Raw water pump – Relief bore check

1. Check relief bore for oil and coolant discharge.
2. Stop engine (→ Page 86) and disable engine start.
3. Clean the relief bore with a wire if it is dirty.
 - Permissible engine coolant discharge: up to 10 drops per hour;
 - Permissible oil discharge: up to 5 drops per hour.
4. If discharge exceeds the specified limits, contact Service.



20700045b

6.17 Engine Mounting / Support

6.17.1 Engine mounting - Check

Engine mounting – Check

Item	Findings	Action
Visually inspect mounts.	• Damage • Brittleness • Deformation • Crack formation • Swelling visible	Replace (contact Service).

6.18 Battery-Charging Generator

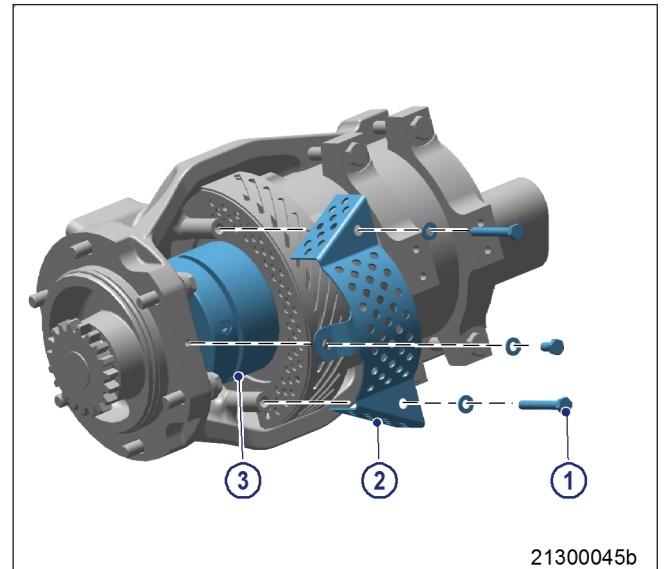
6.18.1 Battery-charging generator drive – Coupling condition check

Preconditions

- ☑ Engine is stopped and starting disabled.

Battery-charging generator drive – Coupling condition check

1. Remove screws (1).
2. Remove protective cover (2).
3. Check resilient coupling (3) for cracks and plastic deformation.
4. If there is serious deformation or crack formation, contact Service.
5. Install protective cover (2) with screws (1).



6.19 Auxiliary PTO

6.19.1 Bilge pump - Relief bore check

DANGER



Rotating and moving engine parts.

Risk of crushing, danger of parts of the body being caught or pulled in!

- Only run the engine at low power. Keep away from the engine's danger zone.

WARNING



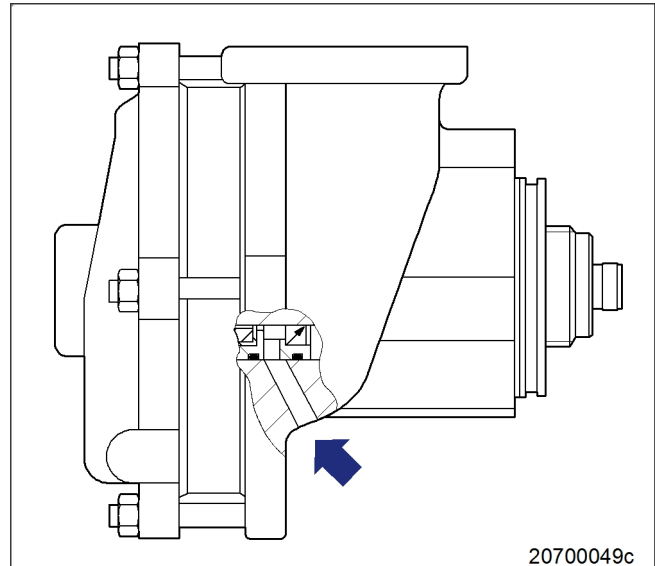
High level of engine noise when the engine is running.

Risk of damage to hearing!

- Wear ear protectors.

Bilge pump - Relief bore check

1. Check relief bores for oil and water discharge.
2. Stop engine (→ Page 86) and disable engine start.
3. Clean relief bores with a wire if dirty.
 - Permissible water discharge: up to 10 drops per hour;
 - Permissible oil discharge: up to 5 drops per hour
4. If discharge exceeds the specified limits: Contact Service.



20700049c

6.20 Fuel Supply System

6.20.1 Water drain valve - Check

Water drain valve – Check

1. Open water drain valve.
2. Check water outlet for obstructions.
3. Close water drain valve.

6.20.2 Differential pressure gauge – Check

WARNING



Fuels are combustible.

Risk of fire and explosion!

- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Checking differential pressure gauge

1. Switch on fuel treatment system (→ Page 84).
2. Set the alarm points at the differential pressure gauge to zero.

Result: Alarm is initiated with preset delay.

3. Reset the alarm points at the differential pressure gauge to the specified values.

6.20.3 Water level probe (3-in-1 rod electrode) – Check

Preconditions

- ☑ System is put out of operation and emptied.

WARNING



Fuels are combustible.

Risk of fire and explosion!

- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Checking water level probe (3-in-1 rod electrode)

1. Disconnect connector from water level probe.
 2. Unscrew water level probe.
 3. Disconnect connector from water level probe.
 4. Immerse water level probe into a tank filled with water until water level reaches the thread.
 5. Switch system on.
- Result: Water drain valve opens.
6. Leave water level probe in tank.
- Result: Alarm must be triggered with the preset delay.
7. Switch off the system.
 8. Disconnect connector from water level probe.
 9. Remove water level probe from tank.
 10. Screw in water level probe.
 11. Connect connector for water level probe.
 12. Fill and vent the system then put it into operation.

6.20.4 Pump capacity – Check

WARNING



Fuels are combustible.

Risk of fire and explosion!

- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Pump capacity – Check

1. Install suitable pressure gauge at the neck of the intake side of the pump.
2. Check pump pressure.
 - a) Switch on fuel treatment system (→ Page 84).

Note: The pressure limiting valve at the pump might respond and open. Audible noise is caused by overflowing fuel and can be disregarded.

- b) Close ball valve at the outlet of the fuel treatment system.
 - c) Check pressure at the pressure gauge in the inlet to the fuel treatment system and note down.
3. Check pump pressure with reduced suction.
 - a) Reduce suction pressure of pump to -0.8 bar with the shutoff valve at the pump intake side.
 - b) Check pressure at the pressure gauge in the inlet to the fuel treatment system and note down.
 - c) Open ball valve at inlet and outlet of fuel treatment system.
 4. Calculate wear limit.

Example:

Measured value (normal condition).	3 bar
Measured value (reduced suction condition).	2.6 bar

If the measured value (reduced suction condition) is 10% lower than the measured value (normal condition), the wear limit is reached. Repair pump (contact Service).

6.20.5 Coalescer filter element – Replacement

Preconditions

- ☑ System is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 6-50 Nm	F30027336	1
Ratchet	F30027339	1
Diesel fuel		
Engine oil		
Coalescer filter element	(→ Spare Parts Catalog)	
Gasket	(→ Spare Parts Catalog)	

WARNING



Fuels are combustible.

Risk of fire and explosion!

- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

NOTICE



Contamination of components.

Damage to component!

- Observe manufacturer's instructions.
- Check components for special cleanliness.

NOTICE



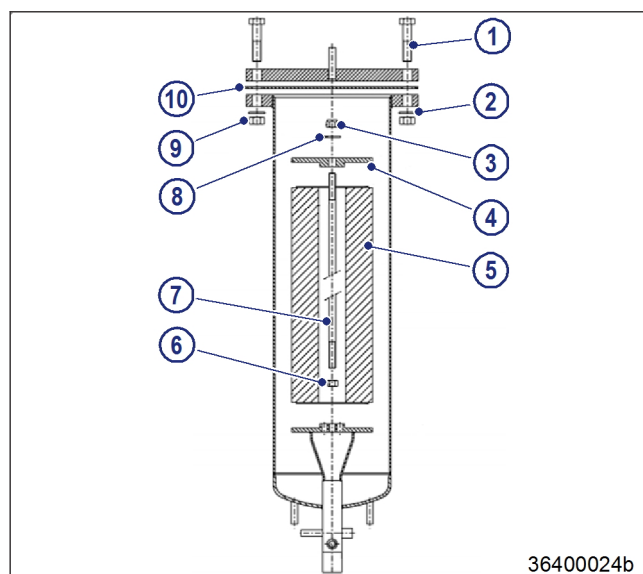
Incorrect installation of components and lines.

Damage to component!

- Ensure that components/lines are installed so that they are never under tension or strain.
- Ensure correct installation position of components.

Coalescer filter element – Replacement

1. Close ball valve at the inlet and outlet of the fuel treatment system.
2. Open drain valve.
3. Drain fuel.
4. Close drain valve.
5. Remove nuts (9) and washers (2).
6. Remove screws (1).
7. Remove cover with gasket (10).
8. Remove nut (3), washer (8) and end plate (4).
9. Remove coalescer filter element (5).
10. Catch fuel as it runs out.
11. Clean housing with a non-linting cloth, rinse with fuel if required.
12. Check housing for corrosion.
13. Clean housing sealing surfaces.
14. Install coalescer filter element (5).
15. Install end plate (4), washer (8) and nut (3).



16. Tighten nut (3) to specified tightening torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Nut	M16	Tightening torque	(Engine oil)	30 Nm +3 Nm

17. Fit gasket (10).
18. Install cover.
19. Install screws (1), washers (2) and nuts (9).
20. Tighten nuts (9).
21. Open ball valve at the inlet and outlet of the fuel treatment system.

Result: The fuel treatment system is ready for operation.

6.21 Wiring (General) for Engine/Gearbox/Unit

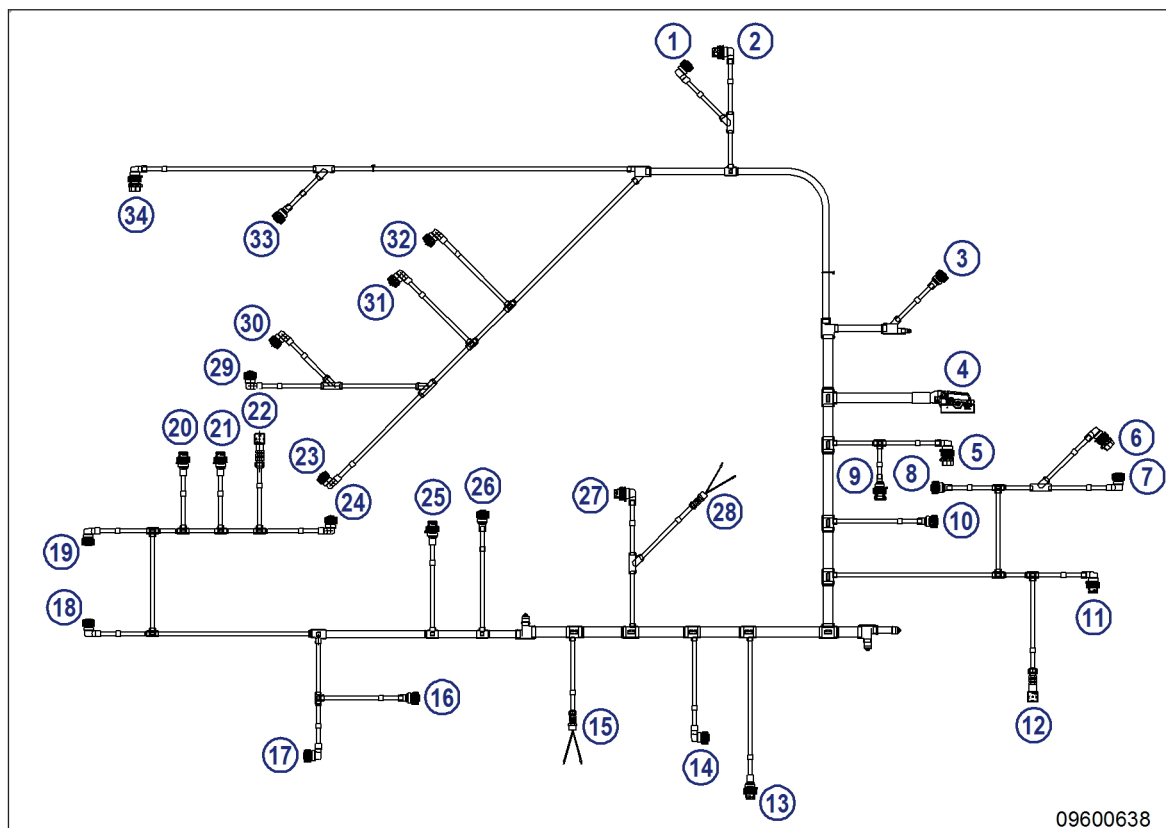
6.21.1 Engine wiring harness - Overview

Engine wiring harnesses – Terminal assignment

Description	Terminal assignment	
Sensors	B1	Camshaft speed
	B3	Intake air temperature
	B4.21	Exhaust temperature, A side
	B4.22	Exhaust temperature, B-side
	B5.1	Oil pressure downstream of filter
	B5.3	Oil pressure upstream of filter
	B6	Coolant temperature
	B7	Oil temperature
	B9	Charge-air temperature
	B10	Charge-air pressure
	B13	Crankshaft speed
	B16	Coolant pressure
	B33	Fuel temperature
	B34.1	Fuel pressure downstream of filter
	B34.2	Fuel pressure upstream of filter
	B34.3	Fuel pressure upstream of external filter
	B44.1	Rotation speed, exhaust turbocharger A
	B44.2	Rotation speed, exhaust turbocharger B
	B48	HP fuel pressure
	B49	Charge air before recirculation
	B50	Crankcase pressure
	B54	Replenishment pump pressure
Level monitor	F33	Coolant level
	XF33	Coolant level adaptation
	XXF33	Coolant level, hull-mounted cooling system
	F46	Fuel overflow level
Pump	M8	Fuel pump
Limit switch	S37.1	Start interlock A
	S37.2	Start interlock B
Adaptation	X2	ECU-7 governor
	X4	ECU-7 governor
	X37	Cranking start interlock
	XG03	Battery-charging generator
Valves	Y26	Charge-air recirculation
	Y27	Exhaust turbocharger

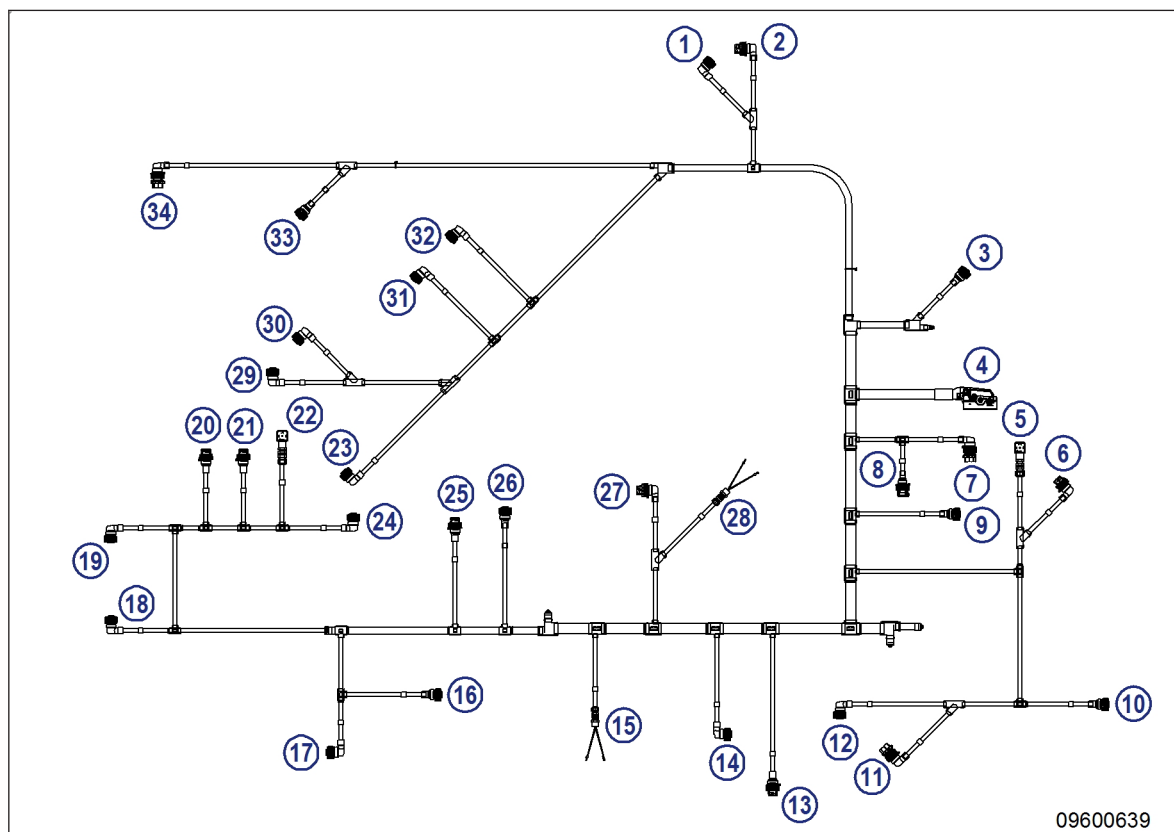
Description	Terminal assignment	
Injectors	Y39A1 to Y39AX	Engine A side
	Y39B1 to Y39BX	Engine B side

Engine wiring harness for sensors, 12V engine



1 M8	13 B4.22	25 B4.21
2 B1	14 B9	26 B10
3 B6	15 S37.1	27 B13
4 X2	16 B34.3	28 S37.2
5 X37	17 B34.2	29 B7
6 XXF33	18 B34.1	30 B5.1
7 F33	19 B50	31 B48
8 B16	20 B49	32 B33
9 XF33	21 B44.1	33 F46
10 B54	22 Y26	34 XG03
11 B44.2	23 B5.3	
12 Y27	24 B3	

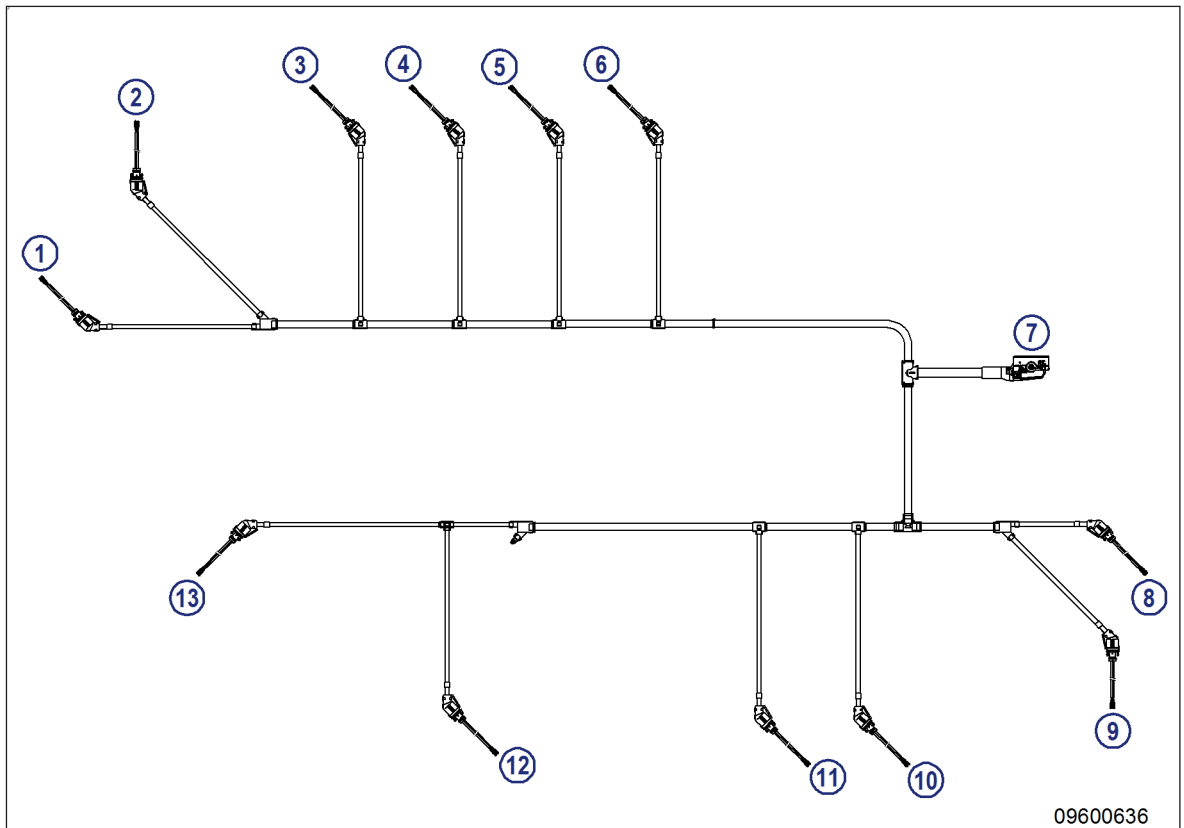
Engine wiring harness for sensors, 16V engine



09600639

1 M8	13 B4.22	25 B4.21
2 B1	14 B9	26 B10
3 B6	15 S37.1	27 B13
4 X2	16 B34.3	28 S37.2
5 Y27	17 B34.2	29 B7
6 B44.2	18 B34.1	30 B5.1
7 X37	19 B50	31 B48
8 XF33	20 B49	32 B33
9 B54	21 B44.1	33 F46
10 B16	22 Y26	34 XG03
11 XXF33	23 B5.3	
12 F33	24 B3	

Engine wiring harness for injectors, 12V engine



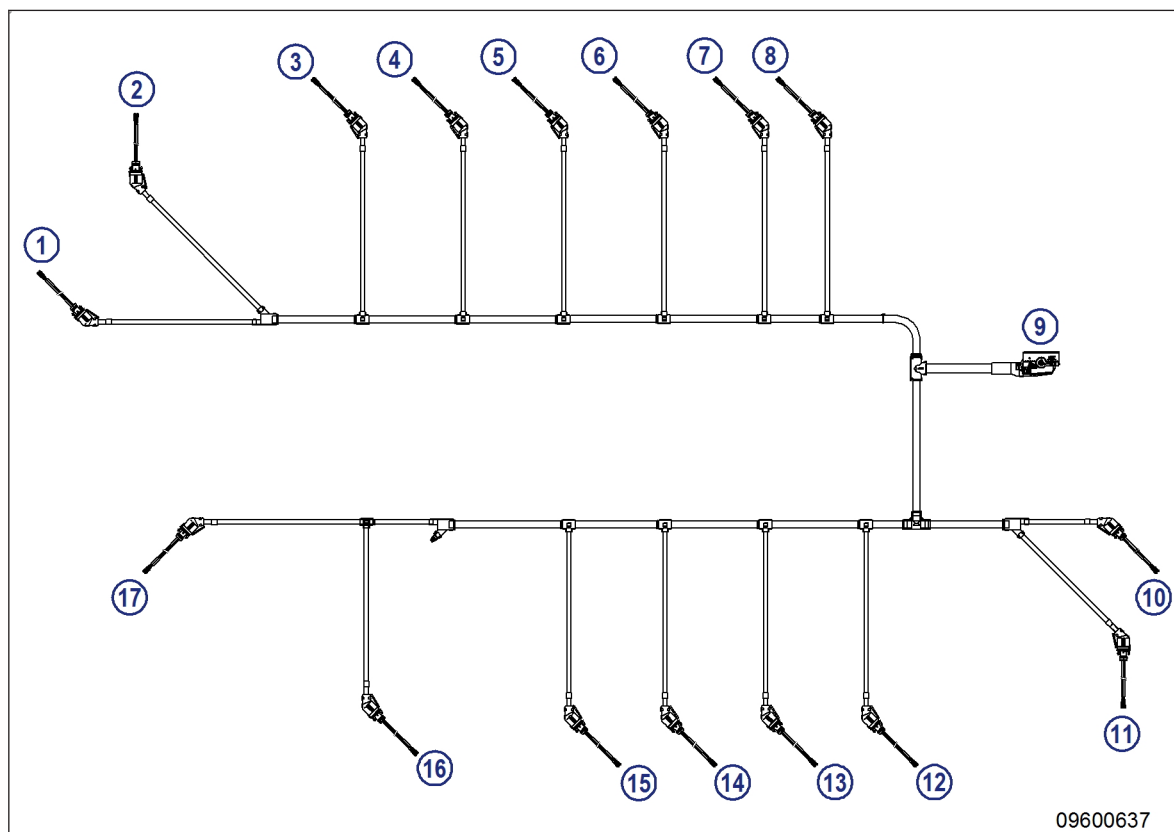
1 Y39A1
2 Y39A2
3 Y39A3
4 Y39A4
5 Y39A5

6 Y39A6
7 X4
8 Y39B6
9 Y39B5
10 Y39B4

11 Y39B3
12 Y39B2
13 Y39B1

09600636

Engine wiring harness for injectors, 16V engine

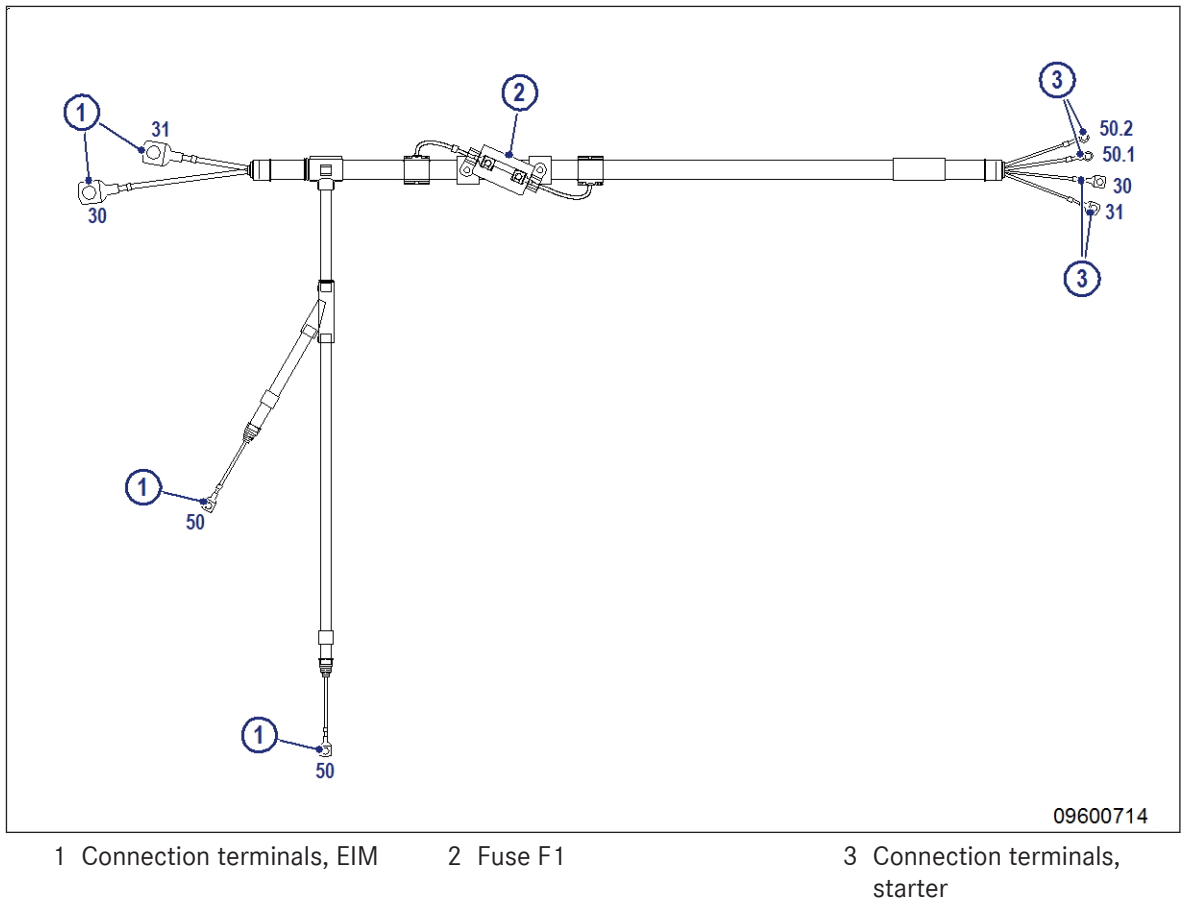


1 Y39A1
2 Y39A2
3 Y39A3
4 Y39A4
5 Y39A5
6 Y39A6

7 Y39A7
8 Y39A8
9 X4
10 Y39B8
11 Y39B7
12 Y39B6

13 Y39B5
14 Y39B4
15 Y39B3
16 Y39B2
17 Y39B1

Engine wiring harness for electric starter



6.21.2 Engine wiring – Check

Preconditions

- ☒ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Isopropyl alcohol	X00058037	1

Engine wiring – Check

1. Check securing screws of cable clamps on engine and tighten loose threaded connections.
2. Ensure that cables are fixed in their clamps and cannot swing freely.
3. Verify that all cable clips are closed and in proper condition.
4. Replace cable clips if defective.
5. Check that cable clamps are firm, tighten loose cable clamps.
6. Replace faulty cable clamps.
7. Visually inspect the following electrical line components for damage:
 - Connector housing
 - Contacts
 - Sockets
 - Cables and terminals
 - Plug-in contacts

Result: Contact Service if cable conductors are damaged.

Note: Close male connectors that are not plugged in with the protective cap supplied.

8. Clean dirty connector housings, sockets and contacts using isopropyl alcohol.
9. Ensure that all sensor connectors are securely engaged.

6.22 Accessories for (Electronic) Engine Governor / Control System

6.22.1 CDC parameters - Reset

Preconditions

- ☑ Engine is stopped and starting disabled.

Note: Failure to reset drift compensation (CDC parameters) will void the emissions certification.

Resetting CDC parameters with DiaSys®

- ▶ (→ Dialog system DiaSys® E531920/..).

Resetting CDC parameters without DiaSys®

- ▶ If no DiaSys® is available, contact Service.

6.22.2 Limit switch for start interlock – Check

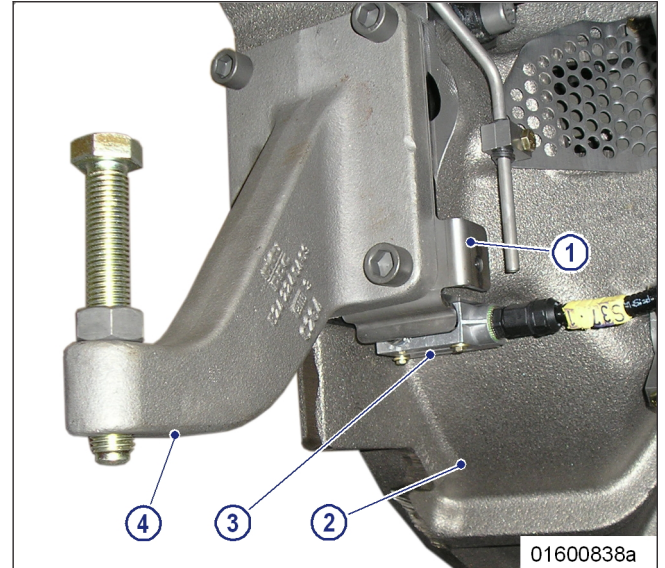
Preconditions

- ☑ Engine is stopped and starting disabled.

Note: In the OFF position, the limit switch initiates a start interlock, i.e. the engine cannot be started.

Checking limit switch for start interlock

1. Check whether switches (3) and guard plate (1) with engine support (4) are installed on both sides of flywheel housing (2).
2. Check whether both switches (3) are actuated.
3. If switches (3) and/or guard plate (1) with engine support (4) is/are not installed:
 - Screw on guard plate (1) with engine support (4).
 - Then screw on switch (3), ensuring that the switch (3) is actuated by the guard plate (1).
4. If switch (3) and guard plate (1) are installed, but switch (3) is in the OFF position:
 - Make certain that the guard plate (1) at the side of the switch (3) is not distorted.
 - Release guard plate (1) and screw on such that the switch (3) is actuated.



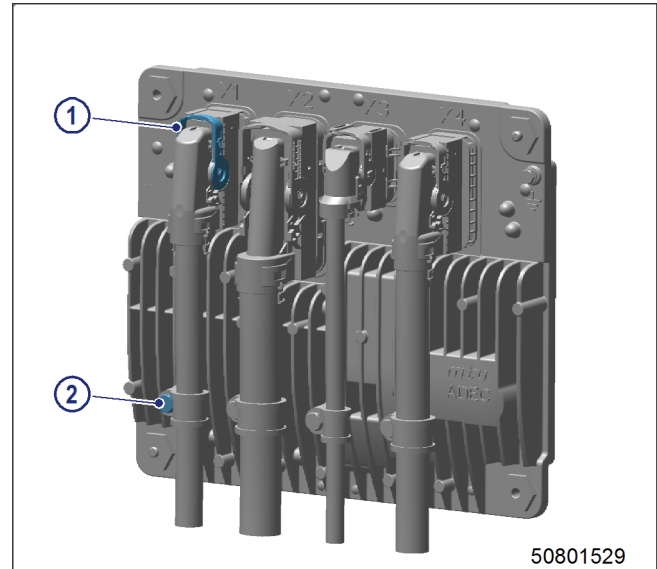
6.22.3 Engine Control Unit ECU 7 - Checking plug connections

Preconditions

- ☑ Engine is stopped and starting disabled.

Check plug connections on ECU 7

1. Check all connectors on ECU for firm seating. Ensure that the clips (1) are engaged.
2. Check screws (2) of cable clamps on ECU for firm seating. Ensure that cable clamps are not faulty.



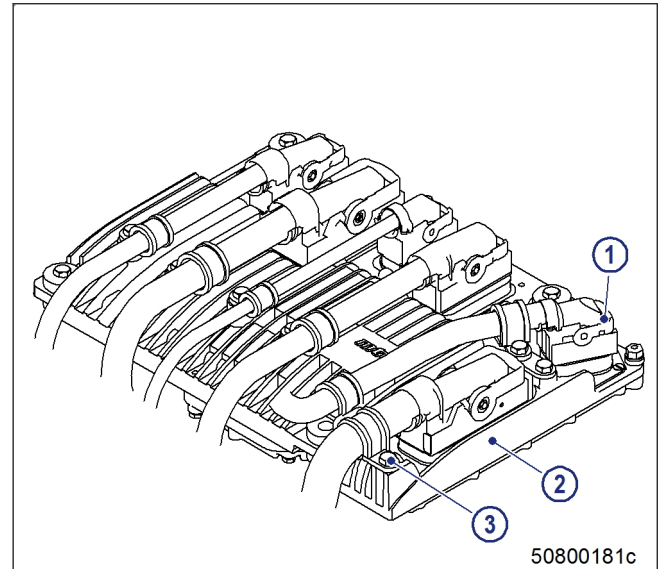
6.22.4 Engine Monitoring Unit EMU 7 - Plug connection check

Preconditions

- ☑ Engine is stopped and starting disabled.

Checking EMU plug connections

1. Check both connectors on EMU (2) for firm seating. Ensure that the clips (1) are engaged.
2. Check screws (3) of cable clamps on EMU (2) for firm seating. Ensure that cable clamps are not faulty.



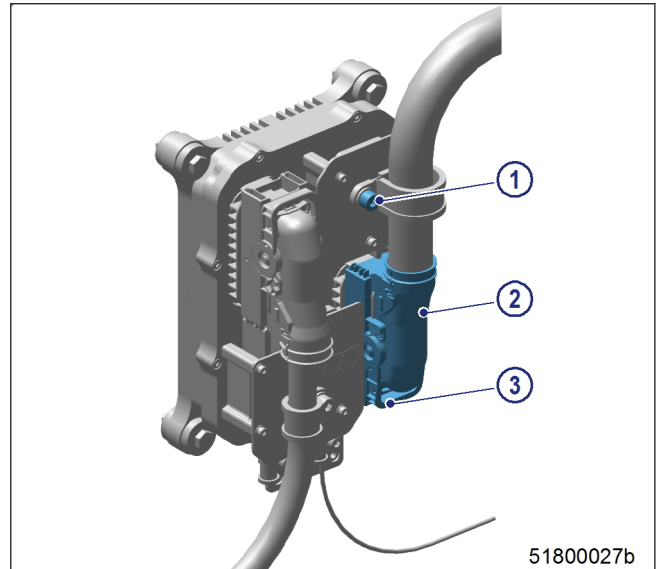
6.22.5 Interface module EIM plug connections - Check

Preconditions

- ☑ Engine is stopped and starting disabled.

Checking EIM plug connections

1. Check both Tyco plugs (62-pole) (2) on EIM for firm seating. Ensure that clips (3) are engaged.
2. Check screws (1) of cable clamps on EIM for firm seating. Ensure that cable clamps are not faulty.



6.22.6 Engine Control Unit ECU 7 - Removal and installation

Preconditions

- ☑ Engine is stopped and starting disabled.

NOTICE



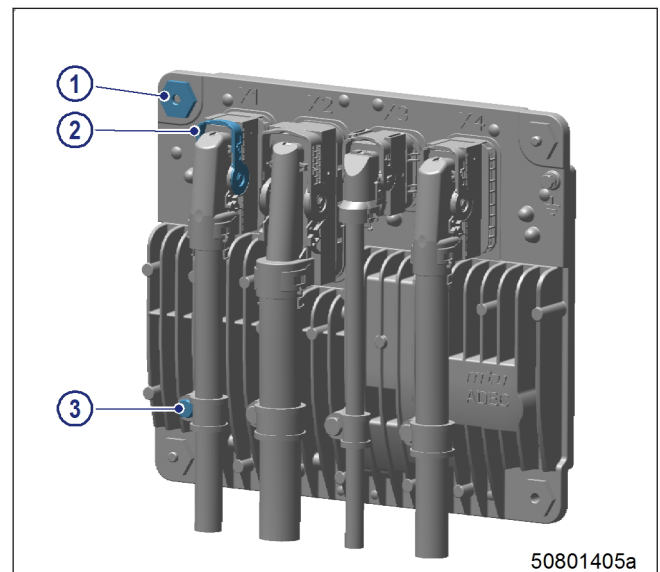
Wrong engine governor installed.

Engine damage!

- When reassembling an engine, make sure that the governor with the data record for the given engine is installed.

Removing Engine Control Unit from engine

1. Note or mark assignment of cables and connectors.
2. Remove all screws (3).
3. Undo clips (2) on connectors.
4. Remove all male connectors.
5. Remove screws (1).
6. Take off Engine Control Unit.



Installing Engine Control Unit on engine

1. Install in reverse order. Ensure correct assignment of connectors and sockets.
 2. Check resilient mount before installing.
- Result: If resilient mount is porous or defective then replace it.

6.22.7 EMU 7 - Removal and installation

Preconditions

- ☑ Engine is stopped and starting disabled.

NOTICE



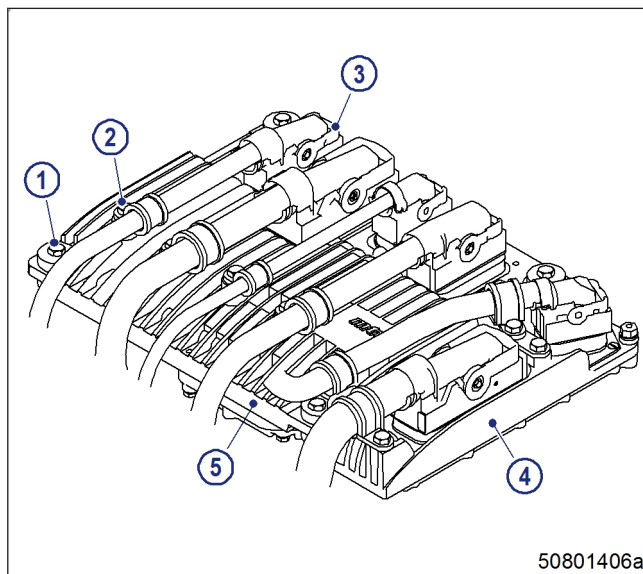
Wrong engine governor installed.

Engine damage!

- When reassembling an engine, make sure that the governor with the data record for the given engine is installed.

Removing ECU with EMU from engine

1. Note or mark assignment of cables and connectors.
2. Remove all screws (2).
3. Undo latches (3) of the connectors.
4. Disconnect all connectors.
5. Remove screws (1).
6. Remove ECU (5) with EMU (4).



Removing EMU

1. Unscrew screws on base of EMU (4).
2. Remove EMU (4) from ECU (5).

Installing EMU

1. Place EMU (4) on ECU (5).
2. Screw in and tighten screws on base of EMU (4).

Installing ECU with EMU on engine

1. Install in reverse order. Ensure correct assignment of connectors and sockets in so doing.
2. Check resilient mount before installing.

Result: Replace resilient mount if porous or defective.

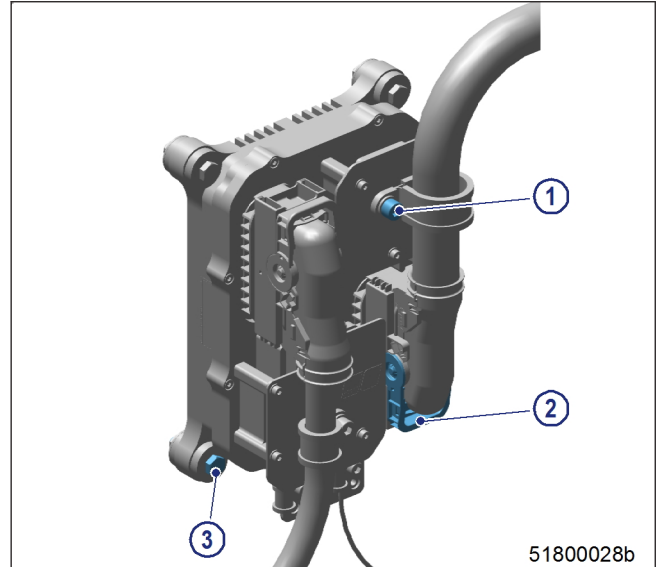
6.22.8 Engine Interface Module EIM – Removal and installation

Preconditions

- ☑ Engine is stopped and starting disabled.

Removing EIM from the engine

1. Note or mark assignment of cables and connectors.
2. Unscrew all screws (1).
3. Undo clips (2) on connectors.
4. Disconnect all connectors.
5. Unscrew power and starter cable.
6. Remove screws (3).
7. Take off EIM.



Installing EIM on the engine

1. Install in reverse order. When doing so, observe correct assignment between cables and plugs.
2. Check seal before installing.

Result: Replace seal if porous or defective.

Downloading software

1. The new EIM still does not have appropriate FSW and parameter/descriptor module (the diagnostic lamp (DILA) indicates flashing code 4 when the power supply is connected, (→ Page 274)).
2. The FSW and the parameter/descriptor module must first be downloaded from the central database (CDB) based on the relevant engine number using the DiaSys software tool, and then loaded in the EIM.

6.22.9 Diagnostic features of EIM

Diagnostic lamp (DILA)

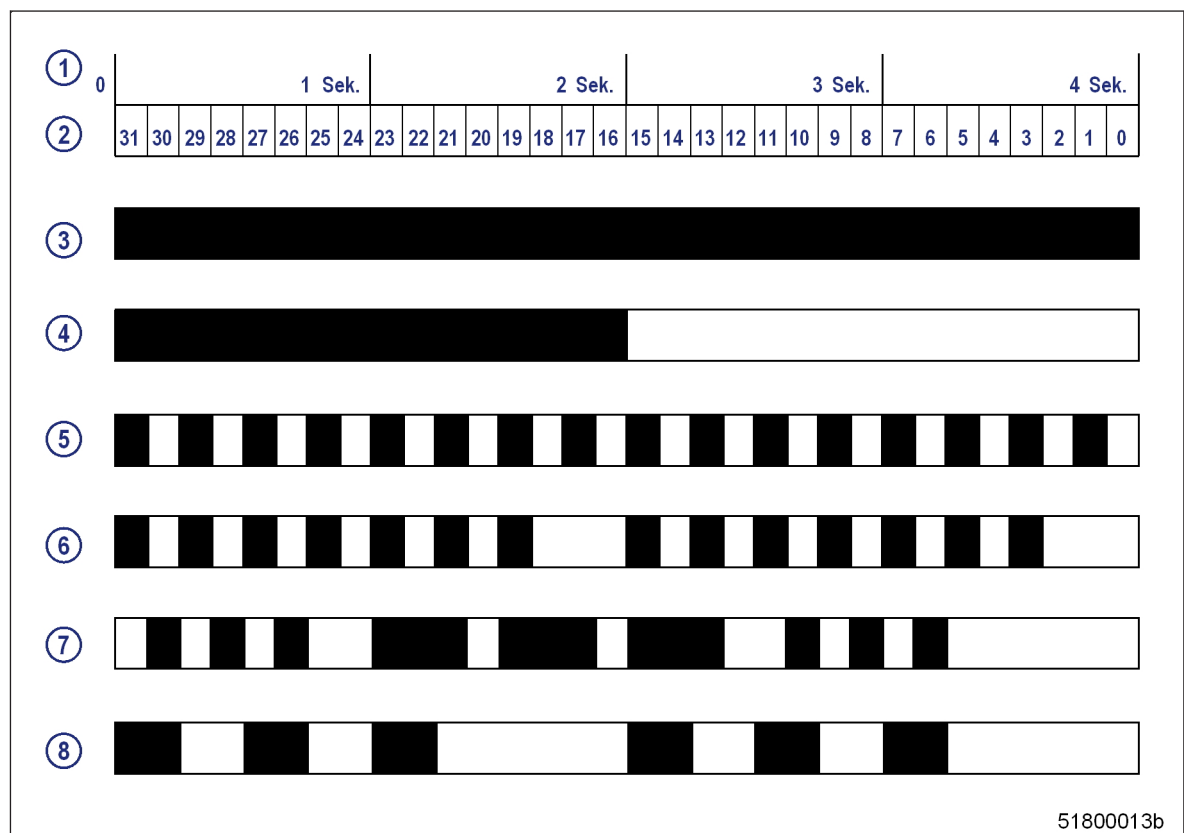
A diagnostic lamp (LED, blue) is integrated in the housing of the Engine Interface Module (EIM).

It indicates the operating status of the EIM.

Functions of diagnostic lamp DILA

DILA lights	Engine Interface Module (EIM) is OK.
DILA dark	EIM supply voltage missing or diagnostic lamp activation is faulty.
DILA flashes	Hardware or software fault in the Engine Interface Module.

The diagnostic lamp (DILA) signals the following states:



Fuse lamp (SILA)

A second indicator is the fuse lamp.

This is also integrated in the housing of the Engine Interface Module. It indicates the status of the fuses.

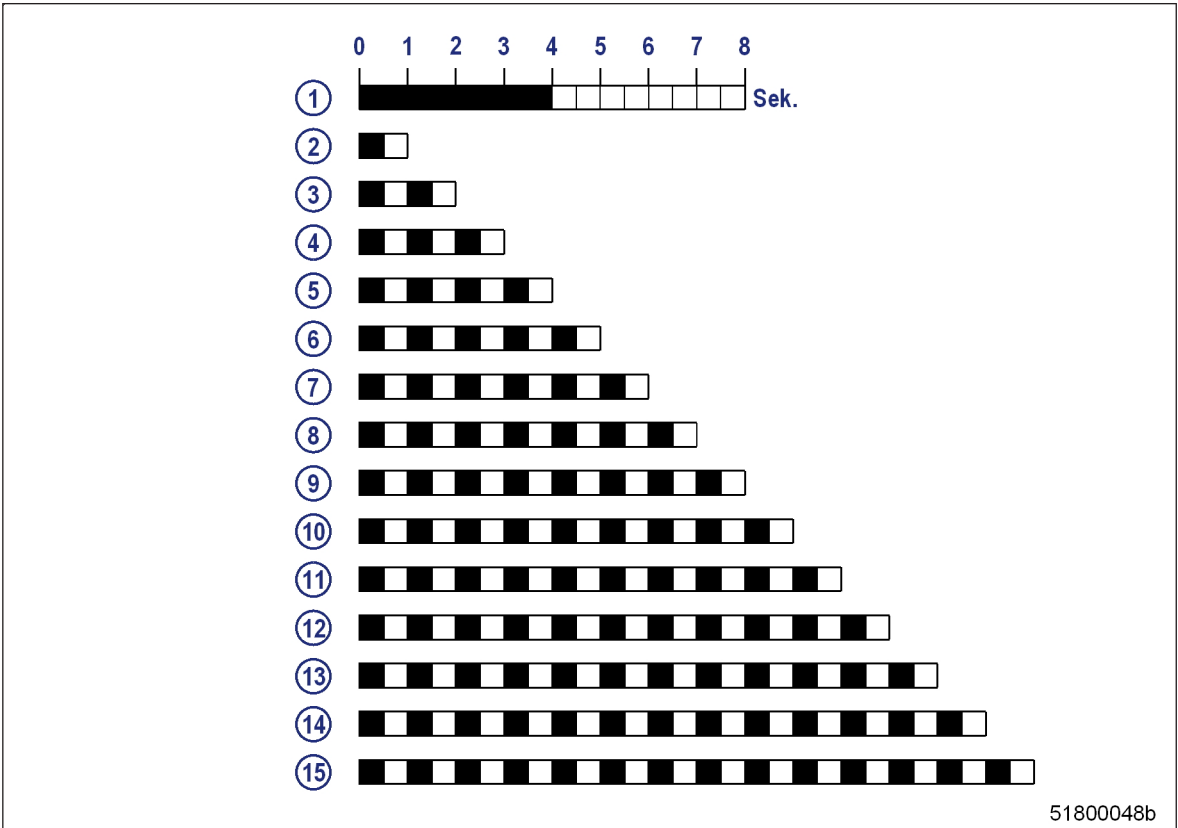
An orange LED is provided to allow diagnosis of a “tripped fuse” fault directly at the unit as it is often difficult to pinpoint a fault in the field without cabling diagrams.

This LED is activated by the controller.

Functions of fuse lamp SILA

SILA dark	Norma operating state.
SILA flashes orange	One or more fuses have tripped.

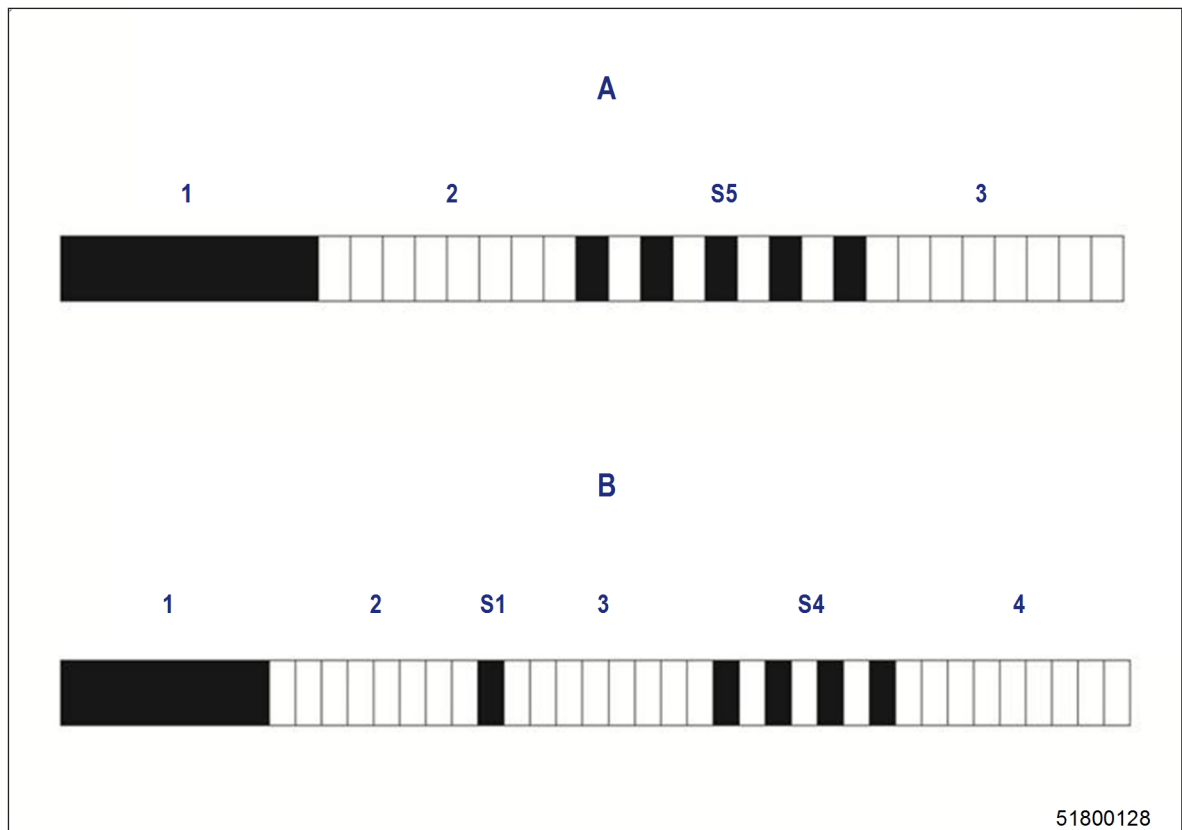
The fuse lamp (SILA) signals the following states:



- | | | |
|---|---|---|
| 1 Preamble | 6 VSP current path failed (S5) | 11 ES pushbutton current path failed - 24V external (S10) |
| 2 ECU current path failed (S1) | 7 SLD current path failed (S6) | 12 Key switch current path failed (S11) |
| 3 MCS current path failed (S2) | 8 DDV current path failed (S7) | 13 SDAF 1+2 current path failed (S12) |
| 4 EMU current path failed (S3) | 9 Gear monitoring current path failed (S8) | 14 PIM current path failed (S13) |
| 5 Starter voltage: Terminal 30, 31 not connected and PR 10.0600.001 has value 1 or 2 (S4) | 10 Emergency stop current path failed - 24V internal (S9) | 15 Spare current path failed (S14) |

The failed current paths are signaled consecutively following the preamble (LED on for 4 seconds (1)). There is a pause lasting 4 seconds in between.

Sample flashing sequences



A Fuse S5 failure (1/2 second steps)

B Fuse S1 and fuse S4 failure (1/2 second steps)

Note:

These bit sequences are transmitted constantly.

Information about the status of the current paths of the EIM is also provided in the CAN message "Status internal power supply".

7 Appendix A

7.1 Abbreviations

Abbrevia- tion	Meaning	Explanation
ADEC	Advanced Diesel Engine Control	Engine governor
AL	Alarm	Alarm (general)
ANSI	American National Standards Institute	Governing body for US American standards
ETC	Exhaust turbocharger	
BR	Baureihe (Series)	
BV	Betriebsstoffvorschrift	Fluids and Lubricants Specifications, MTU Publication No. A01061/..
CAN	Controller Area Network	Data bus system, bus standard
CDC	Calibration Drift Compensation	Setting for drift correction with DiaSys in engine governor
CPP	Controllable Pitch Propeller	
DILA	Diagnostic lamp	on EIM
DIN	Deutsches Institut für Normung e. V.	German Standardization Organization, at the same time identifier of German standards ("Deutsche Industrie-Norm")
DIS	Display unit	Display panel
DL	Default Lost	Alarm: Default CAN bus failure
ECS	Engine Control System	Engine management system
ECU	Engine Control Unit	Engine governor
EDM	Engine Data Module	Memory module for engine data
EIM	Engine Interface Module	Interface to engine monitoring system
EMU	Engine Monitoring Unit	
SPC	Spare Parts Catalog	
FPP	Fixed Pitch Propeller	
GCU	Gear Control Unit	
GMU	Gear Monitoring Unit	
HAT	Harbor Acceptance Test	
HI	High	Alarm: Measured value exceeds 1st maximum limit
HIHI	High High	Alarm: Measured value exceeds 2nd maximum limit
HT	High Temperature	
ICFN	ISO - Continuous rating - Fuel stop power - Net	Power specification in accordance with DIN-ISO 3046-7
IDM	Interface Data Module	Memory module for interface data
IIG	Initial Injector Equalization	Entering of injector code with DiaSys in engine governor
IMO	International Maritime Organization	
ISO	International Organization for Standardization	International umbrella organization for all national standardization institutes
KGS	Kraftgegenseite	Engine free end in accordance with DIN ISO 1204

Abbrevia- tion	Meaning	Explanation
KS	Kraftseite	Engine driving end in accordance with DIN ISO 1204
LCD	Liquid Crystal Display, Liquid Crystal Device	
LCU	Local Control Unit	LOP subassembly
LED	Light Emitting Diode	
LMU	Local Monitoring Unit	LOP subassembly
LO	Low	Alarm: Measured value lower than 1st minimum limit
LOLO	Low Low	Alarm: Measured value lower than 2nd minimum limit
LOP	Local Operating Panel	Control console, control panel
LOS	Local Operating Station	
MCS	Monitoring and Control System	
MG	Message	
MPU	Microprocessor Unit, Microprocessing Unit	Microprocessor (unit)
TDC	Top Dead Center	
P-xyz	Pressure-xyz	Pressure measuring point xyz
PAN	Panel	Operating panel
PCU	Propeller Control Unit	
PIM	Peripheral Interface Module	
RCS	Remote Control System	
RL	Redundancy Lost	Alarm: Redundant CAN bus failure
SAE	Society of Automotive Engineers	U.S. standardization organization
SAT	Sea Acceptance Test	
SD	Sensor Defect	Alarm: Sensor failure
SDAF	Shut Down Air Flaps	Emergency-air shutoff flap(s)
SILA	Fuse lamp	on EIM
SOLAS	International Convention for the Safety of Life at Sea	
SS	Safety System	Indicated alarm is initiated by the safety system
SSK	Emergency-air shutoff flap(s)	
T-xyz	Temperature-xyz	Temperature measuring point xyz
TD	Transmitter Deviation	Alarm: Sensor comparison fault
BDC	Bottom Dead Center	
VS	Voith Schneider	Voith-Schneider drive
WJ	Water Jet	Water jet drive
TC	Tool Catalog	
ZKP	Zugehörigkeit-Kategorie-Parameter	Numbering plan for ADEC ECU signals

7.2 MTU contact persons/service partners

Our worldwide sales network with its subsidiaries, sales offices, representatives and customer service centers ensures fast and direct support on site and the high availability of our products.

Local support

Experienced and qualified specialists place their knowledge and expertise at your disposal.

For locally available support, go to the MTU Internet site: <http://www.mtu-online.com>

24h hotline

With our 24h hotline and the outstanding flexibility of our service staff, we are always ready to assist you – either during operation, for preventive maintenance, corrective work in case of malfunction or changed operating conditions, or for spare parts supply.

Your contact person in our Customer Assistance Center:

E-mail: info@mtu-online.com

Tel.: +49 7541 9077777

Fax: +49 7541 9077778

Asia/Pacific: +65 6100 2688

North and Latin America: +1 248 560 8000

Spare parts service

Fast, simple and correct identification of spare parts for your drive system or vehicle fleet. The right spare part at the right time at the right place.

With this aim in mind, we can call on a globally networked spares logistics system, a central warehouse at headquarters and on-site stores at our subsidiary companies, agencies and service workshops.

Your contact at Headquarters:

E-mail: spare.parts@mtu-online.com

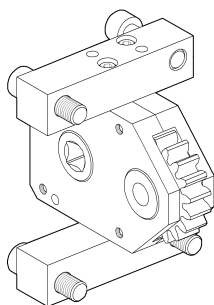
Tel.: +49 7541 908555

Fax: +49 7541 908121

8 Appendix B

8.1 Special Tools

Barring device

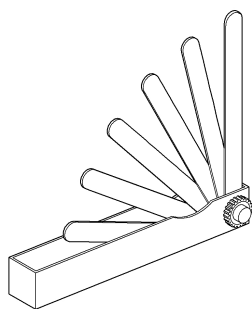


Part No.: F6555766

Qty.: 1

Used in: 6.1.1 Engine – Barring manually (→ Page 162)

Feeler gage

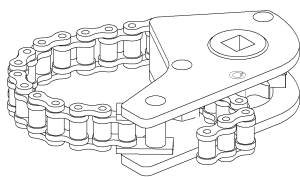


Part No.: Y20010128

Qty.: 1

Used in: 6.4.2 Valve clearance – Check and adjustment
(→ Page 173)

Filter wrench



Part No.: F30379104

Qty.: 1

Used in: 6.7.2 Additional fuel filter – Replacement (→ Page 186)

Qty.: 1

Used in: 6.7.3 Fuel filter – Replacement (→ Page 187)

Qty.: 1

Used in: 6.14.1 Engine oil filter – Replacement (→ Page 223)

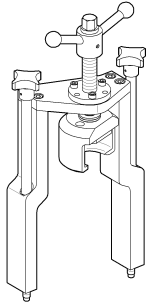
Qty.: 1

Used in: 6.14.3 Centrifugal oil filter – Cleaning and filter sleeve
replacement (→ Page 227)

Qty.: 1

Used in: 6.15.8 Engine coolant filter – Replacement
(→ Page 243)

Installation/removal jig

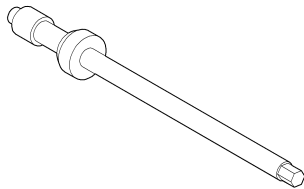


Part No.: F6789889

Qty.: 1

Used in: 6.6.2 Injector – Removal and installation (→ Page 180)

Milling cutter

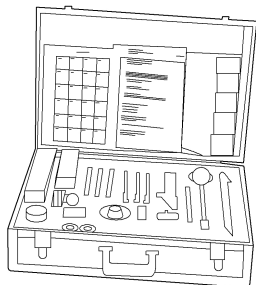


Part No.: F30452739

Qty.: 1

Used in: 6.6.2 Injector – Removal and installation (→ Page 180)

MTU test kit



Part No.: 5605892099/00

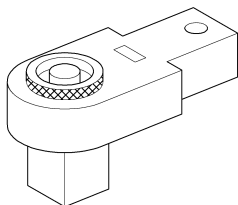
Qty.: 1

Used in: 6.13.3 Engine oil – Sample extraction and analysis (→ Page 221)

Qty.: 1

Used in: 6.15.7 Engine coolant – Sample extraction and analysis (→ Page 242)

Ratchet

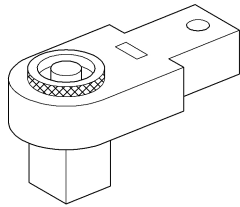


Part No.: F30027339

Qty.: 1

Used in: 6.20.5 Coalescer filter element – Replacement (→ Page 257)

Ratchet adapter



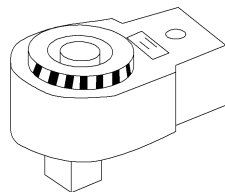
Part No.: F30027340

Qty.: 1
Used in: 6.6.2 Injector – Removal and installation (→ Page 180)

Qty.: 1
Used in: 6.7.8 Fuel prefilter with water separator – Filter element replacement (→ Page 195)

Qty.: 1
Used in: 6.8.2 Compressor wheel – Cleaning (→ Page 205)

Ratchet adapter

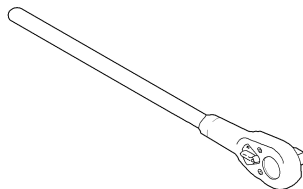


Part No.: F30027341

Qty.: 1
Used in: 6.6.2 Injector – Removal and installation (→ Page 180)

Qty.: 1
Used in: 6.13.2 Engine oil – Change (→ Page 219)

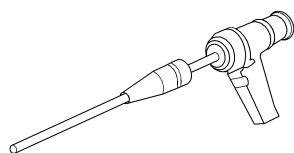
Ratchet with extension



Part No.: F30006212

Qty.: 1
Used in: 6.1.1 Engine – Barring manually (→ Page 162)

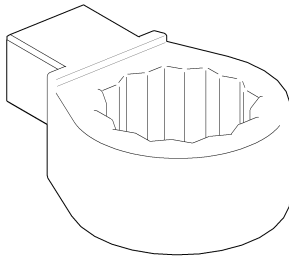
Rigid endoscope



Part No.: Y20097353

Qty.: 1
Used in: 6.2.1 Cylinder liner – Endoscopic examination (→ Page 165)

Socket wrench, 24 mm



Part No.: F30039526

Qty.: 1

Used in: 6.4.2 Valve clearance – Check and adjustment
(→ Page 173)

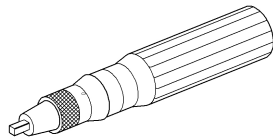
Steam jet cleaner

Part No.: -

Qty.: 1

Used in: 3.14 Plant – Cleaning (→ Page 89)

Torque wrench, 0.5-5 Nm

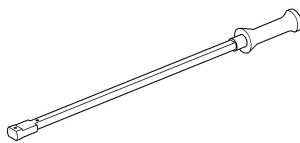


Part No.: 0015384230

Qty.: 1

Used in: 6.6.2 Injector – Removal and installation (→ Page 180)

Torque wrench, 10-60 Nm



Part No.: F30452769

Qty.: 1

Used in: 6.6.2 Injector – Removal and installation (→ Page 180)

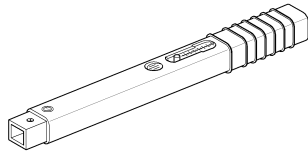
Qty.: 1

Used in: 6.7.8 Fuel prefilter with water separator – Filter element replacement (→ Page 195)

Qty.: 1

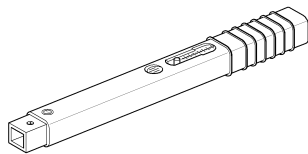
Used in: 6.8.2 Compressor wheel – Cleaning (→ Page 205)

Torque wrench, 40-200 Nm



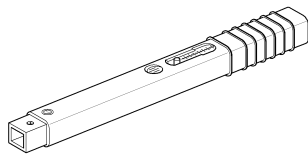
Part No.:	F30027337
Qty.:	1
Used in:	6.13.2 Engine oil – Change (→ Page 219)

Torque wrench, 6-50 Nm



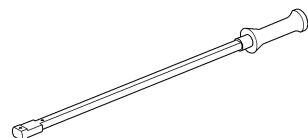
Part No.:	F30027336
Qty.:	1
Used in:	6.14.3 Centrifugal oil filter – Cleaning and filter sleeve replacement (→ Page 227)

Torque wrench, 6-50 Nm



Part No.:	F30027336
Qty.:	1
Used in:	6.20.5 Coalescer filter element – Replacement (→ Page 257)

Torque wrench, 60-320 Nm



Part No.:	F30452768
Qty.:	1
Used in:	6.4.2 Valve clearance – Check and adjustment (→ Page 173)
Qty.:	1
Used in:	6.6.2 Injector – Removal and installation (→ Page 180)

8.2 Index

Preheating unit [244](#)

Numerics

12V 4000 M23F engine data, RheinSchUO, stage II, IMO Tier II [56](#)

12V 4000 M23S engine data, IMO Tier II, EPA Tier 2 [62](#)

12V 4000 M23S engine data, RheinSchUO, stage II, IMO Tier II [59](#)

16V 4000 M23F engine data, RheinSchUO, stage II, IMO Tier II [65](#)

16V 4000 M23S engine data, IMO Tier II, EPA Tier 2 [71](#)

16V 4000 M23S engine data, RheinSchUO, stage II, IMO Tier II [68](#)

A

Abbreviations [277](#)

Actuators

- Overview [32](#)

Additional fuel filter

- Replacement [186](#)

ADEC (ECU 7)

- Fault codes [97](#)

- Fault messages [96](#)

After stopping the engine [88](#)

Air filter

- Removal and installation [215](#)

- Replacement [214](#)

B

Battery-charging generator drive

- Coupling condition check [251](#)

Bilge pump

- Relief bore check [252](#)

C

CDC parameters

- Reset [266](#)

Centrifugal oil filter

- Cleaning [227](#)

Checks

- Prior to start-up [80](#)

Coalescer filter element

- Replacement [257](#)

Compressor wheel

- Cleaning [205](#)

Contact persons [279](#)

Controls [74](#)

Coolant

- Change [235](#)

Cooler

- Charge-air

- Checking condensate drain for water discharge and obstruction [213](#)

Crankcase breather

- Oil mist fine separator

- Replacement [171](#)

Crankcase breather system

- Overview [169](#)

Cylinder

- Designation [52](#)

Cylinder head cover

- Installation [176](#)

- Removal [176](#)

Cylinder liner

- Endoscopic examination [165](#)

- Instructions and comments on endoscopic and visual examination [167](#)

D

Designations

- Engine sides and cylinders [52](#)

Differential pressure gauge

- Check [254](#)

Drain and vent points [230](#)

Drift compensation

- Reset [266](#)

E

ECU 7

- Installation [271](#)

- Removal [271](#)

EMU 7

- Installation [272](#)

- Plug connection check [269](#)

- Removal [272](#)

Engine

- Barring manually [162](#)

- Barring with starting system [164](#)

- Emergency stop [87](#)

- Main dimensions [53](#)

- Start [77](#)

- Stopping [86](#)

- Wiring check [265](#)

Engine Control Unit ECU 7

- Checking plug connections [268](#)

- Installation [271](#)

- Removal [271](#)

Engine coolant

- Change [235](#)

- Draining [236](#)

- Filter replacement [243](#)

- Sample analysis [242](#)

- Sample extraction [242](#)

Engine coolant level

- Check [234](#)

Engine coolant - Filling [239](#)

Engine governor ADEC (ECU 7)

- Fault codes [97](#)

- Fault messages [96](#)

Engine Interface Module EIM

- Removal and installation [273](#)

Engine layout [28](#)

Engine Monitoring Unit EMU 7

- Plug connection check 269

Engine mounting

- Check 250

Engine oil

- Sample extraction and analysis 221

Engine oil

- Change 219

Engine oil filter

- Replacement 223

Engine oil level

- Check 218

Engine sides

- Designation 52

Engine wiring

- Check 265

Engine wiring harness

- Overview 259

F

Fault codes

- Engine governor ADEC (ECU 7) 97

Fault messages

- Engine governor ADEC (ECU 7) 96

Filter

- Coalescer element
 - Replacement 257
- Engine coolant
 - Replacement 243

Filter sleeve

- Replacement 227

Firing order 55

Fuel

- Treatment system
 - Switching on 84
 - Troubleshooting 95
- treatment system
 - Shutdown 85

Fuel filter

- Replacement 187

Fuel prefilter

- Flushing 193

Fuel prefilter

- Draining 191

Fuel prefilter with water separator

- Filter element replacement 195

Fuel prefilter with water separator - Rotary slide valve O-rings

- Replacement 197

Fuel prefilter - Differential pressure gauge

- Adjustment 190
- Check 190

Fuel system

- Venting 189

Fuel treatment system

- Putting into operation 81
- Shutdown 85
- Switching on 84

H

Hotline 279

HP pump

- Filling with engine oil 177
- Relief bore check 178

HT coolant pump

- Relief bore check 241

I

Injector

- Installation 180
- Removal 180
- Replacement 179

Intercooler

- Checking condensate drain for water discharge and obstruction 213

Interface module EIM

- Check 270

L

Limit switch for start interlock

- Check 267

M

Maintenance schedule

- Maintenance task reference table [QL1] 90

MTU contact persons 279

O

Oil indicator filter

- Check 225
- Cleaning 225

Operational checks 78

P

Plant

- Cleaning 89

Plug connections

- Check 270

Preheater

- Overhaul 247
- Function and leak-tightness
 - check 248

Product description 16

Pump capacity

- Check 256

Putting the engine into operation after extended out-of-service periods (>3 months) 75

Putting the engine into operation after scheduled out-of-service-period 76

R

Raw water pump

- Relief bore check 249

S

Safety notices, standards 15

- Safety regulations
 - Auxiliary materials 13
 - Environmental protection 13
 - Fire prevention 13
 - Fluids and lubricants 13
 - Important provisions 7
 - Maintenance work 10
 - Organizational requirements 8
 - Personnel requirements 8
 - Repair work 10
 - Safety notices, standards 15
- Sensors
 - Overview 32
- Service indicator
 - Signal ring position check 216
- Service partners 279
- Spare parts service 279
- Starter
 - Condition check 217
- Supplementary fuel filter
 - Overview 185

T

- Tasks
 - After extended out-of-service periods 79
- Tasks after extended out-of-service periods (>3 weeks) 79
- transport 9
- Troubleshooting 92
 - Fuel treatment system 95
- Turbocharger
 - Overview 198

V

- Valve clearance
 - Adjustment 173
 - Check 173
- Valve gear
 - Lubrication 172

W

- Water drain valve
 - Check 253
- Water level probe (3-in-1 rod electrode)
 - Check 255